6

The bird in the hand

6.1 INTRODUCTION

The obvious reason for ringing birds is to mark individuals so that they can be recognised if they are encountered again later on, either as retraps, resightings or recoveries. From these records, knowledge about migration, dispersal, survival rates and longevity is obtained. However, a great deal of additional information can be gained from the bird in the hand. This information is important to understanding the biological processes and life histories of many poorly known and poorly studied species.

When birds are caught for ringing purposes, the opportunity should be taken to collect appropriate biometric data, as well as information on moult. There are many biometric measurements that can be taken but many of these are unnecessary or redundant. Measurements should be restricted to those that are important for the particular species, and these vary from species to species.

An important project on which little progress has been made is the production of a comprehensive guide for ageing and sexing southern Africa's bird species. Some general principles are described in this chapter. Moult is another aspect of the life history of southern African birds that needs more attention and to which ringers are excellently placed to make a major contribution.

Many of the principles that are used for ageing and sexing are not easy to apply, and they present a challenge more difficult than any crossword puzzle. Many ringers have derived an enormous amount of personal satisfaction by developing theories of how to age and sex the birds of a species, testing the ideas, revising and refining them. They write up their methods in *Safring News*, where other ringers can use the methods at their ringing sites, and perhaps fine-tune them further.

Likewise, understanding the basics of moult is not trivial. The process of moult is a vital component of the life history of birds. The importance of moult comes into sharp focus when one realises that, by moulting their flight feathers, most birds effectively replace their organs of locomotion every year. Their strategies for doing this must therefore be a critical component of the study of birds.

6.2 GLOSSARY

To be able to identify and describe a bird in the hand it is essential to be familiar with the topography of a bird. Maclean (1993) gives the topography of a typical passerine bird.

It is advantageous if all ringers use the same terminology to describe the different parts of a bird because this will simplify communication and the use of references. In the glossary below, the meaning of some terms used by ringers are given.

Abdomen – the part of the body containing the stomach, bowel and reproductive organs.
Adult – a bird that has reached its fullest development.
Alar – of the wing.
Alula – the bastard wing, the quill feathers attached to the first digit.
Anterior – more to the front, opposite of posterior.
Bare parts – or soft parts, all areas of the body not covered with feathers, namely the bill, gape, eyes, legs, feet and wattles.
Belly – the same as abdomen.
Brood patch – or incubation patch, bare patch developed on the abdomen of most incubating birds.
Carpal joint – carpus, the foremost point of the folded wing.
Caudal – of the tail.
Cere – the fleshy covering of the upper part of the upper mandible in certain orders of birds – e.g. raptors.
Cloaca – the vent, a body exit, serving both excretory and sexual functions.
Cloacal protuberance – the swelling around the cloaca – often used for sexing birds during the breeding season.
Contour feathers – the outer feathers covering the body. Usually applied only to the small body feathers (but strictly speaking they include all the wing and tail feathers).
Coverts – contour feathers that overlie the bases of flight feathers. Also feathers that cover the ear opening.
Culmen – the central ridge of the upper mandible.
Dimorphic – of a species occurring in two forms, frequently referring to differences between the male and female.
Distal – farthest from the centre of the body or from the point of attachment, e.g. a limb; the opposite of proximal.
Dorsal – of the back or upper surface, opposite of ventral.
Emargination – a step or abrupt narrowing of the web of a primary feather occurring towards the tip. Usually restricted to the outer web.
Eyebrow – or eye stripe or supercilium . The feather marking, often a stripe, over the eye.
Feather tract – in nearly all species the feathers are not distributed evenly over the body, but in a series of groups known as tracts – e.g. spinal, ventral, etc. The feathers in a tract usually moult at about the same time.
Flight feather – the primary, secondary and tail feathers.
Furculum – the wishbone, formed by the fused clavicles. Sometimes used to denote the depression or pit at the base of a bird's neck, which lies between the fused clavicles.
Gape – the open beak.
Gape flange – the protuberant, often brightly coloured, skin in the angle between upper and lower mandibles of young birds.
Greater coverts – collective term for the primary and secondary coverts.

Growth bars – alternate, often barely visible, bands of darker and lighter shading in feathers.
Immature – a bird which is not an adult.
Iris – the coloured part of the eye which surrounds the dark pupil; it may show inner and outer rings of different colour.
Juvenile – a free-flying bird still under parental care.
Mandible – the upper or lower parts of the beak.
Morphometrics – the study of the data of the measurements of the size and structure of birds.
Notch – an abrupt narrowing of the inner web of a feather, usually a primary.
Nuchal – of the nape, i.e. at the back of the head.
Orbital – surrounding the eye.
Patagium – the fold of skin, covered with tiny feathers, which links the forepart of the wing with the body.
Posterior – more to the rear, opposite of anterior.
Polymorphic – a species occurring in several forms, e.g. Ruff.
Preen gland – a gland situated immediately above the base of the tail feathers and secreting oil used in preening.
Primaries – the outer remiges, growing distally from the carpal joint.
Proximal – towards the inside, nearer the body; the opposite of distal.
Rachis – or shaft; the strong, tapering central quill of the feather.
Rectrices – the main tail feathers.
Remiges – collective term for primaries and secondaries.
Rictal bristle – bristles situated at the angle of the gape.
Secondaries – remiges growing from the ulna.
Tarsus – properly it is called the tarsometatarsus, the bone between the ankle and the toes.
Tertials – the innermost secondaries; their tips do not usually line up with those of the true secondaries on the open wing.
Tongue spot – contrasting dark spots found on the tongues of nestlings of many species; often retained for months and thus sometimes a pointer to age.
Tracheal pit – sometimes referred to as the furculum (q.v.) A standard place for assessing fat deposition.
Ventral – the under-surface of body, wing, etc., opposite of dorsal.
Web – of a feather, the vane projecting from either side of the shaft.
Wing point – the number of the longest primary feather, measured from the carpal joint.

6.3 MEASUREMENTS

6.3.1 Reasons for measuring

Many measurements can be taken from the live bird in the hand, but it is each individual ringer's choice which measurements to take. This is determined by the specific project that the ringer is working on or whether general data are being gathered.

The lengths of the wing, beak, tarsus, head and tail have a long tradition of being the fundamental taxonomic measurements of birds. These measurements may be of value:

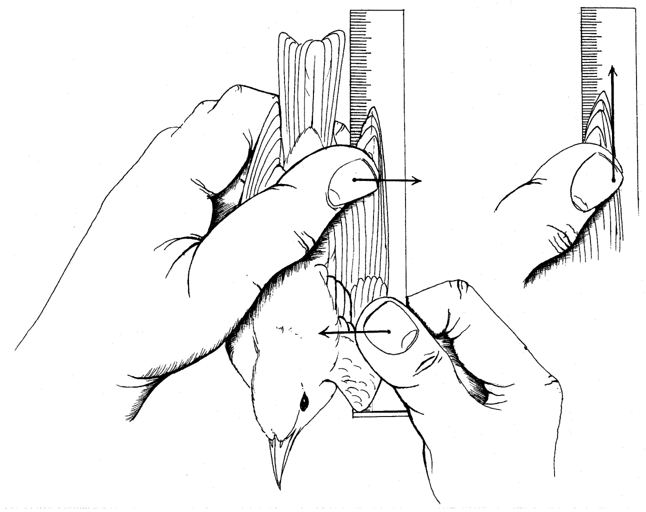


Fig. 6.1. Measuring the wing length of a bird. The bird should be held in the 'ringer's hold' (see Fig. 3.5 on page 21). The bird is only shown here in this position for clarity.

- ❑ in separating races of the same species;
- ❑ in distinguishing sexes;
- ❑ in studies of the growth rate of juveniles;
- ❑ in studies of the growth rate of remiges and rectrices and the process of abrasion;
- ❑ in mass studies, to provide a measure of an individual's body size.

6.3.2 Wing length

Wing length is defined as the distance on the closed wing from the foremost extremity of the carpus to the tip of the longest primary feather. The bird wing is not a simple structure, for apart from the lateral curvature of the primaries there is also a camber along and across the wing. There are three ways of measuring wing length, depending on the extent of wing flattening. A stopped rule is needed for all three methods of measurement.

- ❑ Unflattened wing, giving minimum chord measurement. **Not recommended.**
- ❑ Flattened chord, giving an intermediate value. **Not recommended.**
- ❑ Flattened straightened wing, giving maximum measurement. **Recommended method.** (Fig. 6.1)

The only acceptable way to measure wing length is the third method, usually known as the 'maximum chord method', although this is not very descriptive of the method. This method is adopted for international exchange of data by bird ringers. This method has been demonstrated to be the one that gives the most repeatable and consistent results. If two trained ringers use the maximum chord method, the results they get are, on average, closer than the results obtained with the other methods. Because all the curvature is not removed, the other methods give wing-length values which are shorter than the maximum chord method. For the purpose of standardisation only the maximum chord method will be described.

Slide a stopped rule under the naturally folded wing and press the carpal joint gently but firmly against the stop, make sure that the wing does not spread during this operation. Gently apply pressure on the median or greater coverts; this will flatten the wing against the rule. This removes the camber along and across the wing. To remove the lateral curvature, straighten the alula so that it falls in line with the longest primary. Now straighten the longest primary by stroking the thumb of the free hand along the shafts of the primaries, from the base to the tip, pressing firmly against the rule all the time. Never pull the tip of the wing; a firm stroking action will straighten the wing. This method has the smallest margin of error of the three methods. Small differences in measurement will occur owing to the variation in the degree of straightness achieved, but the method does eliminate inaccuracies caused by the alteration of the lateral curvature during trapping and handling or caused by dampness. Measure the wing length to the nearest 1 mm.

The most common mistake made when using this method is the failure to keep the wing in a natural position as close as possible to the bird's body while taking the measurement. This will lead to inaccurate measurements.

Do not measure wing length if the longest primary is in moult and not fully grown. Old feathers have worn tips, and abrasion over the year between moults may lead to an apparent shortening of wing length by 2–3%. When reporting wing lengths, for example in *Safring News*, state that the maximum chord method was used.

The wing lengths given in fieldguides and handbooks are often derived by averaging the wing lengths reported in many publications. Many of these refer to wing lengths of museum specimens, in which the wing lengths shrink by approximately 2%. Others refer to wing lengths measured by the two methods that underestimate the correct value. Ringers need to understand that the published wing lengths in books are mostly 1% or 2% smaller than they ought to be. This has implications for using the wing lengths published in these books to sex birds.

6.3.3 Wing formula

The wing formula of a bird consists of the measurements of the primary feather lengths in millimetres in relation to the length of the longest primary feather (Fig. 6.2). The wing formula can be used for identification purposes; specifically so for some of the more difficult species, e.g. Palearctic warblers, where some species can only be positively identified by using this technique. Little work has been done on the wing formulae of passerine species in southern Africa. Most passerines have 10 primaries of which the outermost is very often reduced or in many cases vestigial. In wing-formula studies the primaries are, by tradition, numbered in the opposite direction from that in which they are numbered in moult studies: from the outermost, number one, to the innermost number ten. Secondaries are always numbered inwards towards the body.

When the wing formula is determined, the bird can be held in two ways. Some ringers prefer the standard ringer's hold with the tail towards the wrist while others use the reverse ringer's hold with the head towards the wrist. Each individual must determine

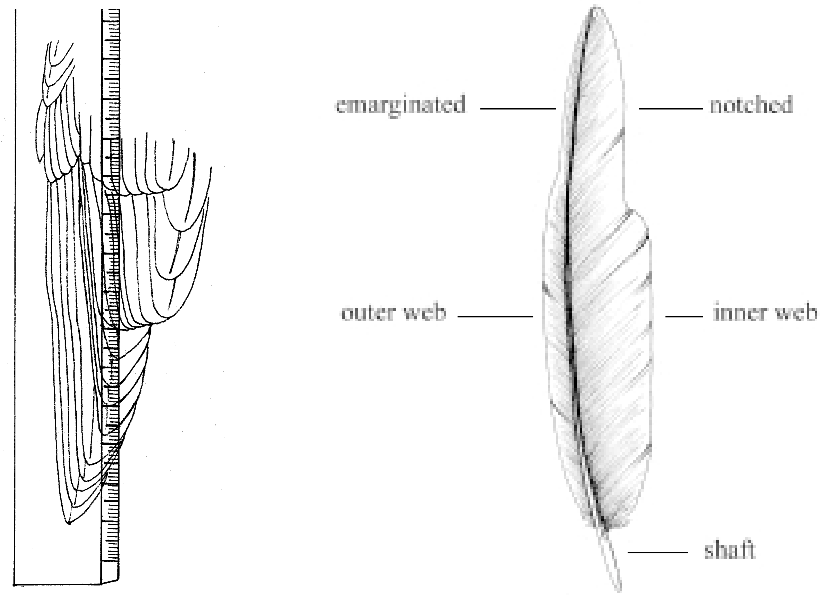


Fig. 6.2. Recording wing formula; parts of a contour feather.

the most comfortable method to use. The first step is to determine whether there is any accidental loss of feathers, by counting the number of primaries. The next step is to determine whether there is any moult in the wing. This is done by looking at the base of the critical feathers for signs of the glossy, grey or greyish-white waxy feather sheaths. When satisfied that the wing is complete, gently put the tips of the feathers in order; these may become disarrayed when the bird is kept in a bag or a box. When determining the wing formula the wing must not be extended; all that is necessary is to splay the feathers slightly so that the tips of all the primaries are visible. If the first primary is very short, then the length is given as so many millimetres longer or shorter than the primary coverts measured along the edge of the wing. This measurement is taken between the point of the first primary and the point of the longest primary covert. The lengths of the other primaries are all expressed as so many millimetres shorter than the longest primary or wing point. Place a transparent rule on top of the naturally folded wing with the scale visible right against the tips and measure the difference in length between each primary and the longest primary. For completeness the distance between the longest primary and the outside secondary can also be measured.

Where emargination of the outer web of the primaries occurs (these are feathers that have a visible narrowing of the outer web), the specific primaries should be recorded. In many cases the emargination is not very distinct and therefore it is not possible to take accurate measurements. Emargination can in some cases be very slight and difficult to see. If the feathers are heavily worn and abraded, the emargination can sometimes not be seen at all.

In some bird species there is an abrupt narrowing of the inner web of the primaries,

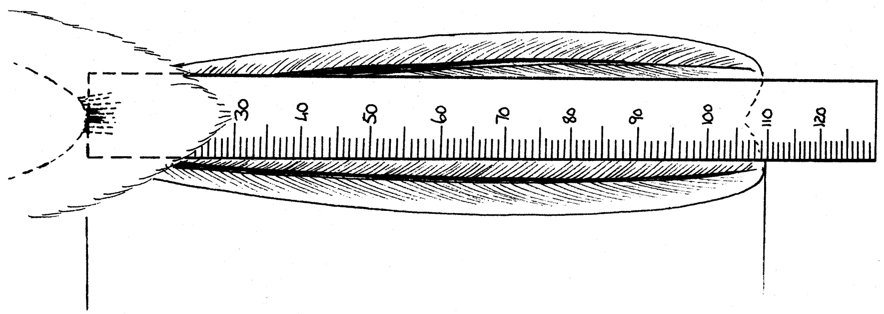


Fig. 6.3. Measuring the tail of a bird.

known as the notch. This is normally distinct and can thus be measured. The notch is considered to be from the point of the primary to where the inner web starts to widen. This measurement is taken between these points and not along the shaft of the feather. The length of the notch in relation to the tips of the other primaries can be diagnostic in the identification of some species. It must be stressed that this method is not foolproof and should only be used in conjunction with all the normal methods of identification, namely measurements, plumage colour and structure. False measurements will also be obtained if there is wing moult or when feathers are heavily worn. In such cases this method should not be used for identification purposes. Whenever this technique is used to identify a species, the measurements should be taken in both wings.

Where the symbols > and < are used, the open end of the > is against the longer feather e.g. P2 >P6 means primary 2 is longer than primary 6.

6.3.4 Tail length

To measure the tail, slide a rule between the rectrices and the undertail coverts until it comes to a stop at the root of the central pair of tail feathers (Fig. 6.3). If necessary, straighten and flatten the tail, and measure the longest feather. Measure to the nearest 1 mm. Do not take measurements from above, as this may damage the preen gland. The rule should not be placed between two tail feathers because this will give inaccurate measurements. A bird's tail may be rounded or forked. The graduation or fork is measured from the tip of the longest to the tip of the shortest tail feather. Measure along the long axis of the tail.

6.3.5 Culmen length

When taking this measurement, utmost care should be taken to prevent injury to the bird's face and eyes; make use of vernier callipers instead of dividers. There are three ways of measuring the culmen length from the bill tip: to the cere, or to the feathering, or to the union with its skull (Fig. 6.4). The most common method used for passerines is from the bill tip to the union with the base of the skull; for owls and birds of prey it is from bill tip to cere; for waders and long-billed birds normally the bill tip to feathering is used. A measurement not recommended is from bill tip to the nostrils. Always

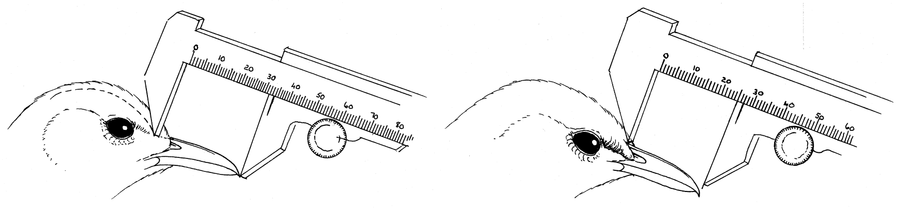


Fig. 6.4. Measuring the culmen of a bird (to the skull; to the feathering).

record the method used in all records, correspondence and publications.

Open the callipers wide enough so that the opening between the outer and inner calliper is greater than the culmen length of the bird being measured. Carefully push the outer calliper along the culmen to the angle in front of the skull; this is usually covered by feathers. Now close the inner calliper until the point of the culmen just touches the inside point of the calliper. Take the measurement to the nearest 0.1 mm. When measuring to the cere or feathering, place the outside calliper at the base of the cere or at the base of the foremost feathers of the forehead (not at the tip of these feathers).

6.3.6 Width of bill

The beak width should always be measured at the point where the exposed culmen begins, that is, where the beak is hard. This will normally give the largest measurement. If this is not the widest part of the beak, also record the maximum width. Avoid measuring over the soft parts of the gape. Report to the nearest 0.1 mm.

6.3.7 Depth of bill

Place the inner calliper on the edge of the lower mandible and the outer calliper on the culmen at the edge of the feathering or at the proximal edge of the nostrils and report to the nearest 0.1 mm (Fig. 6.5). Always record where the measurement was taken.

6.3.8 Tarsus length

This measurement is actually the length of the tarsometatarsal bone. It is measured by placing the one calliper in the notch of the intertarsal joint and the other at the lower edge of the last complete scale before the toes diverge (Fig. 6.6). In another method, the foot is bent downwards to approximately 90 degrees to the tarsus, and measured from the notch of the intertarsal joint to this point. This gives more reproducible measurements than the first method. This last method is the prescribed method of the European–African Songbird Migration Network; for purpose of international standardisation this is the recommended method for measuring the tarsus. Report measurements to the nearest 0.1 mm and make a note of which method was used.

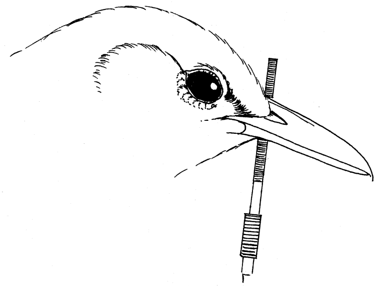


Fig. 6.5. Measuring bill width.

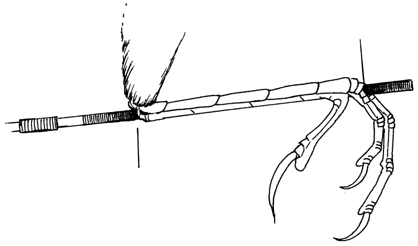


Fig. 6.6. Measuring tarsus length.

6.3.9 Toe length

Toes are measured on the upper side from the base of the claw (including the fine skin at the base of the claw) to the joint between the toe and the tarsus.

6.3.10 Claw measurement

Claws are measured on the upper side of the claw from the tip of the claw to the edge of the skin (Fig. 6.7).

6.3.11 Total head length

Total head length is also known as 'head+bill length' or 'overall head length' (Fig. 6.8). This is an accurate and reproducible measurement, which can be taken to 0.1 mm. Open the callipers wider than the expected head length, place the outer calliper at the back of the birds head and close the inner calliper until it just touches the beak point. The head can be gently rocked up and down to ensure that the maximum measurement is obtained. Callipers are best modified by fixing a butt to one end, against which the bird's skull is placed. Unbutted callipers can make it difficult to find the back of the bird's head. Care should be taken that the tip of the bill, which is flexible, is not pressed and a too short measurement is obtained.

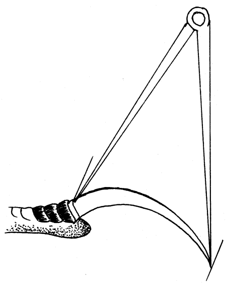


Fig. 6.7. Measuring claw length.

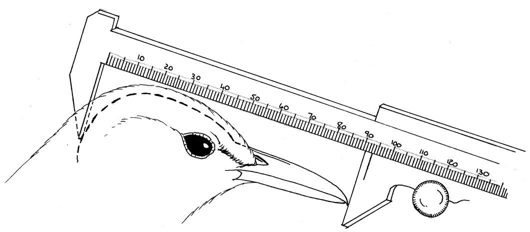


Fig. 6.8. Measuring head length.

6.3.12 Length

This measurement has poor repeatability and reproducibility and must cause some discomfort to the bird because the head is bent backwards into an unnatural position (not illustrated). This is not a recommended measurement, and is mentioned only for completeness. Put the bird with its back down on a stopped rule with the tail tip touching the stop. The bird is held by the legs and the tail is pushed down with the thumb. With the other hand hold the beak of the bird and stretch it very gently until the beak is approximately parallel to the rule whilst the crown of the bird rests against the rule. The measurement is taken to the nearest 1 mm.

6.3.13 Weighing birds

Birds can be weighed in a cone or in a bag. In the first case, the bird is placed in a tapering plastic cone. Two or three cones of suitable size will cover the normal range of birds. The advantages of the cone method are that it gently prevents the bird from moving, and the weight of the cone does not change. If a bag is used, it must be weighed immediately after each bird has been weighed, because the weight changes with use owing to excreta or moisture. Birds often move in the bag as they are being weighed; so it takes longer to get an accurate weight.

The type of balance used for determining weight is not important and a variety are available from beam- and spring balances to electronic top loaders. Most commonly used in South Africa are the spring balances, because of cost and ease of use.

Weight is the one measurement of birds that is subject to significant variation during the day, being lowest at dawn and highest at dusk; this is the other way around for nocturnal birds. The time of weighing therefore becomes important and should thus be recorded when every bird is weighed, using the 24-hour clock.

6.4 AGEING

The most valuable recovery information for birds ringed is for those that were ringed as nestlings because their exact age is known. In southern Africa, very few nestlings of the smaller and passerine birds are ringed and most birds in these groups are caught as free-flying birds, many as juveniles. Little work has been done on the ageing characteristics of smaller southern African birds up to now and a wide field lies open for any ringer who wants to explore and study this subject. There are several general characteristics to help with the determination of whether a bird is a juvenile or adult. Some of these characteristics are described below to assist the ringer in the identification of young birds. A bird should preferably be aged on several of these characteristics.

A complete list of the identification, ageing and sexing guides published in *Safring News* between 1972 and 1993 was compiled by L.G. Underhill (Underhill 1994).

6.4.1 Plumage

Juvenile plumage is often distinct and the birds can easily be identified by its features, e.g. much duller colours, mottled, spotted, striped or prominently barred. In these species the juveniles can be recognised until the first complete moult has taken place.

6.4.1.1 Body feathers

The juvenile body feathers in most species are weaker and more loosely textured than the following generation of feathers. This is especially so for the feathers of the neck, mantle and undertail coverts because they have hardly any interlocking barbules, and only a small area at the tip of the feather is relatively firm textured. These feathers have a soft and downy appearance.

6.4.1.2 Wing feathers

The juvenile primary coverts and remiges are often more pointed and narrower and in general shorter than the corresponding feathers of the later generation. This method should, however, be approached with care as there may be a considerable overlap between juvenile and adult feather shape. If two feather generations are present in the same feather tract, they may differ in shape and length which then will give a positive juvenile identification. The outermost short primary (P10) of juveniles of some species, on the other hand, may be both longer and wider than in adult birds.

6.4.1.3 Tail feathers

The tips of the feathers of a bird’s first tail are often noticeably narrower and more pointed than those of adults. This is a structural character due to the fact that adult feathers have on average longer and denser barbs, making them wider and more glossy and making the tips rounder. A word of caution: birds that have been kept in bags or boxes might have had their tail shape altered considerably. This will make ageing with this method difficult or impossible.

6.4.1.4 Growth bars

Wing and tail feathers often have numerous bands of a different darkness, but not of a different colour across each feather, called growth bars. These growth bars are caused by structural differences and are developed as the feathers are growing. The growth bars can best be seen in reflecting light; hold the feathers at an angle of 45° to strong light. The distance between the bars and the width of each bar varies, depending on the growth rate of the feather and varying metabolic conditions.

Therefore if the growth bars on the tail all line up across the whole width of the tail and follow its shape, it is an indication that all the tail feathers grew simultaneously. This will always be the case for a bird’s first tail feathers. One should, however, be careful because some birds moult all the tail feathers simultaneously as adults and this may cause errors. This can happen also to all other species in the case where the tail was lost accidentally. Do not use this technique in isolation but always combine it with one or more of the other techniques.

6.4.1.5 Wing coverts

The lesser and median wing coverts are often the last of the juvenile feathers to be moulted. Immature birds often have brown or buff tips to the lesser and median coverts.

This is sometimes affected by worn feather tips and in some species can look similar to those in adult birds. Care should therefore be exercised.

6.4.1.6 Underwing feathers

Immature birds usually grow their underwing coverts last and can be identified by pink bare skin over the wing bones and muscles long after fledging.

6.4.2 Post-juvenile moult

Most young passerine birds undergo a partial post-juvenile moult in the early part of their first year of life, usually during the period that their parents undergo a complete post-breeding moult. During a partial post-juvenile moult only the ‘body feathers’ are replaced, not the tail feathers or the flight feathers in the wing. Many species replace a number of coverts in the wing adjacent to the body during a partial post-juvenile moult, while the other coverts are retained from the juvenile plumage for the next year. In many cases the new feathers are different in colour, shape, length and structure or only structure compared to the juvenile feathers, and this creates a contrast between the inner series of renewed feathers and the outer series of old coverts (Fig. 6.9). This contrast is in some species barely visible and cannot be used for ageing (except perhaps after much experience) while it is so strikingly obvious in other species that it can be used as a character of age during observations in the field. In Europe, contrast features in the wing which result from a partial post-juvenile moult are currently the most widely used plumage criteria for the age determination of passerines (see Ginn & Melville 1983; Svensson 1992; Jenni & Winkler 1994).

A contrast between moulted and unmoulted juvenile feathers can be present within any series of the smaller feathers on the wing (greater, median or lesser coverts, carpal covert, alula feathers and tertials), and in a few species contrasts between different series can also be used, though cognisance needs to be taken of the fact that different series (e.g. greater coverts and primary coverts) may naturally have different colour and structure, even when all moulted (such as in adults). The contrast between moulted and retained juvenile feathers is usually most easily detected in the greater coverts. Clearly,

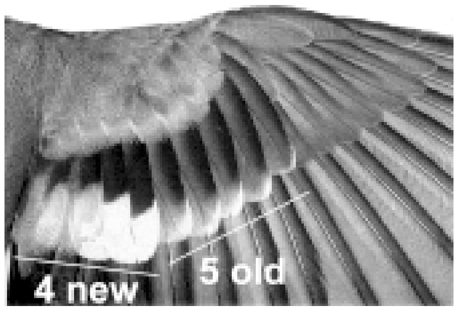


Fig. 6.9. Contrast in wing coverts. Taken from Herremans (1995).

juvenile birds of any species which renewed all coverts in the wing cannot be distinguished from adults any more on the presence of a plumage contrast in the wing.

In order to use feather contrasts from the post-juvenile moult correctly, it is essential that the moult cycles of the species involved are known. Basic moult sequences in southern African birds are incompletely documented (e.g. review by Craig 1983), but it can be assumed that, except for some larks, bulbuls, starlings, sunbirds, weavers and waxbills (which undergo a complete post-juvenile moult), most southern African passerines undergo only a partial post-juvenile moult. In species with a reasonably well-defined local breeding season, any bird caught after the breeding season and up to the end of the next winter with clear contrasts in the wing coverts between a new inner series and an older outer series can be assumed to be a juvenile bird which underwent a partial moult.

With the arrival of spring, matters are more difficult. In species known not to undergo a moult just prior to breeding, the method is reliable in principle. However, with increasing time since the post-juvenile moult, feather wear may start to obscure the contrast between ‘old’ and ‘new’. For species which develop a breeding plumage during a partial pre-breeding moult, wing-feather contrasts can no longer be used for ageing during the period between the spring moult and the post-breeding moult, because most of the contrasts seen in that period may well result from the partial pre-breeding moult, which all birds irrespective of age undergo more or less in the same way.

The method of ageing on wing-feather contrast is likely to apply to a variety of species in southern Africa, particularly in the groups of thrushes, tits, warblers, flycatchers, wagtails, shrikes, finches, buntings and canaries; it was found useful in 23 species in Botswana (Herremans 1995).

6.4.3 Gape flange

The gape flange of juvenile birds is usually thick, swollen and conspicuously coloured (white, yellow, etc). This thick swollen gape disappears rather quickly after fledging and is therefore only reliable for a short period of time. There are, of course, exceptions; in some of the weavers, the gape changes slowly over a long period of time. Adults of some species always show a gape flange; examples are the Greyheaded Sparrow and Redheaded Finch, but these are not as puffy as for juvenile birds. Once again care should be exercised when ageing a bird on the gape flange.

6.4.4 Palate colour

The palate colour of juvenile birds often differs in colour from that of the adult bird.

6.4.5 Bill colour

The bill colour of young birds often differs from that of adults by being paler, brown or even black. This is especially so in many species with bright-coloured bills. The bill colour of many birds changes with age; usually it becomes brighter and more intense. In some species the bill colour becomes paler after the breeding season and confusion between adults and young birds can occur.

6.4.6 Eye colour

The eye colour (iris) may differ between young birds and adults; in young birds the eye is usually duller. The young birds usually have a dark eye (iris); dark grey, olive grey and dark brown are the common colours. With ageing the colours can become lighter or warmer.

6.4.7 Feet and legs

The feet and legs of immature birds usually have a soft texture and a slightly fleshy and swollen appearance, while the legs of adult birds are usually hard textured and slightly thinner. Immature and young birds may have a different leg colour to that of adults, usually being paler. Once again practice and knowledge are very important in this technique.

6.4.8 Other methods

There are still other methods available for ageing birds, e.g. beak shape, skull ossification and tongue spots, but these are difficult techniques in the sense that they need a lot of experience and practice. Although they are reliable, one needs a lot of data to be able to use these techniques with confidence.

6.5 DETERMINATION OF SEX

6.5.1 Plumage

To be able to determine the sex of a bird adds a considerable amount of value to the information collected from them. The most frequently used method for determining the sex of a bird is the variation in plumage patterns between male and female.

6.5.2 Measurements

Sexual dimorphism among birds is a well-known phenomenon which includes differences in size of male and female for many species. In passerines, it is normally the male that is larger than the female. In birds of prey and in waders, this is normally reversed and the male is smaller than the female. It is therefore sometimes possible to use measurement data to sex species fairly reliably for which there are no plumage differences between males and females. There will always be an element of uncertainty when using this method. If the measurements of the males and females have little overlap, and a large amount of data are available, the uncertainty might be small.

When possible do not rely solely on measurements. This is because measurement techniques may differ, geographical size variation may occur, worn plumage may give false measurements, and there is usually some overlap so that birds of one sex fall into the ranges given for the other sex. When using this method, it is recommended that all relevant measurements be taken and the bird be assigned to a sex based on the full range of measurements.

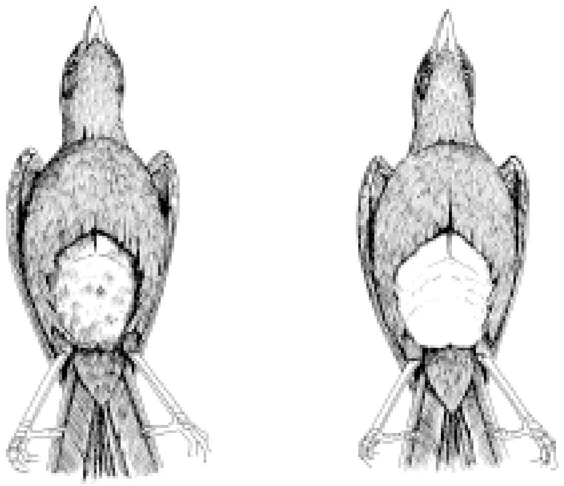


Fig. 6.10. Brood patch beginning to develop; distinct brood patch.

6.5.3 Incubation patch

An incubation or brood patch is developed by many birds just before the actual incubation starts. This is a patch on the ventral surface where all or nearly all the down feathers are dropped, creating a bare patch where the skin becomes thicker and frequently wrinkled, with the blood vessels increasing in size and number (Fig. 6.10). A well-developed incubation patch is completely naked, or nearly so, with a pink to red colour. The incubation patch helps to increase the efficiency of the heat transfer from the body to the eggs. Not all birds develop an incubation patch, e.g. ducks. In those birds where both sexes incubate, both may develop a brood patch; while in the species where only the one sex incubates, only that sex may develop one. Some birds will only develop a semi-patch and this is especially so for many male birds. As a rule in passerine birds, the incubation patch is developed only in females and is thus uncommon in males.

After incubation the patch slowly returns to normal. During this retrogression process the skin often becomes wrinkled and scaly with a yellowish appearance. The feathers, however, do not grow until the autumn moult. In the species that are double brooded (or more) the process repeats itself again before each incubation.

The incubation patch is a useful method for sexing birds during the breeding season provided that utmost care is taken, as mistakes can easily be made. In southern Africa, little has been published on the reliability of the incubation patch for sexing different species of birds.

6.5.4 Cloacal shape

In many species of passerine birds it is possible to determine the sex of the bird by the characteristic shape of the external sexual parts, because these become enlarged during

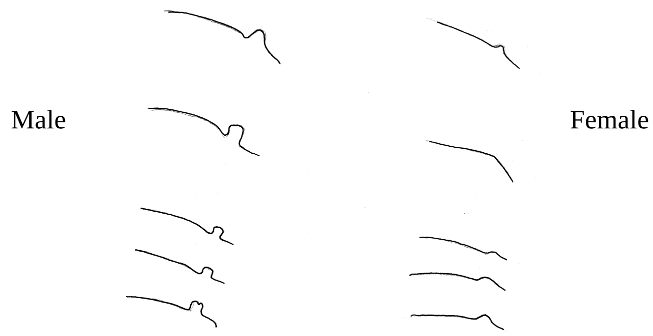


Fig. 6.11. Variation in cloacal shape in male and female birds.

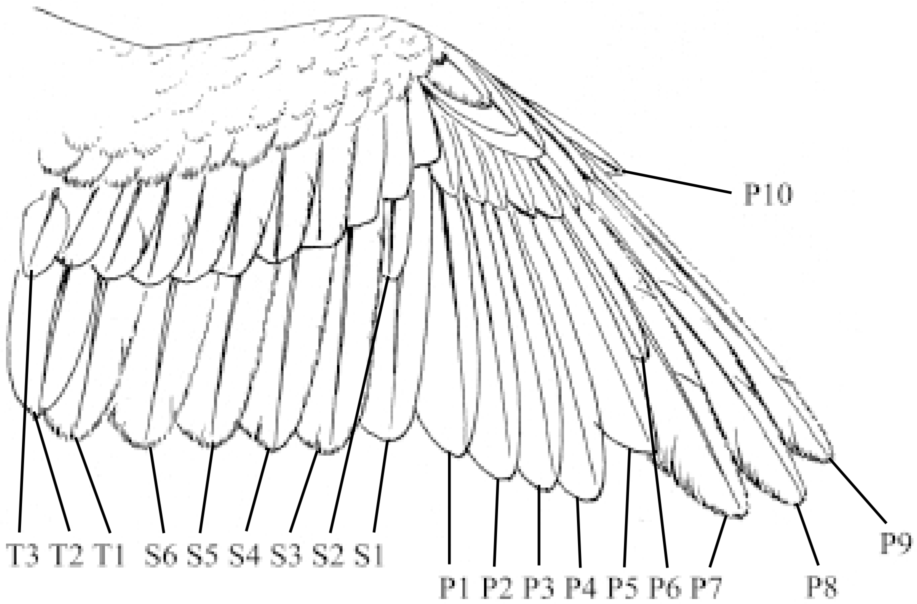
the breeding season. This method is useful where the different sexes look alike. When fully enlarged, there is usually a clearly discernible difference in cloacal shape between males and females (Fig. 6.11). In the male the cloaca points upwards or forwards (parallel sided) and will usually show a fold between the front of the cloaca and the abdomen. The female cloaca usually points backwards (sloping sides) and shows no fold or crease. Although the cloacal shape can be used as a sexing technique on its own, it is always better if it can be used in conjunction with another technique, for instance the incubation patch. Outside the breeding season the reliability of this method has not yet been proven. When one examines the cloaca, the feathers should only be blown apart to expose it: do not wet the feathers or use your fingers. Examining the cloaca of birds of known sex is a good way to gain experience in this technique.

6.5.5 Other techniques for sexing birds

More techniques exist, but these are not recommended for ringers. The internal cloacal examination, used mainly for ducks but also used for passerines by some workers, is a method not recommended at all by Svensson (1992). Another technique is laparotomy where the bird's gonads are examined by making an opening in the abdomen. This procedure should only be performed by researchers who have been specifically trained to use it.

6.6 MOULT

Apart from the fact that feathers are a unique feature of birds, distinguishing them from all other forms of life, they also play an important role in the bird's existence. Feathers form the outside light-weight protective barrier against impact, solar radiation and water and contribute to the bird's aerodynamic shape. Feathers are also responsible for the thermal insulation and thus play an important role in the thermal regulation. Last but not least, they are also responsible for the bird's appearance, and in many species are used to communicate breeding status and quality. The feathers need to be kept in a good condition. This is achieved by the bird by daily care in the form of preening, dust



Tertials			Secondaries						Primaries									
T3	**T2**	**T1**	**S6**	**S5**	**S4**	**S3**	**S2**	**S1**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**
2	5	0	0	0	0	0	2	5	5	5	5	5	4	3	0	0	0	X

Fig. 6.12. Scoring moult in primary, secondary and tertial wing feathers.

bathing and sunbathing. Even with all the care taken by the bird, the condition of the feathers still deteriorates owing to abrasion, exposure to the elements and ultraviolet light. With the deterioration the feathers also lose their sheen and colours tend to fade.

Because of this deterioration feathers have to be replaced regularly, and this natural replacement of feathers is known as moult. In most species moult takes place once a year, although in some species, such as the Willow Warbler, the flight feathers are replaced twice per year. In the larger species, such as the larger birds of prey, it occurs only once in two to three years with feather growth continuing over the whole period. Ducks and geese moult their primaries and secondaries simultaneously and thus become flightless for about a month every year.

Moult information is essential to understanding how birds have adapted to their often difficult and variable environment. The annual cycle of a bird cannot be understood properly without knowledge of its moult strategy. Moult studies have also become very important in the ageing of birds and can also be helpful when identifying species and subspecies.

The study of moult can be undertaken without the ringing of birds. Doing the two together, however, is sensible as birds are already being handled when ringing. This also has the advantage that birds can be recaptured and moult progress can be measured. Ringers should therefore participate in the SAFRING moult scheme if at all possible. With a little training and practice the writing up of basic moult can be mastered by anybody.

The aim of this section is to provide ringers with the basic knowledge to fill in a SAFRING moult card. A prerequisite for being able to fill in moult cards is being familiar with the different feather tracts that are examined during the moult determination as well as the codes used for feathers in various stages of growth (Fig. 6.12). These codes are:

0 = old feather remaining
1 = feather missing or new feather in pin
2 = feather emerging from sheath up to $^1/_3$ grown
3 = new feather between $^1/_3$ and $^2/_3$ grown
4 = new feather from $^2/_3$ to fully grown but with remains of waxy sheath persisting
5 = new feather fully developed with no trace of sheath remaining at base
8 = full-grown feather of uncertain age

This gives a numerical scoring system to indicate the progress of moult. For example, in a bird with ten primaries the primary moult score before moult starts will be zero (10×0). At the end of moult, when all the primaries are new and full grown (5) the score will be 50 (10×5) for each wing.

When checking moult of the wing, one should not just count the primaries from the outermost feather inward until the right number of primaries have been counted and then assume that the last feather counted is the inner primary. Missing feathers or feathers in the early stages of growth are sometimes very difficult to see and can be missed easily; a check should therefore be built in. In many species the primaries differ in shape or colour pattern from the secondaries, with the primaries usually more pointed than the secondaries. The secondaries are more square, or rounder and less pointed at the tip with shafts that tend to curve towards the body. If the wing is gently opened and closed, the division will usually become clearer, as the primaries move as a unit and the outermost secondaries pivot over the innermost primaries. To confirm the correctness of the diagnosis, count both the primaries and secondaries to see that the correct number of feathers can be accounted for.

Old feathers can usually be recognised by their worn and faded appearance. The tips of the old feathers will be abraded and ragged, while new feathers usually have smooth and uniform tips with warm and rich colours.

The following feather tracts are considered as a whole and not as individual feathers; the codes used for these tracts are printed next to the boxes on the moult card:

- ❑ lesser and median coverts
- ❑ underwing coverts
- ❑ head
- ❑ upperparts
- ❑ underparts

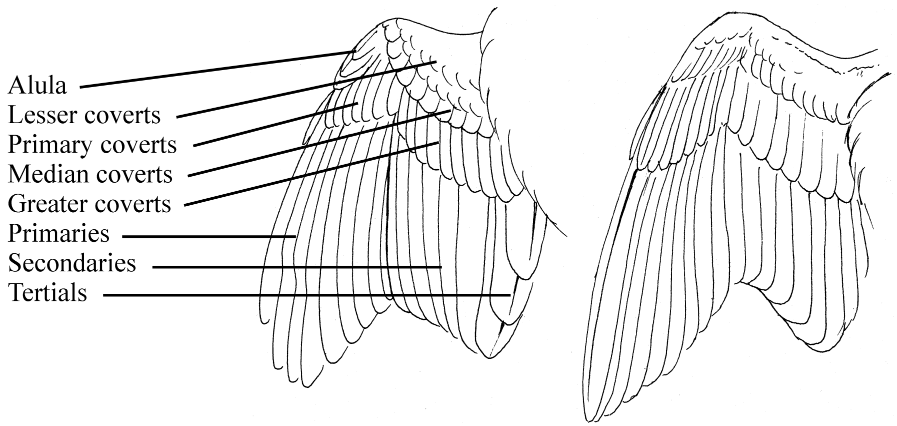


Fig. 6.13. Upperwing and underwing of a bird.

The purpose of this writing is not to give a complete overview of the moult process but only to give the basic background. It is recommended that anybody who wants more information and detail on moult should refer to Ginn & Melville (1983) or Jenni & Winkler (1994).

6.6.1 Primaries

The primaries are the flight feathers on the outer part of the wing; anatomically, these are attached to the metacarpus and the digits. This is the part of the skeleton that would be equivalent to the human hand. Primaries 1 to 6 are attached to the metacarpus whilst primaries 7 to 10 are attached to the digits, P7 to the third digit, P8–9 to the first phalange of the second digit and P10 to the second phalange of the second digit. In flying birds the number of primaries varies between nine and eleven. All passerines have ten primaries although in many species the tenth primary is much reduced or even vestigial.

In southern Africa, the following three categories are mainly found for passerine birds:

- ❑ **Ten primaries present, P10 present, markedly shorter than P9 but easily found:** drongos, orioles, crows, tits, tree-creepers, babblers, cuckooshrikes, bulbuls, thrushes (including chats and robins, etc.), warblers, flycatchers, shrikes, bush shrikes, helmetshrikes and sunbirds.
- ❑ **Ten primaries present, P10 vestigal and usually only to be found by careful search**: larks, starlings, weavers (including sparrows, bishops and waxbills).
- ❑ **Nine primaries present, P9 well developed or even the longest:** swallows, wagtails (including pipits and longclaws), white-eyes, canaries and buntings.

In the non-passerines all families have ten primaries with the exception of the honeyguides which have only nine primaries and the grebes and storks which have eleven primaries.

The number of primaries rarely differs within a species. However, in species which have the outer primary much reduced, this primary sometimes grows to nearly the same length as the other primaries. Very occasionally, birds have one more or one less primary than normal for the species; this can occur either in one or in both wings. Although rare, ringers should always be on the lookout for such anomalies. In modern moult studies, the primaries are always numbered descendantly; that is from the carpal joint outwards from the body. In most species, the moult progresses descendantly through the primaries, so that the numbering of the primaries coincides with the order of moult. When reading old literature on primary moult, if it does not appear to make sense, it is likely that the author numbered the primaries ascendantly, from the outside inwards. The Pied Flycatcher is the only species occurring in southern Africa that is known to moult ascendantly.

Moult of the primaries usually starts with P1 (occasionally with P2 or P3) and proceeds descendantly towards P10. Primary moult usually extends over the entire moult period for all feather tracts, and can therefore be taken as a reference for moult progress in the other feather tracts. Because P10 is usually small, it is often fully grown before P8 and P9. Usually moult proceeds symmetrically in both wings.

6.6.2 Secondaries

The flight feathers that are attached to the ulna (this is the equivalent of the human forearm) are called the secondaries . The secondaries are numbered ascendantly from the carpal joint towards the body. The secondaries vary in number between species; in passerines this is normally nine with a few species having ten or eleven secondaries. In the non-passerines the number seems to be related to the length of the ulna or forearm. Woodpeckers have eleven secondaries; vultures have between 18 and 25 and the Wandering Albatross has 32 secondaries.

Moult of the secondaries usually starts with S1 and proceeds ascendantly towards the body. The numbering of the secondaries is in the general order in which they are replaced. Secondary moult usually starts at about the same time as P5 is moulted; the last flight feathers to complete moult are usually S5 and S6.

6.6.3 Tertials

The inner three secondaries normally differ in shape, size and colour from the six outer secondaries and normally they also have a different moult sequence. The tertials should not be considered separately from the secondaries because, if we do so, we will be completely lost if we make comparisons with species in which these feathers do not differ morphologically. Therefore it is better to consider all the feathers attached to the ulna as secondaries. The tertials, however, have their own moult sequence which is usually in the order of TO, T9 and T7; however, this order can be fairly erratic and can either start with T7 or T9. On average the tertial moult starts when P4 is in growth and is completed by the time P8 and P9 are growing.

6.6.4 Alula or bastard wing

On the upper leading edge of the wing attached to the pollex (equivalent to the human thumb) is a group of feathers called the alula or bastard wing. Normally the feathers of the alula number three but there may be as few as two or as many as seven feathers. The relative length of the alula feathers varies, with the distal feather being the longest. The alula feathers are numbered from the innermost to the outermost, that is, from the shortest to the longest. This is also the moult sequence. Moult of the alula normally starts when P5 and P6 are growing and the feathers are rated individually.

6.6.5 Greater and primary coverts

The base of each wing feather (remex) on the upperwing is covered with a smaller feather called a covert, each secondary is covered by a greater covert (GC) and each primary by a primary covert (PC). Moult of the primary coverts is not addressed on the SAFRING moult card and is thus not usually done. The moult of the greater coverts starts soon after primary moult has begun and is usually completed by the time that the secondary moult starts. In general, the greater coverts moult simultaneously but there is great variation in moult patterns.

6.6.6 Carpal covert

In some species of birds (gulls and fowls) there is an extra remex between the innermost primary and outermost secondary, namely the carpal remex with its own covert called the carpal covert (CC). In other species it may be very small and lack a carpal covert, for example, the woodpeckers. In the passerines the carpal remex is absent but the carpal covert is present. The carpal covert usually moults in sequence with the greater coverts and is considered a part of that tract.

6.6.7 Median and lesser coverts

Above the greater coverts there are eight or nine median coverts and several rows of lesser coverts. These feather tracts are considered as one on the moult card and the feathers are not looked at individually but as a whole: an average assessment is thus filled in.

6.6.8 Underwing coverts

The greater and median underwing coverts are those feathers that cover the base of the remiges of the underwing. These feathers are also considered collectively and an average moult is reported for these. Moult of the underwing coverts usually starts during the second half of the primary moult.

6.6.9 Rectrices

The flight feathers of the tail are called rectrices. The number of rectrices vary more than the wing feathers do. The rectrices occur in even numbers and are usually numbered in pairs from the centre outward (centrifugally). The number of rectrices varies greatly between species and may comprise as few as four or as many as 30. Most of the passerines have twelve rectrices; an exception to this is the prinias which have ten rectrices. Moult of the rectrices usually starts with R1 and proceeds centrifugally in pairs. Although centrifugally is the common sequence, this can also be very erratic and

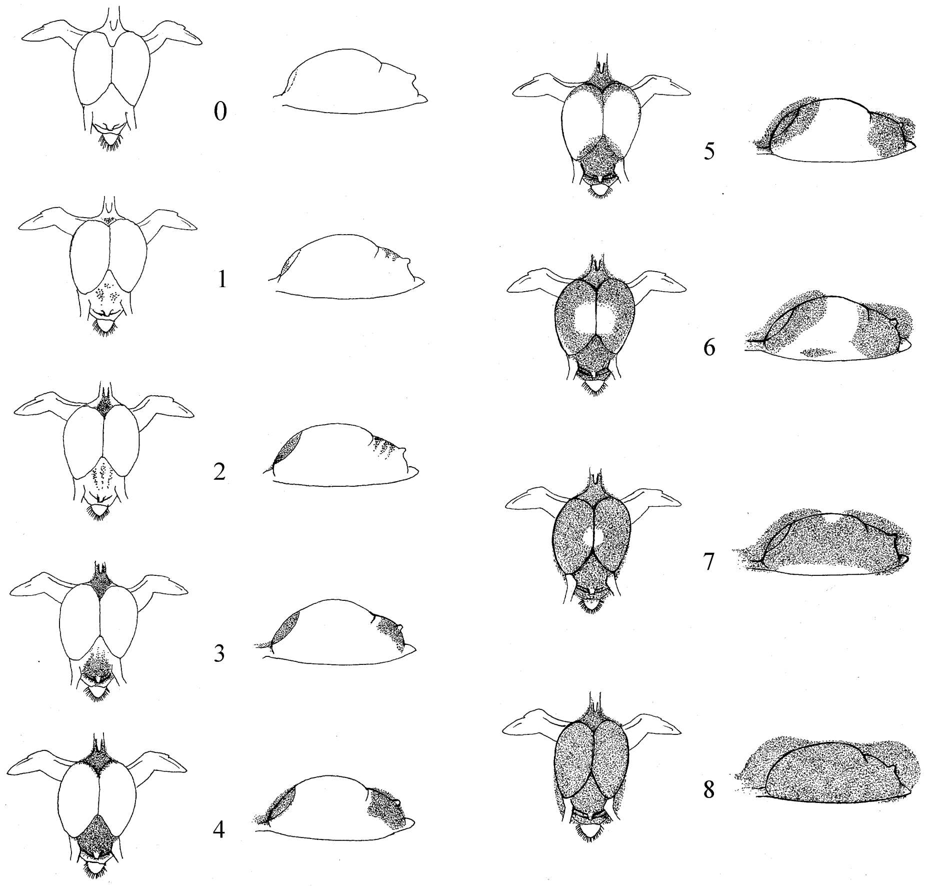


Fig. 6.14. Fat-score stages in birds: fat classes 0 to 8; fat = stippled areas.

moult can start anywhere among the rectrices. A common phenomenon, especially amongst the Palaearctic warblers, is that all the tail feathers moult simultaneously. Rectrice moult starts approximately when P4 is growing and is completed by the time that P8 and P9 are growing.

6.6.10 Body feathers

The body feathers are the small contour feathers that cover most of the body of the bird; for moult recording purposes these are divided into head, upperparts and underparts. Moult is assessed as a whole for each of the three areas and an average moult is reported in the specific box on the form. Body and head moult normally starts after the beginning of primary moult and is completed soon after primary moult is completed. The feathers on the head are normally moulted last.

6.7 SKULL OSSIFICATION (SKULL PNEUMATISATION)

Passerines are characterised by having a double-layered skull with air between the layers. Young passerine birds leave the nest before the skull roof bone is completely grown and when it still consists of a single layer of bone. A second layer of bone is formed under the original skull bone layer, and the layers are connected by tiny bone pillars keeping the layers apart. This second bone layer starts growing from the back of the head towards the forehead and normally follows a fixed pattern, either a general pattern or, in certain families, more specialised patterns. The progress of the skull growth (pattern) can be used for aging young birds. Good books are available for the serious ringer and can be read for detailed information on this subject. Two recommended books are:

- ❑ **Identification Guide to European Passerines** by Lars Svensson.
- ❑ **Moult and Ageing of European Passerines** by Lukas Jenni and Raffael Winkler.

6.8 FAT SCORE

The measurement of the fat score of birds is relatively unknown in southern Africa although it was introduced in Europe some years ago. The method was standardised with the introduction of the fat-score classification as developed by Kaiser. With southern African participation in international projects, there is a need to become familiar with Kaiser’s fat scoring method. This technique is easy to master: it needs a demonstration and some experience.

Subcutaneous fat deposits of birds can be estimated visually. Kaiser developed a method where the fat score is rated on a nine-point scale from 0 to 8. On this scale there are nine main fat-score classes; these were adopted by the European–African Songbird Migration Network in its *Manual of Field Methods* (Fig. 6.14). When determining the fat class, look at the two most important regions for fat deposits: the furcular region or tracheal pit and the abdomen. The bird must be positioned correctly before the determination can be made. Lie the bird on its back in the one hand and hold the legs with the other hand. Stretch the neck slightly so that the furcular fat deposit becomes prominent; now blow the feathers of the furculum and abdomen apart. Determine the fat score by comparing with Kaiser’s diagram. Because the skin is semi-translucent, a bright light helps to give a better contrast between yellowish fat layers and reddish muscle tissue.