Genetic and environmental factors influencing skin traits of South African farmed ostriches

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South African ostrich industry

- Domestication of ostriches in RSA ~ 1864
- 70% of global population

40%

20%

40%

Ostrich leather

- ❑ Exotic & luxury leather
- ❑ Feather nodules make it unique
- ❑ Appearance and quality - VERY important
- ❑ Grading of ostrich skins - very strict

Defect: Healed scratch mark

Defect: Open small defects

Defect: Typical scar caused by partially healed wound

Aim

- to assess different skin characteristics and to estimate genetic and environmental parameters for these skin traits

Methods

- ❑ Slaughter records (n=2660) - 1998-2018
- ❑ Slaughter age - 210 to 596 days

Ostrich skin traits studied

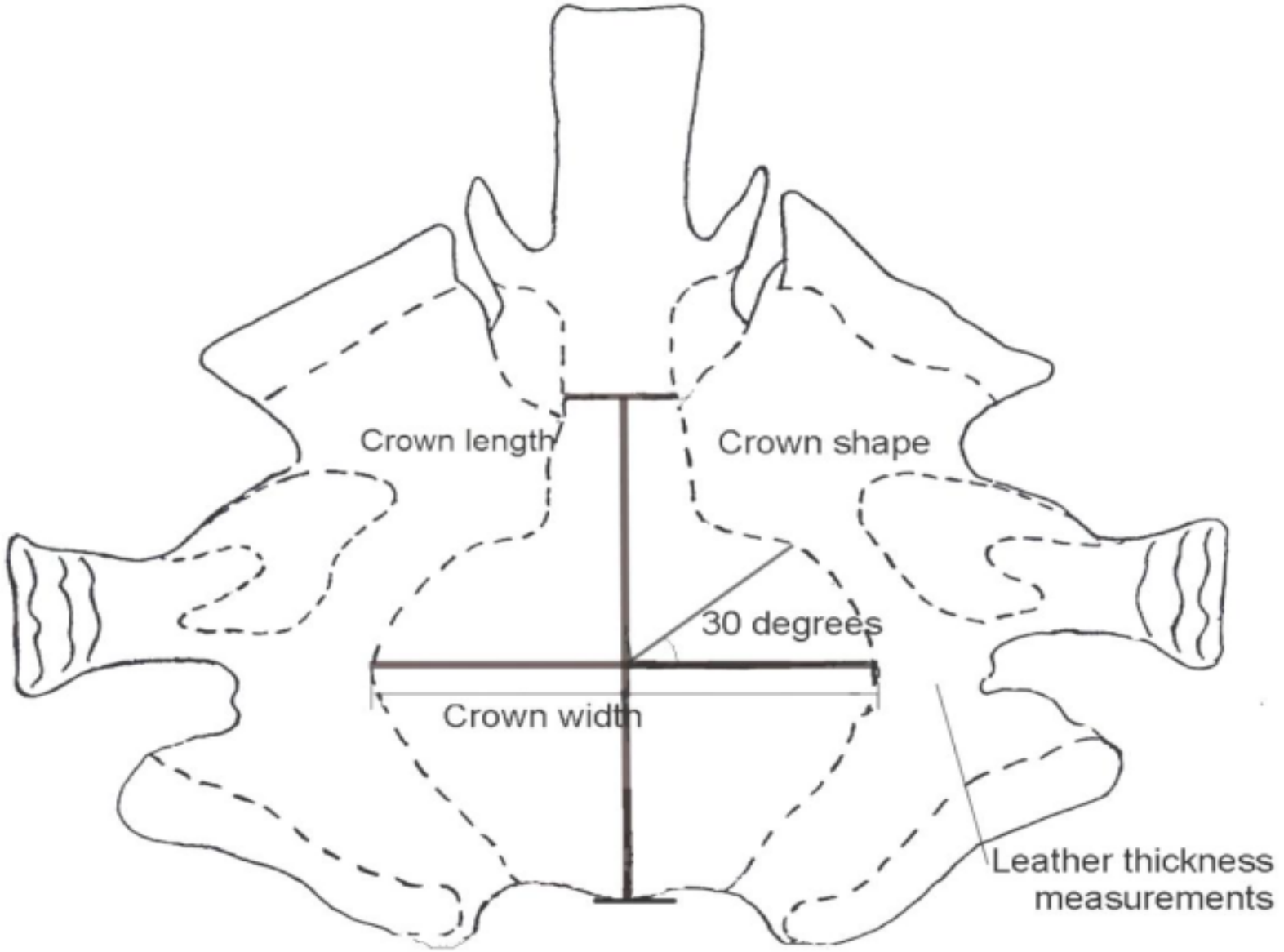
Continuous traits (Quantitative)

- Slaughter weight
- Skin traits (weight, thickness)
- Crown traits (dimensions / size)
- Neckline traits (dimensions / size)

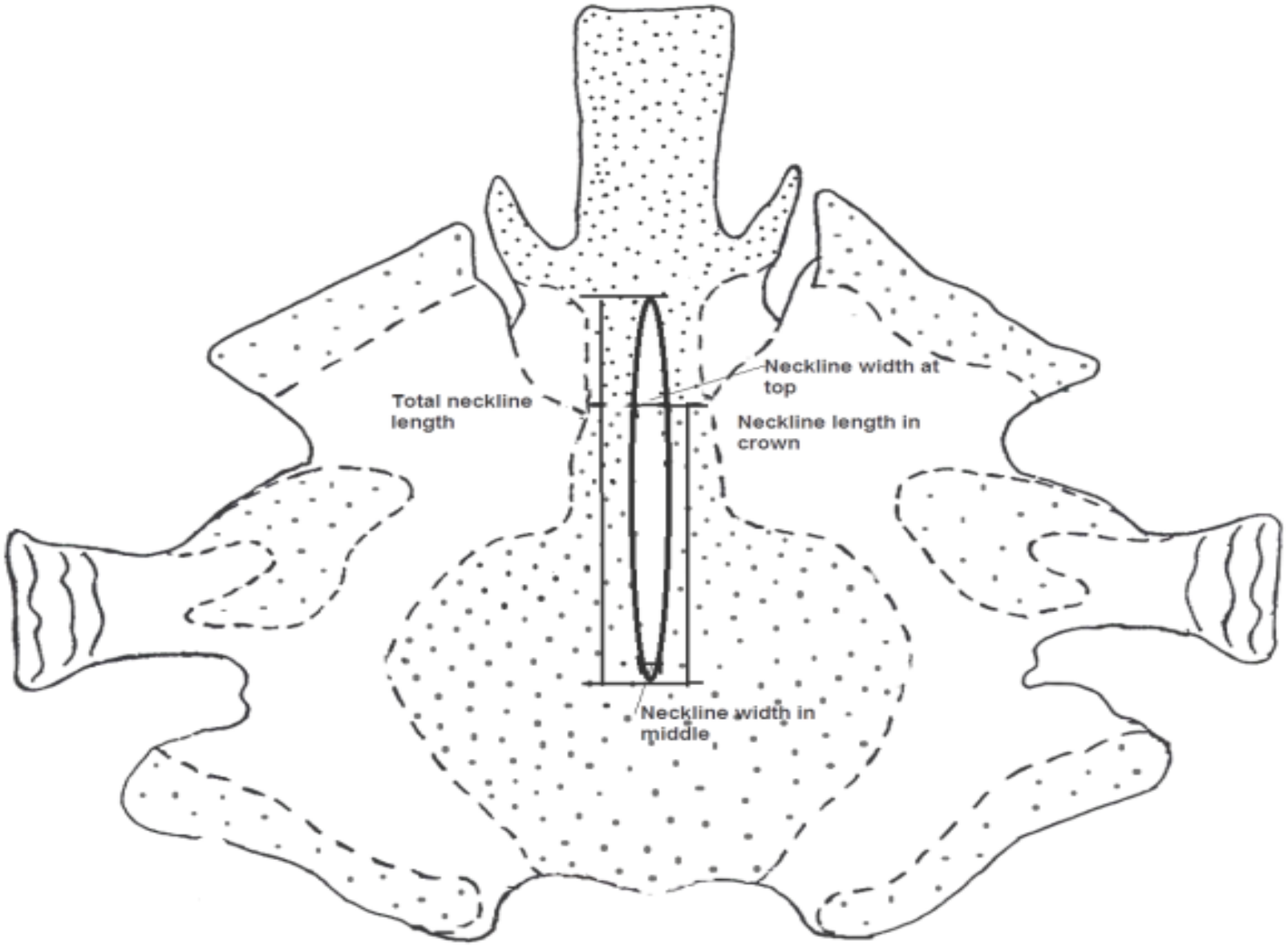
Threshold traits (Qualitative)

- Skin grade
- Quill value (nodule acceptability)
- Nodule traits (size, shape, distribution)
- Defects:
  - Presence of hair follicles
  - Presence of pit marks

Measurements on crown area & leather thickness



Measurements on neckline



Data analysis

- Fixed effects: contemporary group, sex, dam age and their interactions
- Slaughter age as covariate
- ASReml - fixed effects, animal as a single random effect and maternal permanent environmental effects
- Multi-trait analysis - genetic correlations (r_g), phenotypic correlations (r_p) and environmental correlations (r_e)

Results

Fixed effects:

- ❑ Slaughter group - significant for all traits
- ❑ All traits age dependent (higher in older birds), except for neckline traits
- ❑ Sex: significant for skin weight, skin thickness, crown length, nodule size & hair follicle score (mostly higher in males)

Single-trait analysis

Variance ratios (±s.e.) for ostrich slaughter and skin traits

Trait	h^2	c^2
Slaughter weight (kg)	0.41±0.06	n.s.
Skin grade (1-5)	0.09±0.04	n.s.
Quill value (1-5)	0.23±0.08	n.s.
Skin weight (kg)	0.27±0.06	n.s.
Skin thickness (mm)	0.20±0.05	n.s.
Skin size (dm^2)	0.37±0.06	n.s.
Crown length (mm)	0.27±0.06	n.s.
Crown width (mm)	0.23±0.08	0.10±0.04
Crown shape (mm)	0.21±0.05	n.s.

Variance components and ratios (±s.e.) for ostrich slaughter and skin traits

Trait	h^2	c^2
Neckline total length (mm)	0.21±0.05	n.s.
Neckline crown length (mm)	0.17±0.05	n.s.
Neckline width top (mm)	0.30±0.06	n.s.
Neckline width middle (mm)	0.14±0.04	n.s.
Nodule distribution (1-3)	0.05±0.04	n.s.
Nodule size (1-9)	0.34±0.06	n.s.
Nodule shape (1-9)	0.21±0.07	0.06±0.03
Hair follicle score (1-9)	0.42±0.06	n.s.
Pitting score (1-9)	0.08±0.04	n.s.

Multi-trait analysis

Direct heritability (h^2), genetic correlations(r_g) and phenotypic correlations(r_p) for slaughter weight with skin traits)

Correlated trait	h^2	r_g	r_p
Skin size	0.35±0.06	0.92±0.03	0.72±0.01
Skin weight	0.27±0.05	0.48±0.11	0.63±0.02
Skin thickness	0.20±0.05	0.15±0.16	0.19±0.03

Slaughter weight and crown traits

- Genetic correlations of slaughter weight with:
  - Crown traits were high
  - Except for crown width - moderate at 0.58
- Breeding values for both crown length and crown shape would increase with an increase in slaughter weight
- These results show that selection for body mass index values will also benefit crown traits
- Maternal effect for crown width

Slaughter weight and neckline traits

- Significant r_g with slaughter weight:
  - 0.36 ± 0.13 with neckline width top
  - 0.40 ± 0.14 with neckline crown length
  - 0.45 ± 0.13 with neckline length
- Generally r_p - same direction as r_g but smaller in magnitude

Correlations between slaughter weight with nodule traits and hair follicle score

Trait	Slaughter weight	Nodule distribution score	Nodule size score	Nodule shape score	Hair follicle score
Slaughter weight	**0.39±0.06**	-0.30±0.23	0.33±0.12	0.24±0.15	-0.16±0.13
Nodule distribution score	0.03±0.03	**0.08±0.04**	0.34±0.22	0.57±0.22	0.08± 0.24
Nodule size score	0.36±0.03	0.17±0.03	**0.34±0.06**	0.71±0.11	0.11±0.13
Nodule shape score	0.19±0.03	0.28±0.03	0.46±0.02	**0.24±0.07**	0.11±0.18
Hair follicle score	0.05±0.03	-0.00±0.03	0.14±0.03	0.05±0.03	**0.42±0.06**

Conclusions

- Skin, crown, and subjectively scored traits influenced by age
- Males had thicker skins, longer crown areas, beter nodules but more hair follicles
- Nodule development is age dependent (needs to be balanced against feed cost)
- High genetic correlation between most important qualitative traits (slaughter weight and skin size): skin yield can be improved through indirect selection
- Slaughter weight favourably correlated to most traits
- Most flocks only record live weight allowing indirect selection gains
- Mostly favourable correlations will aid development of a selection index for ostriches

- Genetic progress feasible – indirect selection for slaughter weight will also benefit most traits

- High genetic correlation (slaughter weight and skin size) - skin yield can be improved through indirect selection

- Mostly favourable correlations will aid development of a selection index for ostriches

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