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Short Note

Age classes of developing Red-necked Spurfowl *Pternistis afer* based on plumage, morphology and behaviour

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This paper describes the plumage and morphology development of 11 age classes of Red-necked Spurfowl *Pternistis afer* to assist with field observations. Sixteen spurfowl were marked with coloured leg rings in the Cannon Rocks Holiday Resort, Eastern Cape, South Africa during March 2006 and observed daily until June 2008 to describe plumage and non-plumage morphological changes. The age classes include natal chicks, six discernible juvenile phases, post-juvenile phase, near-adult phase, non-territorial and territorial males. Red-necked Spurfowl only attain the adult plumage phase at about 240 d. However, if the development of the bare red throat and spurs are excluded, this near-adult plumage stage is attained at about 180 d. Territorial male Red-necked Spurfowl have long spurs similar to other *Pternistis* spp. The cryptic downy pattern of chicks assist the birds to blend in with their habitat. However, the plumage of juveniles is simply a transitional phase between the cryptic plumage of downy chicks and the less cryptic plumage of adult spurfowls.

Classes d'âge de développement du Francolin à gorge rouge *Pternistis afer* en fonction du plumage, de la morphologie et du comportement

Cet article décrit le développement du plumage et de la morphologie de 11 classes d'âge du Francolin à gorge rouge *Pternistis afer* afin de faciliter les observations sur le terrain. Seize Francolins ont été marqués avec des anneaux de jambe colorés au centre de vacances Cannon Rocks, dans la partie Est du Cap, en Afrique du Sud, en mars 2006, et ont été observés quotidiennement jusqu'en juin 2008 pour décrire les changements morphologiques liés au plumage mais aussi à d'autres caractères. Les classes d'âge comprennent les poussins à la naissance, six phases juvéniles discernables, la phase post-juvénile, la phase presque adulte, les mâles non territoriaux et territoriaux. Le Francolin à gorge rouge n'atteint la phase du plumage adulte que vers 240 jours. Toutefois, si le développement de la gorge et des éperons nus et rouges est exclu, ce stade du plumage presque adulte se situe vers 180 jours. Le mâle territorial du Francolin à gorge rouge possède de longs éperons similaires à ceux des autres *Pternistis* spp. Le duvet cryptique des poussins aide les oiseaux à se fondre dans leur habitat. Cependant, le plumage des juvéniles est simplement une phase de transition entre le plumage duveteux cryptique des poussins et le plumage moins cryptique des Francolins à gorge rouge adultes.

Keywords: age classes, camouflage, morphology, plumage development, *Pternistis afer*, Red-necked Spurfowl

The plumage development and morphological characteristics of Cape Spurfowl *Pternistis capensis* (Hëyl 1988), Crested Francolin *Dendroperdix sephaena* (van Niekerk 2002, 2018), Grey-winged Francolin *Scleroptila afer* (Little and Crowe 1992) and Helmeted Guineafowl *Numida meleagris* (Siegfried 1966) have been studied in South Africa. The study on the Crested Francolin was based on trapping and field observations, whereas the other studies were conducted in captivity. Knowledge of plumage and the related age phases of Red-necked Spurfowl *Pternistis afer* is a prerequisite for behavioural, ecological and demographic studies (van Niekerk et al. 2009; Sutherland et al. 2010; Lovette and Fitzpatrick 2016). Our understanding of *Pternistis* spp. plumage development is limited to a simplistic division between natal, juvenile, near-adult and adult phases (Madge and McGowan 2002). This paper describes the development of plumage and morphology of 11 discernible age classes of Red-necked Spurfowl and diagnostic behavioural associated with certain age groups.

Sixteen Red-necked Spurfowl of known age were trapped, marked with coloured leg rings and released in the Cannon Rocks Holiday Resort (33°44′44.20″ S, 26°32′58.63″ E) during March 2006 (van Niekerk et al. 2009) and observed daily until June 2008. The four hens with chicks visited a feeding site daily, which enabled the description of plumage development and morphological phases of the chicks and their designation to relative age classes. The feeding site is the core where the spurfowls

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were ringed. The movements and ecological behaviour of the spurfowls were also observed to associate age classes with ecological behaviour (van Niekerk et al. 2009).

Given some differences between authors, moulting phases are generally described as natal down, juvenile, near adult and adult (Johnsgard 2008). I have kept these broad intervals but have added intermediate gradations. Since these spurfowl retain down plumage over the body for weeks, I have chosen to use five juvenile phases before the chicks attained a complete transformation to post-juvenile feathers over the entire body including the head. This finer gradation is practical to estimate the different age classes of the developing spurfowl chicks in the field. Raw data were recorded during field work and noted in a book and 20 photographs of chicks, immature and adult individuals and two video recordings were also analysed. Photographs were also taken of museum skins in the American Museum of Natural History in New York, USA. The plumage development phases and morphology are associated with corresponding habitat-use patterns and behaviour to provide more cues about the different age classes. Comparative mean group size was determined using a single-factor ANOVA in Excel (Gardener 2012).

Eleven age classes could be distinguished based on the progressive development of differentiating plumage and non-plumage morphological features (Table 1). The natal (hatched) chick is completely covered in down feathers (Figure 1). The juvenile chick (post-natal) has a black-brown cap on a lighter yellowish-brown background down the sides of the face, composed of down feathers. At the 5th juvenile phase, the head loses its natal appearance (Figure 2). The juvenile phase ended at 16 weeks, when all downy feathers were moulted. The subadult phase began when bare red skin started developing around the eye and on the throat (Table 1).

Young adult females (nine months and older) are indistinguishable from adult females and near-adult males without long spurs. These young spurfowl, including females, form coalitions, but there were no courtship displays observed between the males and females within these coalitions.

Table 1: Plumage development and morphological phases that differentiate age classes of Red-necked Spurfowl *Pternistis afer* in the field

Plumage name	Age (approx.)	Mandible	Legs and feet	Head	Back	Breast	Wing feathers
Down	1–3 days	Dark grey	Orange-reddish	Yellowish down with brown crown cap and prominent darkish eyeline	Brownish down with dark brown longitudinal bands	Plain light grey down	None
1st juvenile phase	2 weeks	Dark grey	Orange-reddish	Yellowish down with dark crown cap and eyeline	Brownish down with dark brown longitudinal bands	Whitish, grey and brown down mottled	Feathers
2nd juvenile phase	3 weeks	Dark grey	Orange-reddish	Yellowish down with dark crown cap and eyeline	Feathers with white diamond shaped markings among mottled among brownish background	Upper area speckled with white diamond shaped markings	Mottled
3rd juvenile phase	5 weeks	Dark grey	Orange-reddish	Yellow down with dark brown cap, but eyeline gone	Feathers with white diamond shaped markings and black blotches against a brown background	Mottled black and white spots, diamond head shaped	Mottled
4th juvenile phase	2–3 months	Dark grey	Orange-reddish	Yellow down with dark brown cap, but eyeline gone and crown mottled	Feathers with white diamond shaped markings and black blotches against a brown background	Entire breast covered with white feathers	Mottled
5th juvenile phase (transitional)	4 months	Dark grey	Orange-reddish	No down feathers, greyish mottled extending on facial areas (natal appearance lost)	Feathers with white diamond shaped markings and black blotches against a brown background	Dark brown background with white and black blotches	Mottled
Post-juvenile (coalitions)	6–7 months	Dark grey, but lighter at tip	Orange-reddish	Brown feathers with some red skin in front of eyes	Brown with faint white speckles (mottled)	Breast feathers like adults - also long and hanging	Mottled
Near-adult phase (coalitions)	8–10 months	Scarlet red	Orange-reddish with bumps as incipient spurs	Dark brown feathers with clear bare red facial parts	Brown with broad dark feather streaks	Dark brown with white streaks	Plain coloured feathers
Adult female	9 months and older	Scarlet red	Orange-reddish, but no spurs	Similar to adult male	Brown with broad dark feather streaks	Dark brown with white streaks	Plain coloured feathers
Non-territorial male	12–20 months	Scarlet red	Orange-reddish spurs, 6–15 mm long	Similar to adult male, but the black edging around red throat skin narrower	Brown with broad dark feather	Dark brown with white	Plain coloured
Territorial male	Probably 2–4 years	Bright scarlet red	Orange-reddish spurs, 25 mm long	Crown dark brown; bold red skin around eyes and red throat patch with broad black edging around red throat	Brown with dark brown feather streaks	Lower breast dark brown with white streaks. Long breast feathers	Plain coloured feathers

Figure 1: Left: dorsal view of a Red-necked Spurfowl chick with downy plumage. Centre: lateral view of the same chick. Right: juvenile chick of 10–14 d with wing feathers

This was followed by the 'non-territorial male' phase, when short spurs of 5–10 mm were observed. These males can also be termed 'floaters'. This is a solitary stage, since preceding this, the coalitions would normally have been separated by territorial males, who would peck at and chase the young males so that territorial males could get access to young females. Young females are not designated to a pre-breeding phase, since they are courted by territorial males once they are independent from parental care. Three marked territorial males were four to five years old when they disappeared from the study area, which may suggest that males only have a life-span of five years.

During the downy chick phase up to the 3rd juvenile phase the chicks are cryptic and rely heavily on their morphological feathers as camouflage to evade predators. The hen would forage close to her chicks and would leave them under cover close to the feeding patch and if it was safe and there were no other spurfowl nearby, she would produce a *kloek* sound, when they would emerge in the open for her to direct them to the food. In one case, the distance from the nest to the foraging patch was about 90 m and it was evident that these natal coveys had been under cover for weeks. In another instance, the hen and her post-natal chicks (up to four weeks) remained in a small area of about 1 ha for three weeks during 28 December 2006 to 18 January 2007.

During the juvenile phase, the hens and chicks were observed up to 400 m from the core often in the open where they were trapped and marked. When post-juvenile spurfowl became independent from parental care, they were often observed in open habitat (e.g. on mowed grass lawns). Four post-juvenile spurfowls moved 600, 400, 650 and 500 m away from the core, showing that the distance in movement increased with age.

During the downy chick phase, the mean brood size was 4.6 individuals (range = 2–7, n = 10, SD = 1.77), during the juvenile phase it was 2.7 (range = 1–6, n = 35, SD = 1.23) and during the post-juvenile coalition phase it was 3.2 (range = 2–8, n = 24, SD = 1.76) (ANOVA: F = 6.41, df = 2,66 , p = 0.0028). These coalitions have a larger mean covey size, since neighbouring young birds join to form coalitions after becoming independent from their parents.

Figure 2: Left: juvenile Red-necked Spurfowl with head covered in down (4th juvenile stage). Right: 5th juvenile stage with head down replaced by feathers (transitional stage)

Grey-winged Francolin attain near-adult plumage at about 50 d (Little and Crowe 1992), whereas Red-necked Spurfowl attain this phase at about 240 d, with the appearance of the

red throat and spurs. If the latter two morphological features are ignored, near-adult plumage is attained by about 180 d. Similar to Red-necked Spurfowl, the near-adult phase for Crested Francolin is at 140–160 d (van Niekerk 2018). The near-adult plumage of Red-necked Spurfowl at 180 d is attained later than that of Cape Spurfowl, which is at about 140 d (Hëyl 1988). Cape Spurfowl do not develop bare throats. Bare facial parts and spurs must be factored into age classes, since they are diagnostic features in the field. The bare throat plays an important role in attracting females during breeding and therefore younger males are probably at a disadvantage to compete (JHvN unpublished data).

Spur development also plays a key role in the dominance structure of spurfowl social life (Stein 2013; van Niekerk 2017), apart from Hartlaub's Spurfowl *Pternistis hartlaubi*, where adult males have only rudimentary spurs (Little and Crowe 2011; Little 2016). Dominant male Red-billed *P. adspersus* and Swainson's *P. swainsonii* Spurfowls have long spurs and are regularly observed in fixed territories (van Niekerk et al. 2009). Territorial male Red-necked Spurfowl also have long well-established spurs compared with younger males.

The evidence suggests that young males of several spurfowl species, including Red-necked Spurfowl, have relatively short spurs for up to 20 months, which is a disadvantage when these males attempt to establish territories. At about eight months, Swainson's and Natal Spurfowls *Pternistis natalensis* have spur lengths of 6 mm or less (Milstein and Wolff 1987), whereas the territorial males of both species have spur lengths of 20–30 mm. On the other hand, the spurs of the male Grey-winged Francolin start to develop at about 75 d (Little and Crowe 1992), while male Crested Francolin spurs are already long and sharp at 150 d. Male Crested Francolin start breeding within 12 months of age and need spurs to survive, since the males are regularly engaged in physical battles to obtain partners and maintain territories (van Niekerk 2018). It is not possible to distinguish a young Red-necked Spurfowl female of 8–9 months from an older female, but based on spur development, it is easy to distinguish males in this age category from older males.

The downy chicks of several francolin species, especially the grassland francolins *Scleroptila* spp., have multiple longitudinal stripes on the crown and sides of the face, whereas Red-necked Spurfowl downy chicks have fewer stripes and a plain cap on the crown. Francolin chicks squat in thick, tallish grass when there is an imminent threat nearby. The striped downy plumage breaks the shape of the head and makes them less detectable. Spurfowls live in more open habitats and their chicks have fewer markings so as not to attract attention, since multiple stripes may draw attention by defining the shape of the chick (van Niekerk and Mandiwana-Neudani 2018).

During the juvenile phase, Red-necked Spurfowl move into the open as the mean brood size decreases from 3.7 to 2.7, which can probably be ascribed to predation. When post-juveniles become independent of parental care they are not particularly cryptic and also develop prominent bare red facial skin. However, during this phase the mean group size is larger due to coalition formation possibly to benefit from the many eyes approach to detect potential predators. These young birds must fill vacancies in the population or, in the case of females, get courted by adult males and probably are in the open regularly to attract attention.

Somveille et al. (2016) found no relationship between the plumage patterns of juvenile or adult birds and habitat structure, suggesting that there was no evidence that birds acquire plumage patterns to blend in with their choice of habitat to evade predation. This does not seem to be the case for downy plumage Red-necked Spurfowl chicks (Johnsgard 2008; van Niekerk and Mandiwana-Neudani 2018) but seems relevant to juvenile and adult spurfowl.

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