Ageing Afrotropical birds in the hand: a revised new system

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Introduction

It is well known that the age and sex of a bird can affect its migration, moult strategies, survival rates, and even foraging and roosting behaviour (e.g. Ginn & Melville 1983; Dougall & Appleton 1989; Gorney & Yom-Tov 1994; Dougall 1996;Tree 2000). Determination of the age is therefore fundamental for a proper understanding of a species' biology. Avian population studies rely heavily on knowledge of the age structure in order to calculate breeding success, mortality / survival rates and to understand the turnover of individuals within a population (Boddy 1993). In a number of species first year birds will have a different migration strategy to adults and moult patterns are different for adults than for young birds in many species (e.g. Svensson 1992). Furthermore, in order to sex a bird accurately, it is often necessary to know its correct age – in many sexually dimorphic species, juvenile or immature birds are very similar in appearance to the adult female e.g. Blackcap *Sylvia atricapilla*, Baglafecht Weaver *Ploceus baglafecht reichenowi,* many sunbird (Nectarinidae) species. Without proper knowledge of a bird's age, a bias may be introduced into data collected that will adversely affect later analysis and interpretation.

Correct determination of a bird's age is therefore of paramount importance in field studies, particularly those involving capturing and marking of individual birds. The importance and usefulness of known-aged birds as against those of undetermined age is indicated by the 4th edition of the Ringer's Manual for the British Trust for Ornithology (BTO) which states that "Submitting the age and sex of ringed birds to the Ringing Unit is mandatory when known" (Redfern & Clark 2001). Where the age of ringed birds is left undetermined, the resulting dataset is of limited value for analysis; data must inevitably be rejected therefore making the results less significant and with limited application (e.g. Prys-Jones 1985).

In order for the ageing of a bird to be of value, the age categories used must be clearly defined. In Europe, the EURING numbered age code provides a neat system by which to categorise the age of an individual of a Palaearctic species in the hand. This system has the advantage that it is based on the calendar year since the annual breeding season occurs on a regular and fixed basis (Redfern & Clark 2001). As such, however, it cannot be used for species breeding in tropical Africa, being applicable only for those Palaearctic migrants which spend the non-breeding season here. For Afrotropical species, the breeding season varies between species, place and year (e.g. Brown & Britton 1980) thus making an ageing system that relies on a regular breeding season unworkable. For these species, a system is needed that is independent of the temporal scale and instead based on the visual physical ageing of the bird itself such as changes in plumage or soft parts.

Various systems already exist in Africa for categorising the age of birds trapped for ringing, but these differ between regions and even between ringers and often there are no clear-cut or easily applied definitions for the given categories. There are two main organised ringing schemes in Africa; In southern Africa, SAFRING ringers use a numbered code to classify birds into nine categories from those ringed as pulli through to a bird that is 'older than 2–3 years old' (c.f. Table 1). This is likely to be easier in the region covered by SAFRING due to the more temperate climate and therefore more regular breeding season for birds – similar to Europe. However, it is not used systematically by ringers and again there exist no easily understandable definitions for the categories (Oschadleus pers. comm.). The Ringing Scheme of eastern Africa has used five age categories that are similar to the basic categories of the SAFRING system (Table 1). These again have no real definition and it is hard to know at what point, for example, an 'Immature' bird becomes an 'Adult'.

Faced with a bird in the hand and the task of ageing it, it became clear that the current systems were inadequate and that something more clearly defined was required. An experienced ringer should know the general characteristics of young birds and how to interpret moult patterns with relation to the bird's age, features which are clearly laid out in handboos such as the "Identification Guide to European Passerines" (Svensson 1992) and "Identification Guide to European Non-Passerines" (Baker 1993). These books of course not only provide general ageing techniques but also a very detailed guide to ageing all species likely to be handled in Europe – many of which migrate into Africa during the northern winter and can therefore be aged using these references. In Africa there is a long way to go before we reach this point though good work has been started by some (e.g. Laycock 1984; Seiler & Fraser 1985). For any of this to be of real value, however, a well-defined age code system is needed that will form a good framework around which further ageing studies may be based. The following system is proposed which was devised over a number of years and with much discussion. It is based on the general ageing techniques for birds in the hand laid out by Svensson (1992) taking into consideration moult patterns and feather wear (Ginn & Melville 1983; Jenni & Winkler 1994). Much of the development of this system has been undertaken with passerines and small non-passerines as the larger non-passerines are not often caught in general mist-netting activities. The categories are, however, applicable to the larger non-passerines alike so long as care is taken to understand the differences in moult strategy, how that affects overall plumage characteristics, and soft part colour which can change seasonally in a number of non-passerines (e.g. Ardeidae).

Age codes for Afrotropical birds in the hand

Pullus (P) Bird in the nest or nidifugous chicks unable to fly

Juvenile (J) Bird in fully juvenile plumage or with no more than c.10% adult or immature *body plumage*; often shows large gape flanges; bare parts colour typically not adult.

Table 1. Current age code systems in use in Africa**SAFRING Age code System East African age code system**

SAFRING	East Africa
1 = Pullus	Pull = Pullus
2 = Juvenile	Juv = Juvenile
3 = Immature	Imm = Immature
4 = Adult	Ad = Adult
5 = 0–½ year	FG = Fully grown
6 = ½–1 year	
7 = 1–2 year	
8 = 2–3 year	
9 = Older	

Immature (I) Bird is unlikely to be sexually mature.
(a) bird in distinct body plumage intermediate between juvenile and adult
(b) bird clearly in mixed juvenile and adult / immature body plumage (with more than 10% new adult body feathers).
(c) bird in more or less 100% adult body plumage but with clearly non-adult bare parts colour
In (b) and (c), skull clearly not fully ossified *. For species which have several recognisable and known immature plumages, e.g. members of the Laridae and Accipitridae, the age may be annotated as "I1" (first-year), "I2" (second-year) etc.

Sub-adult (S) Bird known definitely to be in its first adult-type body plumage. Basically in 98-100% adult body plumage but identifiable as being in first adult plumage by retained juvenile remiges or rectrices (often only one or two juv inner secondaries); sometimes a few retained juvenile or immature body feathers (not clearly mixed plumage and no more than c.1-2% juvenile body feathers); wing coverts usually showing retained juvenile / immature feathers (sometimes just one or two); soft part colour not fully adult (where adult colours known); skull may or may not be fully ossified.

Full Adult (F) Bird known definitely to be in full adult plumage; body, wing, tail and soft parts fully adult in appearance; skull fully ossified.
Individuals that appear fully adult but are of a species known to undergo a complete post-juvenile moult should be classified as 'Adult' unless clearly incomplete skull ossification merits 'Sub-adult' category.

Adult (A) Bird in full adult plumage, and therefore not 'Immature', i.e. it "looks like an adult"; possibly sexually mature. But:
(a) species not sufficiently well-known to confidently age further as 'Sub-Adult' or 'Full Adult' using juvenile or immature characteristics (retained feathers or soft part colours). Extent of skull ossification unclear or may be complete.
(b) species known to undergo complete post-juvenile moult (and therefore to have attained full adult plumage within three to four months of fledging).

Fully Grown (G) Bird out of the nest and free-flying but age unknown. For individuals of species where adult and immature plumages are very similar and not well enough understood. Also where data inadvertently unrecorded.

Full definitions of age codes

Pullus — this is the easiest category to define, the bird being a chick still in the nest or a nidifugous species which is as yet unable to fly. In those species where young birds are able to fly before they reach full size, 'Pullus' would be reserved only for birds which were as yet incapable of flight. This is true for game birds Phasianidae and ducks Anatidae sp. — though note that these should not be marked with a metal ring before they reach full size but rather some other form of mark that allows for the growth of the bird.

Juvenile — This is for birds that are clearly very recently out of the nest – thus giving a somewhat more accurate date of fledging than for 'Imm' or 'SA' birds. Many species have a juvenile plumage clearly different to that of the adult bird. This is often heavily spotted and/or a

* Skull ossification has so far only been shown to be an applicable and useful ageing method in Passerines and owls, Strigidae (Baker 1993).

Table 2. Matrix showing percentages of juvenile / immature / adult body plumage for each Age Category.

	Juv body pl	Imm body pl	Ad body pl	Soft parts colour (where relevant)
Juv	100-90%	0-10%	0-10%	Juv - dull
Imm	90-0%	10-100%	10-100%	Dull; clearly not ad
Sub-Ad	0-2%	0-2%	98-100%	Slightly dull, not fully ad *or* fully ad but with retained juv feathers in wing or body
Full-Ad	0%	0%	100%	Definitely ad
Ad	0%	?%	100?%	Possibly fully ad *or* indistinguishable for spp with complete post-juv moult
FG	?	?	?	?

different colour, e.g. many thrushes (Turdidae) and flycatchers (Muscicapidae). These are easy to age, but the feathers of all juvenile birds tend to be weaker, 'looser' in texture and a duller colour than the corresponding adult feathers making it possible with experience to distinguish a clearly juvenile bird from an older one even when the ringer is not familiar with the species. A 'Juv' therefore, would have almost entirely juvenile body and wing feathers, showing up to a maximum of 10% adult feathering. Juvenile wing feathers, notably the remiges, are often a light or lighter brown for those which are black or dark brown in adult plumage, e.g. Common Bulbul *Pycnonotus barbatus*, Olive Thrush *Turdus olivaceus*, White-browed Robin Chat *Cossypha heuglini* (pers. obs.), and juvenile wing coverts can be several millimetres shorter than adjacent adult feathers. Bare parts are frequently quite brightly coloured in Afrotropical species, "bare parts" being defined as the eyes, orbital ring / facial skin, bill and legs. For juvenile birds, these invariably tend to be duller than in the adult bird and those species with coloured eyes in the adult will tend to have a dark charcoal grey eye-colour in the juvenile which gradually pales to the adult colour over time (different in length depending on species). Leg colour is more difficult to generalise about, and must be learnt from experience in handling a given species. Most juvenile birds will also have clear enlarged, fleshy gape flanges that reduce over time and some have a clear-cut colour change with age such as in some sunbirds (Nectariniidae; Tree 1991). Beware however of certain species where the gape flanges are retained long into the life of the bird and can be misleading if the ringer is unaware of this, e.g. some cuckoo-shrike (Campephagidae) and thrush (Turdidae) species.

Immature — a number of species have a distinct 'Immature' plumage intermediate between the juvenile and adult stage. For individuals of species known to exhibit this characteristic and where it is understood, this category is straightforward to apply. For less well-known species however, this can be difficult to interpret as birds in the immature plumage can superficially appear like adults (most frequently the female) and will often show adult or nearly adult colours for the soft parts, e.g. Baglafecht Weaver where the immature plumage closely resembles adult female plumage

(pers. obs.). For many species, however, a distinct immature plumage does not occur and it is therefore not an issue. The ringer will need instead to judge the proportion of adult : juvenile/ immature body feathering that has grown to classify the bird as either a Juvenile, Immature or Sub-adult. To be classified as 'Imm' as opposed to 'Juv', a bird must have more than 10% adult body feathers. If the bird has almost 100% adult body feathers, then to be still classified as 'Imm', it must have significantly juvenile-coloured bare parts, otherwise it would be classified as 'Sub-ad' (see below). If a ringer is not conversant with the species in hand, and there is any doubt as to its age, it would be wiser to leave the age as 'Fully Grown'. Soft part colour is often a very useful criterion for classifying birds into this category. This again will be very dependent on the experience of the ringer and/or the literature available for that species.

Sub-adult — A basic technique for ageing birds in the hand using plumage is to look for *contrast* between feathers, particularly within a single feather group. This is the technique best employed to distinguish a 'Sub-adult' bird. For a bird to be classified as 'Sub-adult', it will have 98-100% adult body feathers but will have retained some juvenile or immature feathers indicating that it is just attaining its first fully adult plumage. Where juvenile or immature feathers are retained this contrast is often quite marked, with these tending to be narrower and more pointed than the new, adult feathers (Svensson 1992). Retained juvenile wing coverts may contrast markedly with new adult coverts particularly with those families with distinct juvenile plumages showing spotting on the covert tips (e.g. thrushes Turdidae, flycatchers Muscicapidae). Juvenile remiges or rectrices are normally narrower and more pointed and will often be a lighter brown colour. The difference between juvenile and adult remiges is often quite subtle, but with care and practice significant contrasts may be distinguished – often the contrast is between the 'background colour' of the feather and also the shaft colour – which will be clearly lighter brown on an older feather and blacker on a newer one. Beware however of birds that have not moulted any wing feathers at all: due to both the lack of a contrast between old and new feathers, and the 'old' juvenile feathers being basically unworn having only been on the bird a few months, the wing can easily be mistaken for an adult wing by someone who is not familiar with the species. Juvenile wing coverts often have spots or distinct markings such as dark sub-terminal bars or smudging (e.g. in some doves and nightjars). Greater coverts, may also be significantly shorter or narrower and more pointed than new adult coverts and can easily be observed, e.g. Zanzibar Sombre Greenbul *Andropadus importunus* (Svensson 1992; pers. obs.). The last feathers to moult in many species tend to be secondaries 4 and 5 (numbered ascendantly) and therefore may be used to age a bird. In particular secondary 4 (S4), if it has yet to be replaced, can be used as an effective gauge against the new (and therefore definitely adult) S3 — if there is a difference in shape, breadth and length that is not due simply to wear. S5 frequently seems to be naturally more pointed and narrow even in adults and is therefore more easily confused as being 'juvenile' when it is in fact an old adult feather. These more subtle differences need to be taught or learned carefully and with particular attention to detail. For those species which have several recognisable immature plumages, the annotated "Imm" age code may be replaced with "Sub-adult" for a bird that has only a few retained feathers or features from its last immature plumage indicating that it is now nearing Full Adult plumage.

Soft part colour should also be considered when classifying a bird as 'Sub-adult'. Where a bird is in full adult body plumage and on wing coverts / remiges would be classified as a 'Sub-adult', if however the soft parts colour is clearly not even nearing adult colour, then the bird should be aged as 'Immature'. Certain species, notably some reed-bed warblers, retain tongue-spots from their juvenile condition well after they have attained adult-like plumage. Similarly characteristics such as the colour of the inside of the upper mandible (e.g. with certain thrushes Turdidae), patterns of spots on the palate of some small seed eating species (e.g. whydahs, mannikins) and measurements of wing, tail or bill where these differ significantly between young and adult birds, can assist in ascertaining the age of a bird that otherwise might appear as an adult.

Full Adult — Where both the moult strategy for a species, and the plumage and soft part characteristics for breeding adult birds are known, an individual that shows all fully adult features should be placed in this category.

Adult — With many Afrotropical species, the full differences of adult versus immature plumage are yet to be sufficiently described and understood. As a result when an individual of an unfamiliar species is trapped, the ringer will not know what features to look for in order to age it as a Sub-adult or Full Adult; the bird may 'look like an adult' (it is clearly not a definite juvenile or immature), have a fully ossified skull (for non-Passerines), but one cannot be certain that a critical feature has been overlooked to enable it to be aged as 'Sub-adult'. In these cases, the principle of "to err on the side of caution" should be applied and the bird aged as simply 'Adult'. For species which are known to undergo a complete post-juvenile moult and have similar-coloured soft parts in the immature as in the adult, a bird that appears like an adult may well be a young bird having just undergone a complete moult. It should therefore be also aged as 'Adult'.

Note that a fully ossified skull for a Passerine does not necessarily mean that the bird is a 'Full Adult'. Ossification may be complete after only a matter of months and in some species a bird may have a fully ossified skull but still retain juvenile or immature feathers — in which case the bird is clearly not a 'Full Adult'.

It is very tempting when using this system to simply age birds as 'Adult' as this can require no decision as to whether it is 'Sub-ad' or 'Full Ad' allowing the lazy ringer not to have to look very carefully at the detail of wing and body feathers. This should be keenly avoided with the understanding that an accurately aged bird provides very significantly useful data. A good ringer will only age birds as simply 'Adult' when s/he is really not sure about the actual age. Very often s/he will age most such birds as '(S)A' or '(F)A' suggesting what s/he thought it probably was but was not 100% confident to claim due to lack of information.

Fully Grown — For some species, very little is known about the juvenile, immature and adult plumages. Furthermore, in even those species which are better understood, sometimes an individual is invariably caught which does not show any clear features for one age class or another. For these birds, they are clearly not pulli and it is likely they are not 'very juvenile' (the features for which are very obvious), but beyond that it is not possible to age them with confidence. In these cases, the bird should be placed in this category.

Note that a bird of a species known to undergo complete juvenile moult and that appears like a 'Full Adult', whilst may still in fact be young, would not be

classified as 'Fully Grown' but rather as 'Adult'. This is because the ageing system operates on the known visual appearance of the bird related to its age. If the plumage it exhibits is known to be the same as a 'Full Adult' but it is also *known* that potentially it could have just finished a complete post-juvenile moult, then that is a known situation and the bird classed as 'Adult'. 'Fully Grown' is reserved for when it is not known whether the plumage being studied is that of a 'Full Adult' or 'Immature' nor what features to look for in order to ascertain if it may be a 'Sub-adult'.

'Fully Grown' is also the appropriate category in which to later classify a bird which was ringed but where the age was accidentally left unrecorded.

Use of soft parts in ageing birds.

Care must be taken when using the colour of soft parts, and in particular eye-colour, in ageing. Eye colour is known to vary with age and, with certain species, with season (e.g. some herons Ardeidae) and even almost instantaneously in the hand (e.g. Black-bellied Starling *Lamprotornis corruscus*)! Variations can be very subtle between the soft part colour of a fully adult and that of a Sub-adult bird, or a Sub-adult and Immature, and it is only with patience, care and practice that these may be learned and accurately applied.

Discussion

It should be borne in mind that in this system the categories laid out here are based on the visual appearance of a bird's plumage, not on its actual age nor biology – though they will be linked. As a result therefore, the assigned age of an individual cannot be related to an actual period of time such as a certain number of months or years as in the EURING code — until the species is well known. Once sufficient ringing and recapture of known-aged individuals has been carried out, then it may be possible to correlate the visual plumage characteristics with a temporal scale. Note however that because of the highly variable breeding seasons for Afrotropical species, this can still only be related to the hatching date of that individual and not to a point on the calendar, nor indeed to the general breeding season of a given species (except perhaps in southern Africa where the breeding season is more predictable). The implications of this mean that analysis of age data for ringed birds may be limited to individual species or species groups and only once a better understanding is gained of those species' biology. For example, from studies carried out by the Nairobi Ringing Group between 1994–98, we found that Baglafecht Weavers take approximately 13 months to reach 'Full Adult' age (pers. obs.). With that information in hand, the value of the dataset of adult and immature birds is greatly enhanced for any population studies that may be carried out on this species — but only confidently in the Central Highland region of Kenya until proven otherwise. The species may well moult differently in different regions — hence the difficulty and challenge of studying and ageing birds in the hand in the tropics.

Above all, it is hoped that by fully defining a set of more clear-cut age codes, this will assist ringers working in the Afrotropical region to more usefully categorise the variations in age-related plumage characteristics they encounter in birds being handled. Moreover, if a single system is accepted and used more widely in ringing studies across Africa, then the data thus collected will be more comparable – unlike the current situation where one ringer's 'Adult' may equal another's 'Immature' (as I have actually seen in practice!).

This code system is not viewed as the "be all and end of all" of age code systems for Africa. It will has already been adjusted from its first publication (Jackson 2001) and will doubtless need further adjustment as more information comes to light and as ringers try to apply it in different regions of Africa where conditions will differ from where it was developed in Kenya. Many a discussion has been held over some unfortunate bird in the hand with relation to its age and this paper arose from just such discussions. It is hoped that this age code system will not do away with these discussions but will rather prompt and fuel further discussion as well as stimulate additional systematic observations of birds being handled throughout tropical Africa in order to better our understanding of the birds we appreciate and are keen to conserve.

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