Effect of Declawing on Behavior of Farmed Emus

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ABSTRACT : The behavior of declawed emus in a farm environment has not been described despite its importance in the husbandry and welfare of the emu. This study examined whether declawing of emus causes chronic pain resulting in permanent changes in the locomotor and general behavior of declawed yearling emus compared to emus not declawed. One group of 40 emus were declawed on the day of hatch by removing the distal phalangeal joint using a Lyon beak-trimming machine. Another group of 40 emus not declawed were the controls. Declawed emus one year of age were allocated to a paddock 250 m×125 m, while the control group was placed in an adjoining paddock of the same dimensions. One hour video records of individual emus from each treatment were made from 08:00 and 17:00 h over 2 periods; firstly when food and water was available and secondly during a period when food and water was not available after being withdrawn overnight. Inactive, ingestive, posture change, grooming, aggressive and locomotor behaviors were monitored from the videotape. There was no behavioral evidence to indicate loss of locomotor ability of declawed emus or to suggest declawed emus were suffering from severe chronic pain as indicated by declawed emus engaging in significantly more bouts ($p<0.05$) and time of searching ($p<0.05$). Declawed emus also engaged in less stereotype pacing ($p<0.05$) indicating they were under less stress and not as frustrated as control birds which engaged in more step pushing behavior ($p<0.05$). Modelling analysis showed that pecking behavior in birds was most closely related to foraging behavior. Birds subject to pecking attacks demonstrated higher levels of stereotype behavior presumably as a method to cope with stress. The behavioral evidence in this study would indicate that declawing does not compromise the locomotor ability of emus and has the benefit of improving the social structure in the groups by reducing stereotype behavior and aggression. (*Asian-Aust. J. Anim. Sci. 2001. Vol. 14, No. 2 : 288-296)*

Key Words : Emus, Declawing, Behavior, Welfare

INTRODUCTION

Declawing is a husbandry practice that is commonly practiced in the emu industry to reduce damage to the skin during aggressive behaviors and to reduce injuries to handlers. There are not only financial benefits of declawing as a result of improved skin quality but also enhanced occupational health and safety of workers and reduction in injuries to birds (Frapple et al., 1997). Declawing however could result in chronic pain for emus. Zimmerman (1986) reports that chronic pain in other species can modify specific walking behaviors, including social behavior. Chronic pain is observed in orthopaedic disease and in some cases following peripheral injury (Gentle, 1992). Tissue and bone damage resulting from declawing could result in persistent pain with the emu undertaking protective guarding behavior and other pain coping behaviors. In heavy breeds of poultry with arthritic complaints loss of locomotor function is common (Thorp, 1994). Animals with this condition are unwilling to stand or walk and there is evidence of one legged standing, limping and sitting as the bird attempts to cope with the pain. In less painful arthritic conditions animals are observed to change their posture more frequently.

The following behavior studies were undertaken to test the hypothesis that locomotor and general behavior of declawed yearling emus is modified compared to a control group maintained in a farm environment and evaluate what any changes in behavior may mean in terms of well being of declawed emus. In addition general linear and regression modelling were undertaken to determine models for aggression in emus and whether declawing reduces regression. The influence of high environmental temperatures and effect of feed withdrawal on emu behavior was also determined as emus are often farmed under these aforementioned prevailing conditions.

MATERIALS AND METHODS

Location and emus

The study was carried out at Southern Emu, a commercial emu farm 10 km east of Waikerie in the Riverland of South Australia from 2-21 January 1999. One group of 40 emus were declawed (O'Malley and Snowden, 1999) on the day of hatch by removing the distal phalangeal joint using a Lyon beak-trimming machine. Another group of 40 emus were not declawed. Birds were brooded and reared apart prior to the experiment.

Four weeks prior to the experiment declawed emus one year of age were allocated to a paddock 250 m×

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125 m, while the control group was placed in an adjoining paddock of the same dimensions. The paddocks were predominantly bare earth with some patches of pasture. Both groups of birds had visual contact with each other. Physical contact between the groups was limited by the wire and post fencing. Limited shelter was available to emus from trees. The birds were provided with oats supplemented with a mineral mix delivered daily, usually between 08:00 and 10:00 h. Approximately 1 kg of food was available to each bird from one feeder. Water was also available from a single drinker in each paddock.

Observations

Two weeks prior to the experiment a 5 m high scaffold of floor dimensions 6 m×3 m with a canvas canopy was installed in an adjacent paddock to provide a good vantage point for filming the emus. Emus were given two weeks to adjust to the presence of humans and the scaffold. Four cameras were mounted onto the scaffold; two cameras recorded an overall view of emus in each paddock and the other 2 cameras were used for tracking of individual birds. Cameras were linked to video recorders and a remote control unit housed in a caravan placed near the scaffold.

The legs and upper body of 30 emus from each treatment were sprayed with paint 5 days prior to filming to aid identification from a distance. One hour video records of 30 individual emus from each treatment were made from 08:00 and 17:00 h over 2 periods; firstly when food and water was available and secondly during a stress period when food and water was not available after being withdrawn overnight. A field view of all the emus in each paddock was recorded over the same period as a back up to the individual tracking of emu behavior. Environmental temperature at time of monitoring was recorded as hot (>30℃), warm (25-30℃), mild (20-25℃) and cool <20℃.

Behaviors

For each emu, behaviors were monitored from the videotapes. These include both timed behaviors and discrete behaviors. A bout was recorded when the emu engaged in the activity for 5 seconds or more. Definitions of inactive, ingestive, posture change, grooming, aggressive and locomotor behaviors were as follows:

Inactive-

Sit down: Sitting with legs folded under the body.
Sitting up: Sitting on knees.
Stand: Standing with head raised.

Ingestive-

Forage: Pecking at the ground and vegetation while standing, walking, sitting up or sitting down. The head may be raised for less than 5 seconds.
Eat: Eating grain as supplied in food bins or in the immediate area where grain was scattered. The head may be raised for less than 5 seconds.
Drink: Drinking from water trough. The head may be raised for less than 5 seconds.
Eliminate: Excretion of faecal and urinary waste.

Change Position-

Step: Any change in position taking less than 5 seconds that occurred while the bird was standing.
Shift sit: A shift in position while sitting in either position.
Stand up: Standing up from either sitting position.

Grooming and other behaviors-

Preen: Using the beak to preen feathers on any part of its body.
Head scratch: Using one of its feet to scratch its head.
Head shake: Shaking its head while walking, standing or in a sitting position.
Stretch: Stretching the body and neck, usually followed by a body shake. Excludes defensive or offensive stretching.
Exhibition: Walking or standing with neck feathers flared out.
Fence Peck: Pecking at the fence wire or post.
Head through fence: Poking the head through the fence while standing or pacing.

Aggressive behaviors-

Run chase: Running at another bird.
Run away: Running from another bird.
Give thrusts: Any action that threatens another bird, including run chase.
Receive thrusts: Any threatening action that the bird receives, including those that make it run away.
Peck: When the bird pecks at another bird.
Pecked: When the bird is pecked by another bird.
Step push: Any change in position from a standing position resulting from a push by another bird.
Kicking: Kicks directed at birds.
Kicked: Kicks received by birds.

Locomotor-

Search: Walking through paddock (other than area within 1.5 m of the fence) with head lowered.
Search pace: Walking parallel to, and within 1.5 m of the fence with head lowered.
Walk: Walking through paddock (other than area within 1.5 m of the fence) with head raised.
Pace: Walking parallel to, and within 1.5 m of the fence with head raised.
Run: Running through paddock (other than area within 1.5 m of the fence).

Run pace: Running parallel to, and within 1.5 m of the fence.

Statistical analysis

For the purposes of this farm study, each declawed and control bird was considered as a replicate. Base SAS software (SAS Institute, 1988) was used to analyse the behavioral data. Analysis of variance by GLM procedure was used to determine the significance of the main effects (declawing, food availability and temperature) and interactions for locomotor, exploratory, inactive, social, ingestive and aggressive behaviors. Duncans multiple range test was used to separate means when significant main effects were detected by the analysis of variance. The SAS step down regression procedure was used to determine the strength of the relationship between aggressive and other behaviors.

RESULTS

Behavior

The means for the behavior variables were expressed as number of incidences of the activity for discrete events and bouts and times involved in the activity for continuing events over a 60 min observation period. Two separate bouts of behavior were recorded if they were separated by a pause of at least 5 sec duration. These results are presented in tables 1-4.

Effect of declawing on behavior

Inactive behaviors- There was no significant difference in the inactive behaviors of emus (table 1) except that declawed emus engaged in fewer bouts ($p<0.05$) of standing. There was, however, no difference in the standing time per bout with the declawed emus spending 34 sec/bout and the control emus 36 sec/bout.

Ingestive behaviors- There was no significant difference in ingestive behaviors of the declawed and control group (table 1). There was a non significant trend ($p=0.11$) for the control group to engage in more frequent bouts of eating, with less eating time/bout.

Posture change behaviors- There was no significant difference in the incidence of changes in posture between the declawed and control group (table 2).

Grooming and other behaviors- There was no significant difference in grooming behaviors (table 2) of the declawed and control group. There was, however, a higher incidence of the control group engaging in the repetitive behavior of putting their heads through the fence into the other paddock.

Aggressive and defensive behaviors- Overall there were no major significant differences in aggressive behaviors between the treatment groups, although the control emus tended to give more thrusts and to receive and give more pecks (table 3). In particular control emus engaged in a significantly ($p<0.05$) higher incidence of the step pushing behavior.

Locomotor behaviors- The declawed emus engaged in significantly ($p<0.05$) more bouts of searching behavior and spent more time searching than the control emus (table 4). In contrast the control emus were involved in a significantly higher ($p<0.05$) number of bouts of pacing and time spent pacing than the declawed emus.

Table 1. Effect of de-clawing, feed withdrawal and environmental temperature on bouts, time (seconds/hour) and incidence of emus involved in inactive and ingestive behaviors over 1 h

	Declawing			Feed withdrawal			Environmental temperature				
Variable	De-claw	Control	l.s.d.	Yes	No	l.s.d.	Cool	Mild	Warm	Hot	l.s.d.
Inactive											
Sit down B	0.7	0.7	NS	0.4a	0.9b	0.4	0.8	0.7	0.7	0.6	NS
Sit down T	681	429	NS	462	652	NS	475	480	584	636	NS
Sit up B	1.7	1.3	NS	1.2a	1.9b	0.6	1.4	1.2	1.5	1.8	NS
Sit up T	492	308	NS	377	428	NS	184b	322b	313b	708a	306
Stand B	31.2a	39.9b	7.8	37.7	33.2	NS	41.4	41.3	34.6	28.5	NS
Stand T	1148	1387	NS	1118	1394	NS	1917a	1205b	1258b	1048b	440
Ingestive											
Forage B	11.4	10.7	NS	10.2	11.9	NS	4.4	13.3	12.8	5.6	NS
Forage T	44	20	NS	14a	50b	35	13	23	27	63	NS
Eat B	38	81	NS	0a	111b	58	141a	54ab	55ab	34b	90
Eat T	363	293	NS	0a	364b	62	386	393	373	184	NS
Drink B	0.8	1.5	NS	0a	2.2b	0.8	1.6	1.3	1.4	0.4	NS
Drink T	17	29	NS	0a	43b	15	48a	23b	22b	12b	24
Eliminate	0.4	0.5	NS	0.3a	0.7b	0.2	0.6	0.6	0.6	0.5	0.4

Means within rows within comparison followed by a different letter are significantly different at P=0.05, l.s.d.=least significant difference, NS=not significant, B=bouts, T=time in seconds.

Effect of feed withdrawal on behavior

Inactive behaviors- Emus that were subject to feed withdrawal had significantly fewer bouts of sitting compared to the control group (table 1). There was, however, no significant difference in the time spent sitting or standing between the treatment groups.

Ingestive behaviors- Clearly while the emus were being deprived of food and water no bouts of eating and drinking bouts were recorded. In addition there was a significant decline in the eliminative behavior (table 2). Time spent foraging also was significantly lower for emus deprived of food and water compared to birds with food and water available.

Posture change behaviors- Emus not subject to the stress of feed withdrawal engaged in more bouts of shifting while in the sitting position but there was no difference in other changes in posture due to stress (table 2).

Grooming and other behaviors- When emus were subject to food withdrawal there was a reduction in bouts and time spent preening and reduction in head scratches. There was no significant difference in other stereotype and display behaviors (table 2).

Aggressive and defensive behaviors- Overall there were no major significant differences in aggressive behaviors between the stressed and non stressed

Table 2. Effect of de-clawing, feed withdrawal and environmental temperature on bouts, time (seconds/hour) and incidence of changes in posture, grooming and other behaviors in emus over 1 h

	Declawing			Feed withdrawal			Environmental temperature				
Variable	De-claw	Control	l.s.d.	Yes	No	l.s.d.	Cool	Mild	Warm	Hot	l.s.d.
Change Posture											
Step	11.3	12.8	NS	12.3	11.7	NS	13.8	11.7	13.0	10.4	NS
Shift while sittting	1.1	2.0	NS	0.9a	2.2b	1.0	1.3	2.0	1.2	2.0	NS
Stand up	1.1	0.9	NS	0.9	1.0	NS	0.8	0.7	1.0	1.3	NS
Grooming and other behaviors											
Preen B	15.1	15.1	NS	10.2a	19.6b	3.5	26.7a	19.5b	13.8c	8.3d	5.5
Preen T	105	97	NS	56a	143b	26	231a	125b	86bc	49c	40
Head Scratch	0.6	0.2	NS	0.2a	0.6b	0.3	1.3a	0.1b	0.5b	0.3b	0.5
Head Shake	3.2	4.2	NS	3.2	4.1	NS	4.5	3.5	4.1	3.0	NS
Stretch	0.5	0.9	NS	0.4	0.9	NS	1.3	0.7	0.6	0.5	NS
Exhibition B	0.9	0.6	NS	0.7	0.8	NS	0.9	1.2	0.8	0.3	NS
Exhibition T	28	11	NS	23	17	NS	17	28	24	9	NS
Fence Peck	74	18	NS	8	82	NS	73	32	78	5	NS
Head 'thro' Fence	0.3a	6.7b	5.6	5.7	1.3	NS	2.7	9.8	1.4	0.8	NS

Means within rows within comparison followed by a different letter are significantly different at P=0.05, l.s.d.=least significant difference, NS=not significant, B=bouts, T=time in seconds.

Table 3. Effect of de-clawing, feed withdrawal and environmental temperature on bouts, time (seconds per hour) and incidence of aggressive and defensive behaviors

	Declawing			Feed withdrawal			Environmental temperature				
Variable	De-claw	Control	l.s.d.	Yes	No	l.s.d.	Cool	Mild	Warm	Hot	l.s.d.
Aggressive behaviors											
Run Chase B	0.8	0.7	NS	1.3a	0.3b	0.9	0.5	0.3	0.7	1.3	NS
Run Chase T	5	4	NS	7	1	NS	2	2	5	6	NS
Runaway B	1.2	1.0	NS	1.4	0.9	NS	1.4	1.3	1.2	0.8	NS
Runaway T	6	6	NS	8	4	NS	8	7	6	5	NS
Give thrusts	1.2	1.7	NS	2.1	0.8	NS	0.7	1.1	1.5	2.0	NS
Receive thrusts	2.0	2.1	NS	2.7a	1.4b	0.9	1.7	2.5	2.0	1.8	NS
Peck	1.4	1.9	NS	1.1	2.3	NS	2.1	0.9	1.3	2.9	NS
Pecked	0.6	1.0	NS	0.8	0.8	NS	0.6	1.1	0.9	0.4	NS
Step push	0.7a	2.0b	1.1	1.3	1.3	NS	1.4	1.7	1.2	0.9	NS

Means within rows within comparison followed by a different letter are significantly different at P=0.05, l.s.d.=least significant difference, NS=not significant, B=bouts, T=time in seconds.

groups. There was however a significant increase in the incidence of run chase bouts associated with the stress period and increase in the incidence of emus receiving thrusts (table 3).

Locomotor behaviors- The stressed emus spent more time ($p<0.05$) walking and there was a significant increase in pacing bouts and time spent pacing (table 4).

Effect of environmental temperature on behavior

Inactive behaviors- Under hot conditions there was a significant increase in the time emus spent sitting, matched by a significant decline in time spent standing. The opposite occurred under cool conditions with emus spending more time standing and less time sitting (table 1).

Ingestive behaviors- During cool periods emus engaged in significantly more bouts of eating and spent more time drinking than emus did during hot periods (table 1).

Posture change behaviors- There was no significant differences in the incidence of changes in posture for emus that could be attributed to environmental temperature (table 2).

Grooming and other behaviors- As environmental temperature increased there was a significant decline in bouts and time spent preening and incidence of head scratching (table 2).

Aggressive and defensive behaviors- Overall there were no major significant differences in aggressive behaviors that could be attributed to environmental temperature (table 3).

Locomotor behaviors- As environmental temperature increased there was a reduction in bouts of walking and running time. Time spent pacing, however, increased as the environmental temperature increased (table 4).

Interactions

No biologically important 2 or 3 way interactions were observed in the behavior for the main effects of declawing, feed restriction or environmental temperature.

The stepwise regression procedure

Because of the overall lack of significant change in behavior associated with the de-clawing treatment it was decided to pool the behavior data and apply the stepwise procedure to find which of all the other independent behavior and production variables could be included in a model for aggressive behaviors pecking, being pecked, giving head thrusts and receiving head thrusts. The stepwise first finds the single variable model which produces the largest R^2 statistic. For each of the other independent variables, stepwise calculates an F statistic reflecting the variables contribution to the model, were it to be included. The variable with the highest F value is added to the model provided the probability associated with the F value is greater than 5%. After a variable is added stepwise looks at all the variables already included in the model. Any variable not producing a partial F-statistic at the 5% significance level is then deleted from the model. Variables are added to the model until none produces an F value of the required probability until the variable deleted is the last variable added. The stepwise procedure was used for the dependent variable giving pecks. All other variables measured (including pecked, receiving head thrusts and giving head thrusts) in this study were included as

Table 4. Effect of de-clawing, feed withdrawal and environmental temperature on bouts of time emus were involved in locomotory behaviors over 1 h

	Declawing			Feed Withdrawal			Environmental temperature				
Variable	De-claw	Control	l.s.d.	Yes	No	l.s.d.	Cool	Mild	Warm	Hot	l.s.d.
Locomotor											
Search B	8.1a	2.8b	2.2	4.6	6.5	NS	7.8	5.3	5.9	4.4	NS
Search T	172a	39b	53	99	117	NS	125	104	109	102	NS
Searchpace B	4.2	5.4	NS	5.7	3.9	NS	3.5	4.8	6.4	2.7	NS
Searchpace T	56	89	NS	53	94	NS	35	66	109	38	NS
Walk B	9.8	8.8	NS	9.3	9.3	NS	12.3a	6.5b	11.2ab	7.8ab	5.0
Walk T	216	147	NS	223a	146	74	175	121	208	121	NS
Pace B	13.9a	29.4b	8.3	25.4a	16.6b	8.3	16.9	27.2	19.8	18.1	NS
Pace T	344a	788b	302	762a	372b	302	232b	823a	470ab	585ab	474
Run B	0.2	0.1	NS	0.2	0.1	NS	0.2	0.1	0.2	0.2	NS
Run T	2	3	NS	3	3	NS	10a	0b	1b	4ab	6
Runpace B	0.2	0.1	NS	0.3a	0b	0.2	0.1	0.2	0.1	0.3	NS
Runpace T	2	1	NS	2	0	NS	0.5	0.9	1.0	1.7	NS

Means within rows within comparison followed by a different letter are significantly different at P=0.05, l.s.d.=least significant difference, NS=not significant, B=bouts, T=time in seconds.

independent variables for this analysis. The following 5 variables forage bouts (R^2=0.29), sit down time (R^2=0.35), time foraging while sitting down (R^2=0.39), stretch (R^2=0.41) and preen bouts (R^2=0.42) were selected in order of importance for their association with emus giving pecks and collectively explained 42% of the variation associated with giving pecks.

For the variable of being pecked the 5 variables selected were; receive thrusts (R^2=0.11), fence peck (R^2=0.16), step push (R^2=0.21), exhibition time (R^2=0.24) and head shake (R^2= 0.27) all of which explained 27% of the variation in being pecked. The 5 variables selected in order of their importance for the variable receiving thrusts were run away bouts (R^2=0.29), giving thrusts (R^2=0.35), run chase bouts (R^2=0.39), pacing time (R^2=0.41) and pecking (R^2=0.42). These variables explained 42% of the variation in emus receiving thrusts. For the variable giving thrusts the 5 key variables which explained 88% of the variation were run chase bouts (R^2=0.82), receive thrusts (R^2=0.85), run away bouts (R^2=0.86), pecked (R^2=0.87) and pecking (R^2=0.88).

DISCUSSION

If the emus were in severe chronic pain there should be evidence that declawed emus would be more inactive compared to control emus and unwilling to stand or walk. In particular there was no evidence in this study of one legged standing, limping and sitting as the declawed bird attempted to cope with the pain.

If emus were suffering from severe chronic pain, the toe stumps would probably feel sore resulting in loss of locomotor function. There was no behavioral evidence to indicate loss of locomotor ability. In fact declawed emus engaged in more bouts and time of searching suggesting the birds were showing little discomfort from chronic pain. In addition declawed emus engaged in less stereotype pacing behavior than control emus. Pacing is considered to be generally observed in confined and restricted animals in which the animals are often unable to express or perform their natural behavioral pattern freely. Confinement and restrictions which deny the exercise of natural behavioral needs could be frustrating (Duncan and Wood-Gush, 1972) leading to the redirection or substitution of behavioral stereotypes (Rushen, 1984, 1985; Odeberg, 1987). For example, stereotypic pacing in laying hens is associated with lack of access to nest boxes (Duncan, 1970) or restriction of feed (Duncan and Wood-Gush, 1972) and rout tracing in caged canaries (Keiper, 1970). It has been suggested that stereotypes could be a positive mechanism to enable the animal to cope with the environment although it is not clear whether the stereotypes themselves are the source of coping (Mason, 1991) or a sign of habituation. The greater levels of stereotype pacing observed in control emus could be the mechanism enabling the bird to cope with the stress of being in a threatening environment where they fear the attack from other emus with intact claws. It was also observed that control animals engaged in greater incidence of the stereotype behavior of poking their heads through the fence while they were pacing which can lead to skin damage. Emus may have analogous behavior to poultry and ostriches (McKeegan and Deeming et al., 1997) as it is well known that with increased levels of frustration, behavioral changes observed include increased displacement, stereotyped pacing and increased aggression by dominant birds (Duncan and Wood-Gush, 1972).

In less painful arthritic conditions it might be expected that birds would change their posture more frequently in an attempt to achieve more comfort. For instance if the emu were in pain they would tend to be restless when both in the standing and sitting position and also make more frequent changes from the standing to the sitting position and vice versa. No evidence could be found in these studies that the declawed emus engaged in more posture changes as a result of feeling discomfort compared to the control emus.

There was a trend for the control emus to show more aggression. In particular control emus gave more threats by stepping toward other emus and pushing them away. Control emus showed more frustration as they engaged in more stereotype behaviors (pacing and head through fence behavior) which often leads to increased aggression particularly by dominant birds. Declawed emus were no different in their ingestive and grooming behaviors providing further evidence that the practice of declawing did not have a major influence on emu behavior.

It is clear from the stepwise regression analysis that emus which give pecks to other emus have a tendency to engage in more bouts and time spent foraging. In poultry, feather pecking is an abnormal behavior which often results in extensive damage to the plumage of birds (Hughes and Michie, 1982). It is usually a problem associated with confinement of animals which is dramatically contrasting environment to the bird's original habitat. The confinement of emus to paddocks may lead to intensive social interaction and more agonistic acts. Feather pecking is generally accepted as a misdirected behavior, due to the lack of environmental stimuli, although there is diversion about its development. Several investigators (Blokhuis, 1986; Blokhuis and Arkes, 1984; Blokhuis and Van der Haar, 1989, 1992; Braastad, 1990) have confirmed the relationship with ground pecking and it may indeed be regulated by the same mechanism (Blokhuis, 1986).

These investigators assert its association with foraging behavior and that ground pecking stimuli can alleviate it. Vestergaard and Limburg (1993) associate it with dust bathing behavior and thus the provision and experience with attractive stimuli, like sand and peat could reduce feather pecking. The current studies have shown that pecking behavior is more closely related to foraging behavior in emus. In poultry, birds able to engage in foraging activities tend to feather peck less. The current studies are in disagreement with this finding. It is considered that confinement of emus in paddocks and the lack of reward for emus in attempting to forage on bare paddocks leads to frustration resulting in the aggressive pecking behavior.

Birds spend most of their time in beak related activities (Hughes and Grigor, 1996) and when there are very limited activity choices there would be more time for feather pecking. It is strongly suggested that ground pecking is an important parameter in the risk of feather pecking in various environments (Blokhuis, 1986) and that may partly explain why feather pecking is more severe in cages than litter systems (Tanaka and Hurnik, 1991). But it could also involve the satisfaction of exploring motivation which may have been limited for the emus foraging in the bare paddocks. Foraging involves both searching and consumption and behavioral instinct to fetch food which could be satisfied by ground pecking. Sherwin (1995) has demonstrated that birds have strong motivation not only to feed but also to explore their environment. Pecking preferences at laying, however, are influenced by prior experience and the ground pecking character may not be stable if pecking incentives are not given during rearing (Blokhuis and Van der Haar, 1992).

It is clear from the regression analysis that birds being pecked were those that step pushed at other emus but also received thrusts. Emus being pecked also had a higher incidence of stereotype behaviors (fence pecking and head shaking). It is believed the reduction of fear is reflected in adaptive or displacement behavior. In this study head shaking and fence pecking were the significant stereotypic behaviors related to birds that were being pecked. Head shakings has been characterised as a coping mechanism and as a symptom of being "better off" (Duncan, 1970; Mauldin and Siegel, 1979) and is a prominent behavior in White Leghorn birds (Webster and Hurnik, 1990). It is also interesting to note that head shaking coincided with the exhibition behavior which in it self could attract aggressive pecking by other birds.

Emu receiving thrusts from other emus tended to be those emus which engaged in the aggressive behaviors of giving thrusts, pecking and running at other emus. Emus under threat also spent more time pacing which is a stereotype behavior indicating frustration. In a similar manner emu giving thrusts were also those birds pecking and chasing other birds but also receiving thrusts and running away.

Withdrawal of feed influenced the behavior of birds to a greater extent than declawing. The emus were more restless and engaged in more aggressive behaviors. In particular birds spent more time walking and also engaged in more bouts and time spent pacing compared to birds with food available.

Under hot conditions it would be expected that birds would rest and this was shown in the study with birds spend more time sitting and less time walking. There was a significant decline in grooming behaviors during hot weather. Grooming is important for birds to maintain the feather condition and placement which assists in the insulation of birds against cold conditions. During hot weather birds could be saving energy by reducing preening and may have a reduced need to keep their feathers in a condition to provide the maximum insulation. Birds did increase their level of stereotype pacing under the hot conditions, yet did most of their drinking during cooler weather associated with increased time spent feeding. It was expected that emus would spend more time drinking when the temperature was high. Drinking water was provided in water troughs that were not shaded. The water was very warm and may have been aversive for emus to drink during the hot part of the day. Methods to keep the water cool for emus under hot weather are required.

Lesions from claws is a major cause of skin damage resulting in a reduction of $30A per skin (O'Malley and Snowden, 1999). Declawing emu chicks immediately after hatch using a hot blade beak trimming machine effectively reduces skin damage and does not result in slower growth rates or higher mortality to slaughter age. The birds are easier to handle and risk of injury to farmers is greatly reduced. Use of the hot blade beak-trimming machine used for poultry is the most effective method of declawing emu chicks. It is recommended that people undertaking the procedure should receive instruction on the accepted technique and be familiar with the appearance of a correctly de-clawed toe (O'Malley and Snowden, 1999). Declawing techniques, which retain the emus toe pad under the claw, will maximise the development of a pad of tissue at the tip of the declawed toe and provided a cushion to the end of the toe. The development of this pad would appear to protect the tip of the toe against injury from rocks and hard surfaces. The best results can be achieved using a hot blade beak-trimming machine to remove the distal phalangeal joint, fitted with a convexed bottom or guide bar and operated to maximise the retention of pad tissue under the claw (O'Malley and

Snowden, 1999). De-clawing emu chicks within 24 h result in a relatively low level of trauma and stress for chicks as has been demonstrated in domestic poultry (Glatz and Lunam, 1994). However it increases the time the chicks take to commence feeding by 24 to 36 h and reduces live weight by about 10 percent at 2 weeks of age. Any live weight depression is recovered by 3 weeks of age. The use of constricting rubber rings, liquid nitrogen and a cold blade without cauterisation to declaw emu chicks are either difficult to apply or result in significant re-growth of the claw (O'Malley and Snowden, 1999).

Anecdotal reports from Industry indicate that adult birds tend to be more relaxed and less aggressive when they are declawed, supporting the findings in this study. Handlers feel more confident because they are not concerned with receiving claw damage from the bird and a better human bird relationship develops. The only issue of concern reported from industry is declawed birds do slip under wet conditions. It is important therefore to have hygienic yards, cleaning out the yards and runs more often and increase the use of sand and sawdust bedding. There is a tendency for regrowth of claws but this problem is mainly caused by operator error during the declawing process.

As a conclusion the behavioral evidence in this study indicates that declawing does not compromise the locomotor ability of emus and has the benefit of improving the social structure in the groups by reducing stereotype behavior and aggression.

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REFERENCES

Blokhuis, J. H. 1986. Feather pecking in poultry: Its relation to ground pecking. App. Anim. Behav. Sci. 16:63-67.

Blokhuis, J. H. and J. G. Arkes. 1984. Some observations on the development of feather pecking in poultry. App. Anim. Behav. Sci. 12:145-157.

Blokhuis, J. H. and W. J. Van Der Haar. 1989. Effects of floor type during rearing and of beak trimming on ground pecking and feather pecking in laying hens. App. Anim. Behav. Sci. 22:359-369.

Blokhuis, J. H. and W. J. Van Der Haar. 1992. Effects of pecking incentives during rearing on feather pecking of laying hens. Br. Poult. Sci. 33:17-24.

Braastad, B. O. 1990. Effects on behavior and plumage of a key stimuli floor and a perch in triple cages for laying hens. App. Anim. Behav. Sci. 27:127-139.

Duncan, I. J. H. 1970. Frustration in The Fowl, In: Aspects of Poultry Behavior (Ed. B. M. Freeman and Gordon, R. F. Edinburgh). Oliver and Boyd. pp. 15-31.

Duncan, I. J. H. and D. G. M. Wood-Gush. 1972. The analysis of displacement preening in the domestic fowl. Anim. Behav. 20:68-71.

Frapple, P., P. O'Malley, J. Snowden and R. Hagen. 1997. Emu processing and product development. Report for the Rural Industries Research and Development Corporation. Research Paper Series No. 97/66.

Glatz, P. C. and C. A. Lunam. 1994. Production and heart rate responses of chickens beak-trimmed at hatch or at 10 or 42 days of age. Aust. J. Exp. Ag. 34:443-447.

Gentle, M. J. 1992. Pain in birds. Anim. Welfare. 1:2325-2347.

Hughes, B. O. and P. N. Grigor. 1996. Behavioral time budgets and beak related behavior in floor housed turkeys. Anim. Welfare. 5(2):189-198.

Hughes, B. O. and W. Michie. 1982. Plumage loss in medium bodied hybrid hens: The effect of beak trimming and cage design. Poult. Sci. 23:59-64.

Keiper, R. 1970. Studies of stereotypy function in the canary. Anim. Behav. 18:353-357.

Mason, G. J. 1991. Stereotypes: A critical review. Anim. Behav. 41:1015-1037.

Mauldin, J. M. and P. B. Siegel. 1979. Fear, head shaking and production in five populations of caged chickens. Br. Poult. Sci. 20:39-44.

McKeegan, D. E. F. and D. C. Deeming. 1997. Effects of gender and group size on the time-activity budgets of adult breeding ostriches (Struthio camelus) in a farm environment. Appl. Anim. Behav. Sci. 51:159-177.

Odberg, F. 1987. Behavioral responses to stress in farm animals, In: The Biology of Stress in Farm Animals: An Integrated Approach (Ed. P. W. M. Van Adrichem and P. R. Wiepkema). Dordrecht: Martinus Nijhoff. pp. 135-149.

O'Malley, P. and J. Snowden. 1999. Emu products. Increasing production and profitability. A report for the Rural Industries Research and Development Corporation. Research Paper Series No. 99/143.

Rushen, J. 1984. Stereotyped behavior, adjunctive drinking and the feeding periods of tethered sows. Anim. Behav. 52:1059-1067.

Rushen, J. 1985. Stereotypies, aggression and the feeding schedules of tethered sows. App. Anim. Behav. Sci. 14:137-147.

Statistical Analyses Systems Inc. 1988. SAS Procedures Guide, Release 6.03 Edition, Cary, North Carolina, USA.

Sherwin, C. M. 1995. Environmental enrichment for laying hens-spherical objects in the feed trough. Anim. Welfare. 4:41-51.

Tanaka, T. and J. F. Hurnik. 1991. The behavior of young layers during the first weeks in aviary and battery cages. Poult. Sci. 70:404-407.

Thorp, B. H. 1994. Skeletal disorders in the fowl: A review. Avian. Pathol. 23:203-236.

Vestergaard, K. S. and L. Limburg. 1993 A model of feather pecking development which relates dust bathing in the fowl. Behav. 126:291-308(Abst).

Webster, A. B. and J. F Hurnik. 1990. Behavior, production, and well being of the laying hen. 2. Individual variation and relationships of behavior to production and physical condition. Poult. Sci. 70:421-428.

Zimmerman, M. 1986. Behavioral investigations of pain in animals. In: Assessing Pain in Farm Animals (Ed. I. J. H. Duncan and V. Maloney). Commission of the European Communities, Luxembourg. pp. 30-35.