INTRODUCTION

1. PRESENTATION

In order to limit the size of this guide, the species covered are the 301 most frequently ringed in Western Europe. This list is based upon the ringing totals, published online, for several national ringing schemes and certain ringing stations as well as figures from wildlife rescue centres. Some of the very largest species have been omitted as these are generally only ringed as pulli and are not likely to be encountered by most ringers. However, some vagrant species which are often caught, eg the majority of Siberian pipits and *Phylloscopus* warblers, are included. Similarly, species that are very infrequently caught but that could be confused with other species are included in this guide to enable accurate identification.

This guide is not intended to be an encyclopaedic work. Only those important criteria used under normal ringing conditions and helpful in identification, sexing and ageing are included. Consequently not all plumage variations are described fully; average measurements are not indicated, etc.

Taxonomy, English and scientific names follow those lists published by the Association of European Records and Rarities Committees, corrected where necessary by the IOC World Bird List, the British Ornithologists' Union, the BTO and the Handbook of the Birds of the World Alive. The names of the orders appear before the first species of each order – or family within the order Passeriformes.

For each species the **heading** will include a variety of information (Fig 1). Passeriformes generally have 10 primaries (P1 vestigial), 9 secondaries and 12 tail feathers; this information is only given again in cases which differ from the rule. For other orders the number of feathers are those given by Cramp & Simmons (2011); other authors state that only members of the Genera *Podiceps, Ciconia* and *Phoenicopterus* have 11 primaries, all other European orders having 10 functional primaries, the vestigial P1 being sometimes considered as a modified covert. In order to avoid errors in interpretation, the relative size of P1 is indicated. The sex of adults involved in incubation and parental care is also given. The youngest age at which individuals return to the breeding areas and at which they may begin to reproduce is included for both non-Passerines and several Passeriformes (the majority of which can begin breeding in their second year). This information is only given for information to help with sexing and ageing when catching a bird at the nest.

The **'Identification'** section is short for easily recognised species. This guide is intended for those who already have a good working knowledge of ornithology so a well-illustrated field guide will enable identification of these 'easy' species. A direct comparison with the species giving rise to the greatest confusion should be the next step in identification (Fig 2). Aberrations in plumage, arising from melanism, albinism or leucism are covered in cases where they can resemble other species. The possibility of hybridisation is also included (not exhaustively), usually only for those cases known to exist in the wild. The possibilities of hybridisation and second intergradation (fertile breeding hybrids) are more common for species widely held in aviculture like many *Anatidae* and *Fringillidae*.

The **'Measurements'** section quotes all measurements in mm. The units are not given if they follow a measurement without ambiguity. In the absence of any contrary indication, the data relate to species or sub-species found in Europe. Other than where indicated, the data are given for length, eg 'wing' = 'length of wing'. If the measurement method is not mentioned in the text (eg 'bill'), it is the most common method for this species or group of species (eg 'to cere' for raptors, 'to feathers' for waders, etc) and it is indicated in the table of measurements. Weight in g is quoted although it rarely helps with identification. Extreme weights, eg emaciated individuals or females carrying eggs, are not included. The measurements are a combination of data from different sources coming from museum specimens or live birds. These data are not directly comparable: museum specimens tend to be up to 4 % smaller than live examples, particularly for wing length and bill length. A correction multiplier, variable according to species, can be applied to wing measurements from museum skins to compensate for the contraction of the dried tissue. The proposed multiplier is: *preserved wing* × *1.017* ≈ *live wing* but the regular use of a multiplier is not recommended. The size of the sample is not given but the accuracy of the measurements quoted is indicated by parentheses and square brackets:

- those measurements based upon a small sample size must be used with caution: (64 - 68).
- extreme measurements: (61) 63 - 68 (70) [72].

The **'Variation'** section – meaning 'Geographical variation' – looks at sub-species found in Europe or those that may occur as vagrants, and their distribution range. They are briefly described or only mentioned if identification necessitates comparison with a series of individuals of known origin, eg museum collections, which is impossible during a ringing session. A more complete

Fig 1 – Informations given within the heading of each species

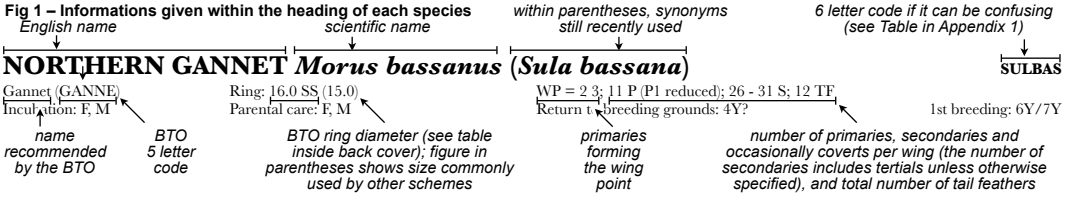


Fig 2 – Example of comparative table of species identification

(1) **European Serin** *Serinus serinus*		(2) **Citril Fincl**	
small ; yellow or yellowish rump			
- tail and PP without yellow	≠ 3	- tail and PP without yellow	≠ 3
- cheeks with a pale central spot	≠ 2	- cheeks and nape without pale spot	≠ 1
(3) **Eurasian Siskin** *Carduelis spinus*			
- tail sides and base of PP yellow	≠ 1 (2)		

characters on the grey background are common to all species in the table (unless otherwise indicated)

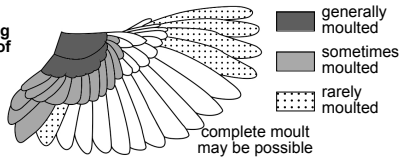
difference from other species in the table, () indicates that this criterion is not absolute; "all" indicates that this difference is valid with all species of the table

serial number of species in the table (only if 3 or more species shown in the table)

treatment is given where field identification of a particular variant is possible, eg Yellow Wagtail *Motacilla flava*. In the case of sexual dimorphism, the male in breeding plumage is generally described. The identification of sub-species can be subjective without a great deal of experience or reference material. The geographical names cited in this guide (except for continents, countries, oceans and seas) are listed in Appendix 2.

The **'Moult'** section provides information on the dates and extent of the moult for juvenile/immature and adult: these dates are given only for information, considerable variations are possible. The term 'moult from 07 – mid-08 to late 08 – early 10' means that moult can start between the beginning of July and mid-August and can finish between end of August and the beginning of October. A good understanding of the progression of moult is indispensable for ageing (chapter 4). Some figures show the extent of the moult period for certain species (Fig 3). In cases where the progression of moult is relatively straightforward, a figure summarising the major stages has been used (Fig 4). These simplified figures are intended as a visual support to the text, to which reference should be made for better understanding of the details.

Fig 3
Fig showing the extent of moult



For numerous species of Passeriformes, the **'Pneumatisation'** section indicates whether this criterion can be used for ageing and until when (chapter 6.7.1).

The criteria for determining **'Sex'** (Male then Female) and **'Age'** (juvenile, immature, then adult) are generally presented by season, **'Autumn'** and **'Spring'**, corresponding respectively to the periods that follow postjuvenile/postbreeding moult and prebreeding moult (as appropriate). Although the majority of juveniles hatch in spring, their plumage following postjuvenile moult is classed '1Y' and logically placed in 'Autumn' (chapter 4.1 Fig 33). In the absence of a prebreeding moult, the criteria used in autumn will generally remain valid in the following spring: thus, sequentially, ageing will follow '1Y - 2Y spring' then 'Ad'. In circumstances where there are no known differences between sexes or age groups, these sections are left empty. It is often necessary to first age a bird to be able to sex it (or vice versa). The order in which this occurs will vary according to species. This may appear confusing but is straightforward, eg it is probably easier to first age a Eurasian Blue Tit *Cyanistes caeruleus* before trying to determine its sex, whilst a Great Tit *Parus major* can usually be sexed before assessing its age. All the different criteria, used in ageing and sexing, do not have equal value: while some can be relied upon, eg moult limits within juvenile and postjuvenile feathers, others may be merely considered helpful, eg shape of feathers, presence of particular marks, etc. To base the determination of age/sex solely on a single criterion can easily lead to errors. Another common mistake is to transpose a criterion from one species to another, eg just because the colour of the iris of the Common Whitethroat *Sylvia communis* can be used to age an individual; it does not mean that the same is true for the Garden Warbler *Sylvia borin*. It is preferable to combine as many criteria as possible when ageing or sexing. **If in any doubt, it is better not to record age or sex.**

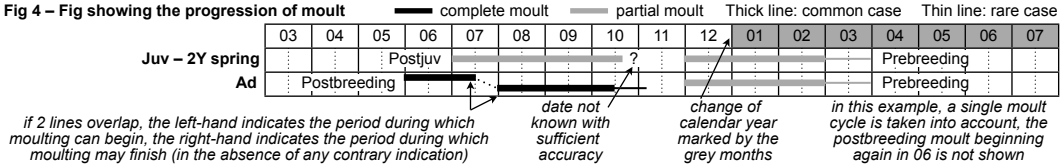
To take account of individual variation, terms such as 'usually', 'often', 'sometimes', 'occasionally', 'rarely' (in descending order of frequency), have been regularly employed. Although these make the guide less easy to read they reflect the great variety that exists in certain cases and also advise caution. Overconfidence can easily lead to mistakes in ageing and sexing.

The most significant **references** are given at the end of the book. Abbreviated references are mentioned after each species but not in the body text. General references dealing with a large number of species are not repeated after each species: eg Cramp & Simmons (2006) for all species, Svensson (1992) for all Passeriformes, etc. Linked references are included in those of the common species if a species is only treated in the identification table. If species is fully treated, references are given at the end of its description. The complete reference list is available on the link <http://ringersguide.e-monsite.com>

For reasons of presentation the order of some sections is adapted to the requirements of each species, eg raptors or *Anatidae*. For each species account the scientific genus names are only given once. When another species of the same genus is referred to, this is indicated by an initial letter (except in cases of possible confusion). The full scientific name of a species is only used once in a description. Eg:

PURPLE HERON *Ardea purpurea*
IDENTIFICATION See Grey Heron *A. cinerea*.
Hybridisation possible with Grey Heron.

Fig 4 – Fig showing the progression of moult



2. IMPORTANT REMARKS ABOUT TERMINOLOGY

The principal parts of the body and details of plumage are illustrated inside the front cover. In other books, the fine circles of feathers or bare skin around the circumference of the eye are often designated respectively as 'eye-ring' and 'orbital ring'. Both terms refer to the immediate area around the eye but are no longer used exclusively for the feathers or the bare skin, which can lead to confusion. To avoid ambiguity in this guide these rings are referred to as, 'the periocular ring of feathers' or 'periocular ring of bare skin'. Occasionally the iris may have a different-coloured ring within it and this is called the 'intraocular ring' (see inside front cover).

In this guide the numbering of remiges and greater coverts is always ascendant, from exterior towards interior, eg outermost primary = P1 (see inside front cover). This choice has been made because it is harder to find the innermost primary than the outermost primary and more so as the number of primaries can vary between different orders. Furthermore, in the majority of the 'classic' guides the primaries are counted descendantly

for the study of moult, including those species that have an atypical moult, eg Spotted Flycatcher *Muscicapa striata*, even if they are counted ascendantly for the wing formula. The use of both methods, at the same time, can be a source of error. Some very recent guides even reverse the numbering according to whether they deal with Passeriformes or not. To avoid confusion, the number of flight feathers and the relative size of P1 are given in the heading for each species (Fig 1 page 5). The tail feathers are numbered from the interior to the exterior, eg TF1 = central tail feather.

The development of an abnormal number of flight feathers may occasionally occur, either asymmetrically or not. It is best to acknowledge this anomaly, particularly when studying moult or in the establishment of the wing formula.

3. METHODS OF MEASURING

Whilst the choice of which measurements to take may be guided by the requirements of a particular study, the well-being of the bird must always come first. The degree of precision when taking measurements should only be what is necessary, not what it might be possible to achieve. For example, it is not necessary, or desirable, to measure the length of the bill to 0.01 mm just because digital callipers can give this level of accuracy; 0.1 mm accuracy is sufficient but nevertheless needed. Measuring a bill with a ruler with an accuracy of 1 mm may not give the level of precision required to allow reliable comparisons. The method of measurement used should be recorded or data risk becoming unusable in the case of doubt being raised over its validity at a later date.

3.1. HOLDING A BIRD

The recommended method for holding a bird is shown in Fig 5. In this position it is possible to take measurements of the wing, tarsus, bill and tail using the free hand. To measure the primaries (Section 3.3), the original procedure recommends holding the bird in the reversed grip (Fig 6).

To hold a bird in your 'favoured' hand, ie use right for someone who is right-handed, allows better feeling. However this can make it harder to write down data. Many people therefore prefer to hold the bird in the left hand leaving the right hand free to manipulate tools and write. The presence of 2 people is sometimes necessary when dealing with larger birds.

Fig 5 Standard grip

Fig 6 Reversed grip

3.2. WING LENGTH

This is the distance between the carpal curve and the tip of the longest primary of the closed wing. This measurement cannot be taken if the longest primary is still growing, badly worn or broken; confirm which primary is the wing point (Fig 1 page 5). In this guide the length will always be that obtained using the 'maximum chord' method, ie wing flattened and stretched to correct for wing curvature (Fig 7). A ruler with a 'stop' should be used. It can be very difficult to correct the curvature of the wing of the larger species; a metre tape can be used to measure the wing by following the natural curve. Accuracy: 1 mm. Tolerance: 0.5 - 1 mm.

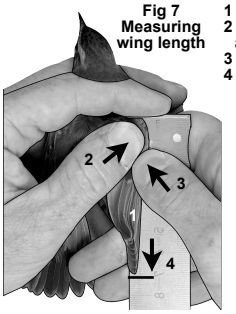
Birds are rarely perfectly symmetrical and this can be appreciated by taking measurements on both sides. However, the accuracy of the observer can be affected by having to change hands.

Juveniles often have a shorter wing than adults. A lengthening of the wing after the first complete moult can thus be frequently observed and is quite normal. Four hypotheses are proposed to explain these differences:

- the amount of food supplied during the breeding period is insufficient to allow juveniles to develop longer wings;
- growing only a short wing could reduce the length of time before fledging (a time of greatest risk for juveniles) and gives the adults the possibility of starting a second brood more quickly;
- a short, rounded wing, could be an adaptation giving rise to greater manoeuvrability;
- the flight muscles may not yet be strong enough to efficiently control the full size wing.

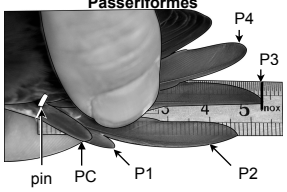
On the other hand, among certain diurnal raptors the juveniles have a longer wing than the adults.

Fig 7 Measuring wing length



1 Wing in its natural resting position
2 Wing flattened, carpal joint pressed against the zero-stop of the ruler
3 Curvature corrected
4 wing stretched

Fig 8 – Measuring P3 Passeriformes



3.3. LENGTH OF P3/P4

This section concerns the measurement of the 8th primary (counting from the innermost primary) being P3 for Passeriformes (10 primaries) or P4 for the majority of other species (11 primaries).

This method allows a comparison to be made between those measurements taken from live specimens with those obtained from museum skins. Contrary to widespread opinion it does not particularly reduce the differences in measurements taken by ringers of different levels of experience. Furthermore, sexual dimorphism between P3/P4 can be less marked than that found between wing lengths. Finally, the first measurement is always shorter than any repeated measurements because of changes at the base of the feathers caused by the insertion of the pin (see below). For a large number of species of Passeriformes, the length of P3 ≈ 75 % of wing length.

The following applies to species with 10 primaries. Use a ruler with a vertical pin of about 1.4 mm diameter. The ruler must be supported firmly, eg on a table, and the original procedure recommends to hold the bird in the reversed grip (Fig 6; do not hold the ruler in the hand). Hold the wing between thumb and index finger (Fig 8). Gently open the wing and carefully push the pin of the ruler between P2 and P3 until it comes up against the fleshy part of the wing. P3 must be completely straight, the curvature being gently corrected. Do not push the ruler in with any excessive force (risk of injury) and make certain that the primary covert adjacent to the pin corresponds to the same primary. In the case of very small birds the pin can cause some lesions, as the space between 2 primaries

is < 1.4 mm. A finer, unstopped ruler can be used instead. Accuracy: 0.5 mm. Tolerance: 0.5 mm.

3.4. Wing formula

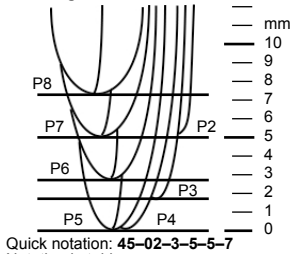
A wing formula consists of measurements of the distance between the wing point and the other primaries (generally P2 to P8) and sometimes S1; as well as the length of any emarginations and notches. P1 is generally vestigial and its length is compared to the longest primary covert. Before taking any measurements, confirm the feathers are in good order (none in moult, broken, missing or supernumerary, etc.). Two alternative methods exist but only the first-described, below, is used in this guide.

a - distance between the point of each primary and the wing point (Fig 9). Hold the closed wing in as natural a position as possible against the ruler, maintaining a firm grip with the thumb and index finger near to the carpal joint, ensuring that the primaries do not move while being measured (Fig 9). Match the wing point to an exact cm line on the ruler. Note the number of this longest primary (Fig 10: 4 5) then read the distance between the wing point and the primary nearest to it and so on in order. This method has the advantage of being quickly completed and leads to a reliable representation of the pattern of the wing but it does not allow for a direct comparison to be made between live birds and preserved skins.

A method of rapid notation (Busse 2000) can be used when wing formulae are recorded systematically: if the wing point is not made by the outermost primary then place a 0 in front of the distance from the wing point for the distal primary (Fig 10: 02 for P3); if a distal primary is the same distance from the wing point as a proximal primary the use of 0 can be omitted (Fig 10: 5 – 5 for P2 and P7). Another method is to record all the information in tabular form, which allows the data to be better visualised (see Appendix 3): write 0 for the longest primary then note the distance from the wing point to each primary; use X for measurements not taken; the length of emarginations and notches can be added in additional rows for each primary.

Fig 9 – Hold primaries on the rule

Fig 10 – Wing formula measurement – P2 to P8



Quick notation: **45–02–3–5–5–7**

Notation in table:

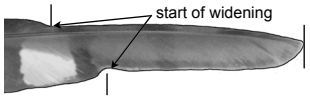
P	1	2	3	4	5	6	7	8	9	10
Formula	X	5	2	0	0	3	5	7	X	X

b - total length of each primary. Each primary (except P1) is measured as described in chapter 3.3; P2 is measured by inserting the pin of the ruler between P2 and P3 and not between P1 and P2. The wing formula is calculated by subtracting the length of each primary from the length of the longest one. Compared to the first method the outer primaries can seem shorter while the inner primaries appear longer. The major drawback is that this method only gives the length of each primary without showing the relationship of one to another and notably fails to account for the gaps between the points of attachment for each feather. It takes longer, particularly for the less-experienced but does allow comparisons to be made between live specimens and preserved skins.

The size of notches or emarginations of the primaries is important information. They should be measured from the tip of the primary to the place where the vane starts to enlarge (Fig 11) and not along the shaft.

The figures accompanying certain species show the principal measurements needed for the wing formula (see inside back cover). An example of a page on which to record wing formulae is given in Appendix 3.

Fig 11 Length of notch and Em of a P



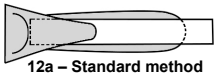
3.5. Tail

Several methods can be used but they are not directly comparable, eg the standard method gives measurements < 15 - 20 % of the method measuring from the back. Accuracy: 1 mm. Tolerance: 1 mm.

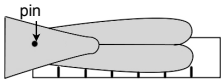
3.5.1. Standard method (Fig 12a)

One of the points of a pair of fine-pointed dividers is inserted at the base of the tail between the 2 central tail feathers with the other point corresponding with the extreme end of the longest tail feather. This method is widely used for museum specimens. For live birds a ruler is placed under the tail, against the roots of the central tail feather, between the undertail coverts and the tail. The ruler must not be placed so that 2 tail feathers are straddling it as there is some doubt over the reliability of this measurement.

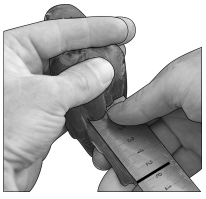
Fig 12 – Measuring tail length



12a – Standard method



12b – Alternative method



12c – Method from the back

3.5.2. Alternative method (Fig 12b)

The alternative method requires a ruler fitted with a pin, which is slid against the roots of TF1, between the undertail coverts and the tail. The results obtained may be comparable with those obtained with the 'from the back' method (see below) but this remains to be verified. Significant differences between observers using this method can be encountered.

3.5.3. Method 'from the back' (Fig 12c)

This method is simple and quick but could cause damage to the preen gland. The body of the bird is held vertically while the tail is held at a right angle to the back. The unstopped ruler is placed firmly against the back (controlling the pressure with the ring finger and little finger on the abdomen); the tail feathers should be in contact with the underside of the ruler for their entire length.

3.5.4. 'Roundness' of the tail (Fig 13)

The 'roundness' of the tail is the difference in length between the short outer tail feather and the longer central tail feather.

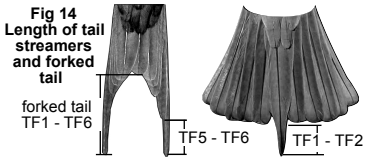
3.5.5. Tail streamers and forked tail (Fig 14)

Tail streamers consist of a pair of tail feathers markedly longer than the others; they can comprise either the outer tail feather or the central tail feather. Left and right-sided streamers are sometimes asymmetric.

The forked tail is the distance between the short TF1 and the longest outer tail feather.

Fig 13 'Roundness' of the tail

Fig 14 Length of tail streamers and forked tail



3.6. HEAD AND BILL

3.6.1. Length of the bill (and head)

Figures 15 to 18 show the principal measurements taken of the bill and the head, all these measurements are taken with callipers. Accuracy: 0.1 mm (1 mm for lengths > 100 mm). Tolerance: 0.3 - 0.5 mm.

The length of the head and bill is measured from the rear of the skull, making sure the callipers are parallel to the head-bill axis (Fig 15a). The length of the bill from the skull is measured from the small indentation in the front of the skull, hidden by feathers (Fig 15b and 16b), using the fine points of the callipers intended for measuring internal diameters. The callipers must be held vertically, if held horizontally the measurement will be too short (Fig 16a). The length of the bill from the feathers is taken from the base of the most frontal feathers of the forehead, not from the tips of these feathers or from the feathers of the nostrils (Fig 15c). The length of the bill from the nostrils is measured from the distal or proximal edge of the nostrils but whichever is used must be made clear (Fig 15d). The length of the bill may sometimes be measured from the gape of the mandibles (Fig 15e).

Fig 15
Head and bill length

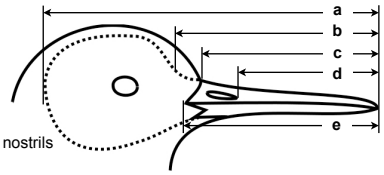


Fig 16
Skull seen from above

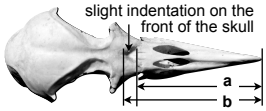
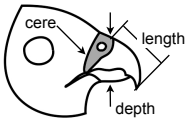


Fig 17
Bill length to cere and bill depth at cere



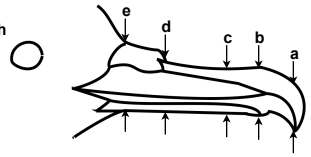
For raptors in particular, measurements of the bill are taken from the cere; this applies to both length and depth (Fig 17).

Certain parts of the body, particularly the bill, can develop abnormally, eg, as a result of genetic problems, an accident, a dietary deficiency, parasites, etc. If a mandible is broken the remainder can grow in an exaggerated fashion, often curving unusually. In such a case the measures obtained are clearly of no use for identification purposes.

3.6.2. Depth of the bill

The measurement of the depth of the bill is less standardised than that for the length and it is important to state clearly at what point the measurement was taken (Fig 18). The proximal or distal edges of the nostrils are commonly used as reference points (always state chosen position clearly). The jaws of the callipers must be perpendicular to the axis of the bill to the bird. Do not apply any pressure and ensure that the mandibles are together in a natural way. Be particularly careful with waders, which can have very sensitive bills. For raptors see Fig 17.

Fig 18
Bill depth

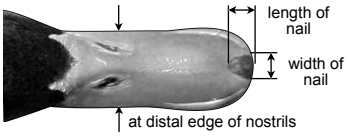


3.6.3. Width of the bill and nail measurements (Fig 19)

The measurement of the width of the bill is delicate because it is difficult to decide where on the bill to take the measurement (always state chosen position clearly). It can be taken at the gonys, at the nostrils or at the joint of the mandibles (take care with recently-fledged birds), or indeed at the point where it looks the widest. The reliability of this measurement may vary between observers.

In certain species (*Anatidae*, skuas, gulls…), the measurement of the nail may be useful.

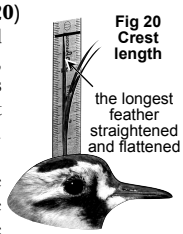
Fig 19
Bill width and nail measurements



3.6.4. Length of the crest (Fig 20)

The length of a crest is measured along the axis of the longest feather, with a fine ruler, from the base of this feather to its point. The feather must be held flat and straightened if curved.

Fig 20
Crest length



3.7. TARSUS, TOE AND CLAW

Figures 21 to 24 illustrate the principal measurements taken of the tarsus and the middle toe. All these measurements, with the exception of the combined length of the tarsus and toe, are taken with callipers. The alternative method for measuring the length of the tarsus (Fig 21) is easier to use with a live bird than the standard method but the results are not entirely comparable. It is recommended that the wider parts of the callipers jaws are used rather than the tips (Fig 21). Unless otherwise stated in the 'Measurements' section, the toe length is the length of middle toe with claw. Accuracy: 0.1 mm. Tolerance: 0.3 - 0.5 mm.

The measurement of the tarsus and longest toe combined (Fig 24) is easier to take than the length of the tarsus alone and is frequently used for waders. Accuracy: 0.5 mm. Tolerance: 0.5 mm.

Other measurements can be taken of the toes and the claws (Fig 25). These measurements are taken by placing

Fig 21 – Tarsus length

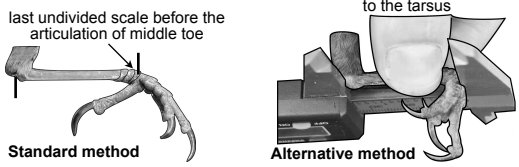


Fig 22

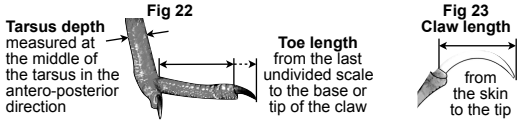


Fig 23
Claw length

Fig 24
Tarsus and middle toe length
with a ruler with a zero-stop

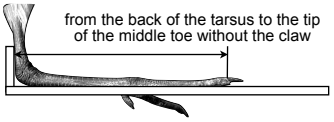
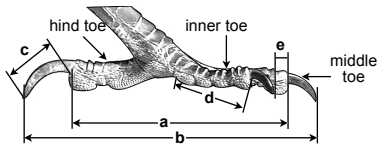


Fig 25
Various measurements on the toes and the claws



a length of hind toe and middle toe without the claws
b length of hind toe and middle toe with the claws
c ventral length of the claw
d cushion length of the inner toe, from the notches separating the toe cushions from the foot cushion to the base of the claw
e distance between the tip of the claw of the inner toe and the ventral base of the claw of the middle toe

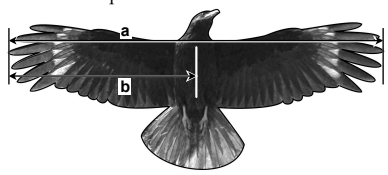
the foot flat on a ruler, straightening the toes and keeping the claws in the same axis as their associated toes. These measurements can be difficult to take accurately and practice is recommended.

The tarsus is generally shorter in adults than juveniles because of a reduction in the amount of cartilage during ossification of the tarsus.

3.8. Other measurements

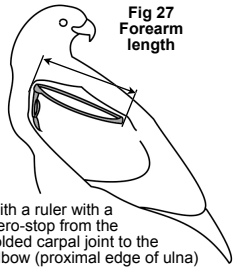
Those measurements that are only used for certain species are described within those species accounts.

Fig 26
Wingspan



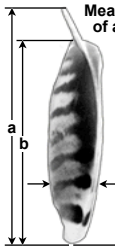
a wingspan
b half-wingspan

Fig 27
Forearm length



with a ruler with a zero-stop from the folded carpal joint to the elbow (proximal edge of ulna)

Fig 28
Measurement of a feather



length
a from the tip of the calamus
b from the base of the web

width at x mm of the tip

Fig 29 – Head width – with a calliper
a in the widest area in the ear-C area behind the eyes
b above eyes

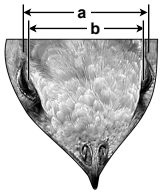
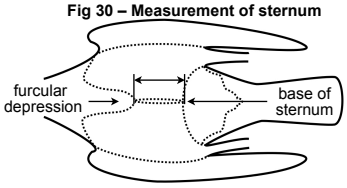


Fig 30 – Measurement of sternum



Wingspan is measured by placing the back of the bird on a ruler and spreading the wings perpendicular to the body, the leading edges of the two wings being nearly in line (Fig 26). The half-wingspan is measured from the centre of the back. The length of the forearm is used for certain raptor and skua species (Fig 27). The width of a feather is measured at a certain distance from the tip (Fig 28). The length of a feather may be measured from the tip of the calamus or the base of the web (Fig 28). The measurement of head width is used eg for sexing Griffon Vultures *Gyps fulvus*, ageing Guillemots *Uria aalge* or to distinguish Common Swifts *Apus apus* and Pallid Swifts *A. Pallidus* (Fig 29). The length of the central part of sternum is measured from the base of the sternum to the base of the furcular depression (Fig 30).

3.9. Body condition

Fat reserves and muscles are the 2 main energy resources used by birds during migration. Fat deposits and development of the breast muscles are indicators of body condition of migrants.

3.9.1. Fat score

Fat is recognised by its yellow colour contrasting with pinkish-red skin. Several scores occur, especially for Passeriformes, and are not directly comparable. It is always advised to use the scale which is advocated in the country in which the ringing survey is conducted.

A scale of 8 classes (Meissner 2009) is used for waders (Fig 31). Axillary deposit is located on top of the flanks under the axillary feathers; this area is an apteria where breast muscles are visible under the skin. Place the bird on its back in the palm of the hand. Consider first the axillary deposit, then the furcular depression, and choose one of 5 options A to E.

- if A = code 0.
- if B = code 1.
- if C, blow the furcular depression; no fat = code 2; less than ⅓ of fat in the depression = code 3.
- if D, blow the furcular depression; fat fills ≈ ½ of furculum = code 4; fat in the depression flat or slightly concave = code 5.
- if E, blow the furcular depression; fat convex or at least flat = code 6; fat overflows the depression and reaches the abdomen = code 7. A code 8 could be assigned if the fat layer covers the entire abdomen and breast.

The difference of determination should not exceed 1 class value between 2 observers. The examination of the furcular depression in large species of waders can be difficult because of its depth; distinguishing between the codes 2 and 3 may then be impossible. Although designed for waders, this scale could be used, after validation, for other species, such as *Rallidae* or large Passeriformes such as *Corvidae*.

3.9.2. Breast muscles

In individuals whose breast is not covered with a layer of fat, the shape of the pectoral muscles can be easily examined. A scale of 4 classes (Bairlein 1995) is estimated visually (Fig 32).

Fig 32 – Breast muscles (cross-section)

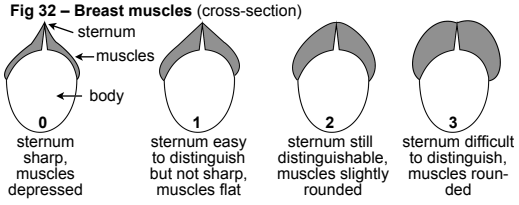
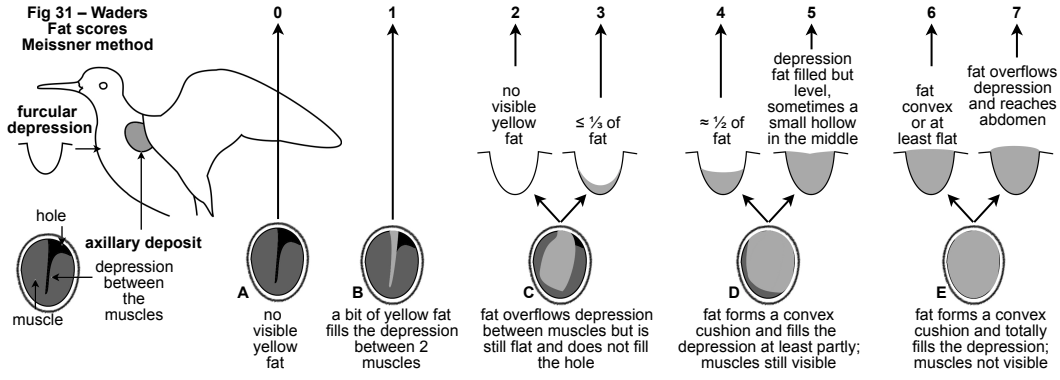


Fig 31 – Waders
Fat scores
Meissner method



4. GENERAL REMARKS ON MOULT

4.1. Moult and plumage sequences

Feathers wear and must be replaced by regular complete or partial moults, these may include respectively all the feathers or only some. Moulting is costly in energy so it does not usually overlap with migration or breeding. Main moult therefore normally occurs between completion of breeding and commencing autumn migration or after migration during the winter months (Fig 33).

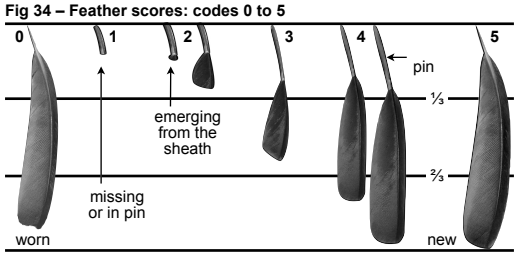
Ageing in birds is strongly based on the state of moult as it progresses across the year. Various terminologies have been used. The one we use in this book is explained below (Fig 33) with EURING age codes for comparison. Another, more complex, terminology that focuses on the evolution of moult cycles is frequently used in North America.

4.2. Moult codes

The Ashmole (1962) scoring system for moulting is used in this book. Each flight feather is scored from 1 to 5 (Fig 34). For primaries, final score is calculated by adding the total of each feather (eg max score is 50 for 10 primaries).

- 0: old feather (V for very old feather).
- 1: old feather missing or new feather completely in pin
- 2: new feather just emerging from the sheath, up to ⅓ grown
- 3: new feather between ⅓ and ⅔grown
- 4: new feather more than ⅔grown, but waxy sheath still at its base
- 5: new feather fully grown with no trace of sheath at its base

Fig 34 – Feather scores: codes 0 to 5

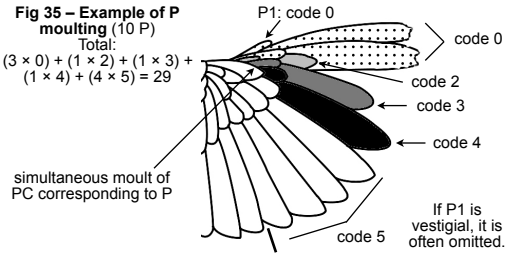


An example is provided for 10 primaries (Fig 35):

- P1 to P3 (outermost primaries) are old, code 0
- P4 does not reach ⅓ grown, code 2
- P5 is between ⅓ and ⅔grown, code 3
- P6 is greater than ⅔grown, with apparent sheath, code 4
- P7 to P10 (innermost primaries) are new, code 5

Following the methodology adopted in this guide, primaries are numbered ascendantly (see inside front cover), including moult study.

Fig 35 – Example of P moulting (10 P)
Total:
(3 × 0) + (1 × 2) + (1 × 3) + (1 × 4) + (4 × 5) = 29



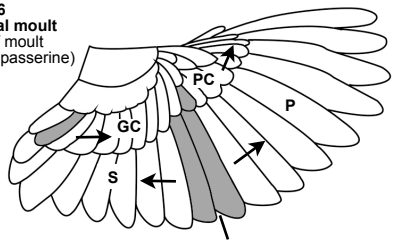
A moult card is established by noting the moult code of each feather (see Appendix 3).

4.3. Moult types

In most species, especially Passeriformes, moult of flight feathers is rather uniform, but some unusual kinds of moult may occur. When moult strategy of remiges and tail feathers differs from basic sequence, the specific sequence is given.

- *Basic sequence* (Fig 36): moult of primaries, greater coverts and primary coverts descendant (from inside outwards); moult of secondaries ascendant (from outside inwards). GC10 is usually renewed after the others.

Fig 36
Conventional moult
direction of moult
(typical wing of passerine)



- *Suspended moult* (Fig 37): the moult is stopped before completion (2 generations of primaries), but will start again from the previously reached stage to complete the process.
- *Arrested or interrupted moult* (Fig 38): a moult which would normally have been complete but is stopped before completion and will not be resumed again later. In Fig 38, the 6 innermost primaries are moulted before stopping, leaving the 4 old outermost ones. When moult starts again, the 2 innermost primaries are renewed but not yet the 4 outermost ones (thus 3 generations of primaries occur simultaneously).

Fig 37 – Moult of P suspended

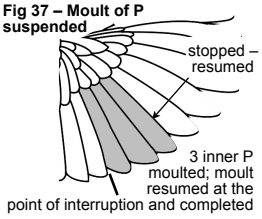
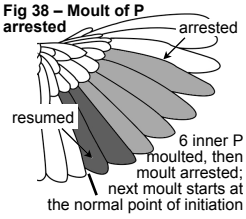


Fig 38 – Moult of P arrested



- *Partial moult*: moult does not involve the whole plumage (different from a complete suspended or arrested moult).
- *Eccentric moult*: the renewal of the feathers starts from a central feather and moves forward in a single direction (generally towards outermost and in primaries only).
- *Divergent moult* (Fig 39): moult of remiges away from the centre in both directions.

Fig 39 – Moult of P divergent

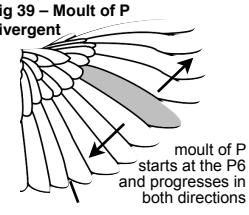


Fig 40 – Moult of P in series

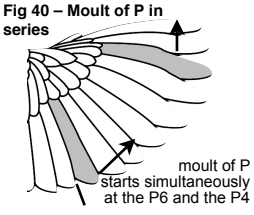
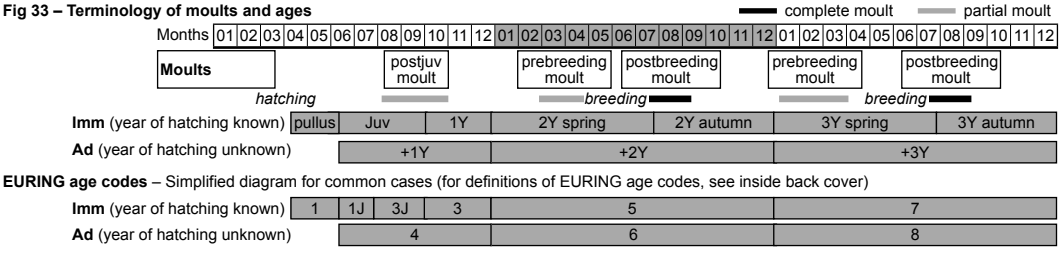


Fig 33 – Terminology of moults and ages



EURING age codes – Simplified diagram for common cases (for definitions of EURING age codes, see inside back cover)

• *Moulting series* (Fig 40): moult of remiges starts simultaneously in 2 or 3 places. If the moult starts from 2 places and each series moves towards the other, it is called *convergent moult*.

• *Simultaneous moult*: all or nearly all the old remiges are lost simultaneously and new ones grow simultaneously.

• *'Fright moult'*: some species are able to suddenly lose a large amount of feathers, usually body feathers and tail feathers, under stress such as predator attack or capture. This appears to be a confusion strategy.

4.4. Moult in Non-Passerines

Moult usually occurs twice in adults: one complete postbreeding moult and one partial prebreeding moult. Primary coverts and primaries are generally renewed simultaneously, except in Piciformes (chapter 4.4.4).

Species belonging to some orders or families renew all their remiges simultaneously and are consequently unable to fly for several weeks: eg Gaviiformes, Podicipediformes, Anseriformes, *Rallidae*. In contrast, in some large species, remiges are renewed over several years.

Several examples are given below in 5 groups whose moult process differs strongly from the norm.

4.4.1. Anseriformes (simultaneous moult of remiges; Fig 41.1)

In adult male, the complete moult leading to eclipse plumage begins in early summer. All remiges fall simultaneously (a few days). Bird is consequently unable to fly for several weeks, until new primaries have reached up to ≈ ¾ grown. When growth of primaries is complete (≈ 4 - 8 weeks), the new breeding plumage is acquired through the moult of body feathers and several wing feathers: tertials, scapulars… The 4 innermost greater coverts are usually acquired through the first moult (eclipse), and are not renewed in the second prebreeding one, leading to breeding plumage in adults differing from first-year birds.

Adult female moult is similar to adult male, but moult leading to eclipse plumage starts after offspring disperse and is consequently delayed by 1 to 2 months compared to male. The moult leading to breeding plumage is very slow and may last until breeding in the following year.

In some cases, adults are unmoulted in autumn: they are easy to distinguish from first-year birds by their very worn feathers. First-year males generally acquire breeding appearance right from first autumn but still keep the juvenile type wing.

How to define the various moult types remains controversial. In this book, we followed the classical approach: moult leading to eclipse plumage = postbreeding moult; moult leading to breeding plumage = prebreeding moult. An alternative approach saying that plumage colouration should not be used to define various moults suggests opposite definitions.

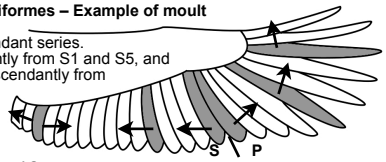
4.4.2. Accipitriformes (series of slow moult of remiges; Fig 41.2)

Moult of females usually begins before that of the males and strongly overlaps with breeding.

Large diurnal raptors moult continuously throughout the year, but suspend flight feather renewal during migration and parental care. Complete remiges renewal takes several years. Primary moult is descendant, in regular series in juveniles but irregular in adults (Fig 42). Secondary moult is ascendant from S1 and S5, and divergent or descendant from the third centre, the longest inner secondary. Moult centre from S5 may be due to the loss of S5 during evolution, although GC5 remains. This phenomenon is called 'diastataxy'.

Small raptor species display a single annual complete moult, starting in spring-summer and ending in late autumn. Primary moult is descendant; secondary moult is similar to most large species.

Fig 42 – Accipitriformes – Example of moult
P1 not shown
P moult in descendant series.
S moult ascendantly from S1 and S5, and divergently or descendantly from the 3rd center of the longest inner S



4.4.3. Falconiformes

Primary moult is divergent, starting from P7 and P8, usually according to the following sequence: P7 (P8 – P6) – P8 (P7) – P6 (P8) – P9 – P5 – P4 – P10 – P3 – P11 – P2 (Fig 43). Secondary moult is generally divergent from the

Fig 43 – Falconiformes
Typical moult sequence of P
P1 not shown

darker = moulted 1st
lighter = moulted last

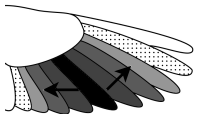
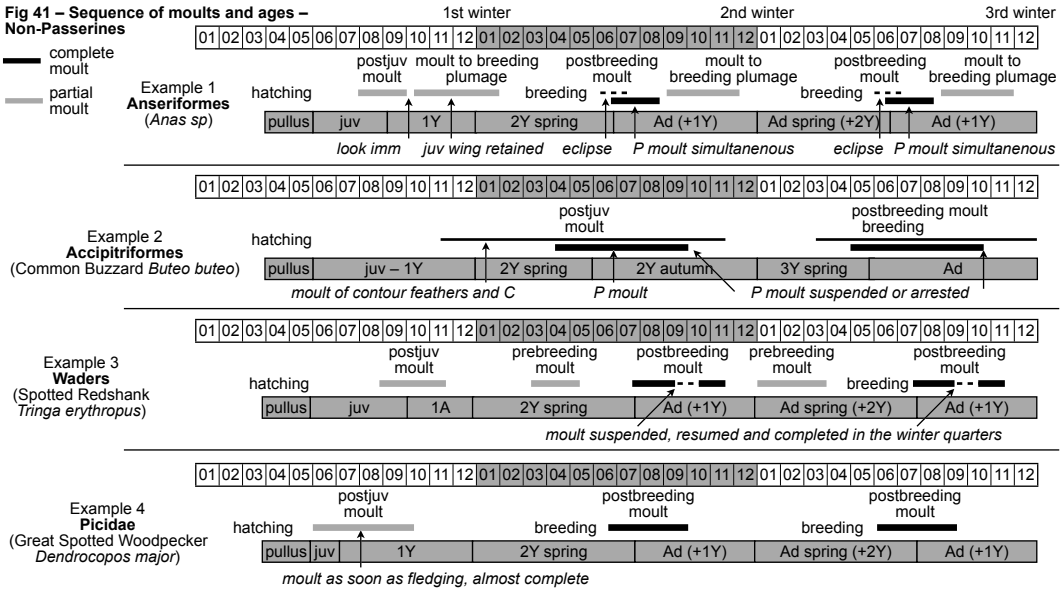


Fig 41 – Sequence of moults and ages – Non-Passerines

complete moult
partial moult



median secondary. It often starts during the breeding period and may be suspended during parental care and/or postbreeding migration.

4.4.4. Waders (Fig 41.3)

Usually, adults moult twice a year: one complete postbreeding (mainly from 08 to 11) and one partial prebreeding (mainly from 01 to 04). Juveniles display either a single postjuvenile partial moult (mainly from 09 to 11), or both a postjuvenile partial moult and a partial prebreeding moult. Second-year birds often start moulting early in spring, thus an individual with a complete non-breeding plumage from 07 – 08 is probably a second-year bird.

Moult generally begins from P11; the loss of 5 or 6 inner primaries is very fast and the following ones fall when inner feathers have grown again. When half the primaries have been renewed, secondary moult starts ascendantly. Tertials are renewed shortly after. In many species, most inner secondaries are then renewed and moult progresses in both directions from the centre of secondaries, otherwise secondary moult is ascendant from S1 and S5, and descendant from tertials. Tail feathers are renewed during secondary moult. Tertials are often renewed a second time during partial body moult.

Moult of remiges may progress in one of three ways:

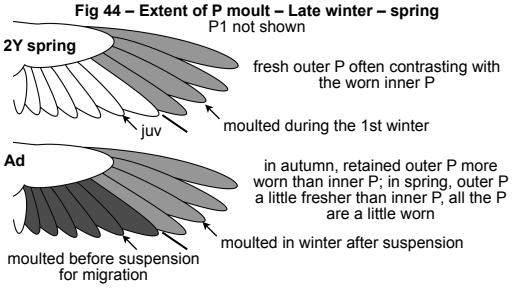
• adults display a complete moult during autumn or winter depending on the date, the period and the extent of migration.

• in many Nordic species, adults start moulting in breeding sites, then suspend and end it in wintering sites (Fig 44). Only the largest species, especially Eurasian Oystercatcher *Haematopus ostralegus*, sometimes arrest the moult of outer primaries (these are retained for 2 years).

• some first winter migrants to the Southern hemisphere may only moult outer primaries and inner secondaries, mostly in wintering sites (Fig 44). A complete descendant moult of primaries may also be observed in first winter birds. Juvenile wing feather moult, especially of coverts and tertials, is delayed in immature birds so wear allows accurate ageing.

Atypically, for some unexplained reason, breeding plumage may be acquired in autumn or early winter in several species. An infirmity may also handicap a bird sufficiently to affect the moult cycle: breeding plumage may consequently be kept in whole or in part.

Fig 44 – Extent of P moult – Late winter – spring
P1 not shown

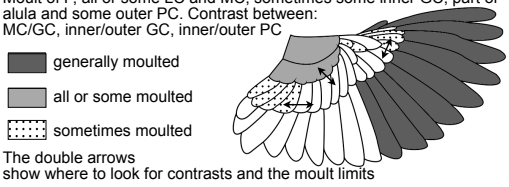


4.4.5. *Picidae* (asynchronous moult of primary coverts; early postjuvenile moult; Fig 41.4)

Adult moult is complete and occurs in summer, ending in autumn – early winter. Moult of primary coverts is not synchronised with corresponding primaries and odd primary coverts are sometimes retained. Secondary moult is divergent from S8 and ascendant from S1. Tail feathers are renewed from TF2 to TF5 and then TF1 (timing of moult may vary for TF6).

Postjuv moult is nearly complete (Fig 45) and starts shortly after fledging or even in the nest. Primaries are moulted descendantly but only some outer primary coverts (or none) are renewed. Secondaries, tertials and all or part of alula and greater coverts are usually retained.

Fig 45 – *Picidae* – Example of postjuv moult
Moult of P, all or some LC and MC, sometimes some inner GC, part of alula and some outer PC. Contrast between: MC/GC, inner/outer GC, inner/outer PC



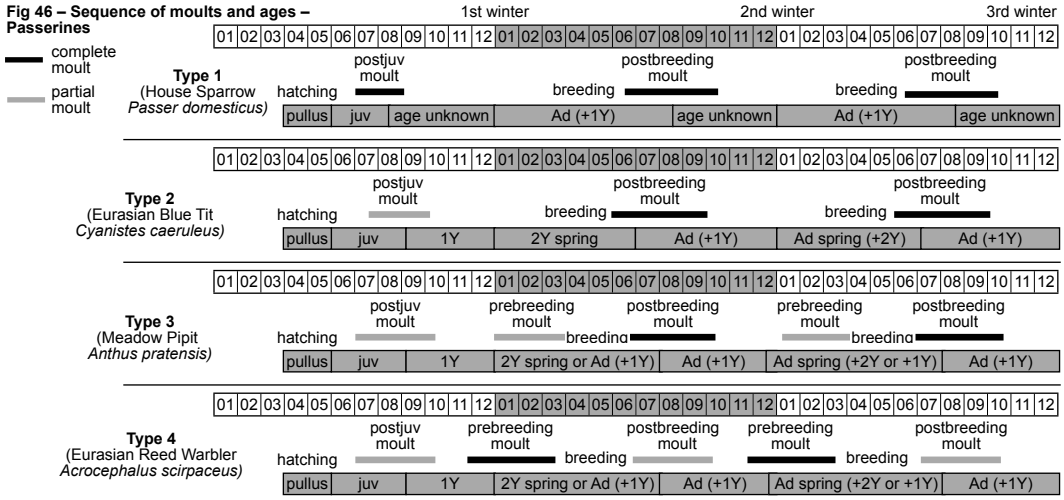
4.5. Moult in Passeriformes

4.5.1. The 4 main types of moult (Fig 46)

• Type 1: juvenile and adult complete moult in summer (Fig 46.1)

This generally concerns sedentary birds. The following species and families are concerned: all *Alaudidae*, Zitting Cisticola *Cisticola juncidis*, Moustached Warbler *Acrocephalus melanopogon*, Bearded Reedling *Panurus biarmicus*, Long-tailed Tit *Aegithalos caudatus*, and all *Sturnidae*, all *Passeridae* and Corn Bunting *Emberiza calandra*. Juveniles of migratory populations of *Fringillidae* may moult completely or almost, as well as a small proportion of *Hirundinidae* and *Sylviidae*.

Fig 46 – Sequence of moults and ages – Passerines



Birds are easy to age before complete moult because structure and colouration of juvenile plumage differs strongly from old plumage, which is very abraded and bleached in adults. Ageing after complete moult is not possible, unless some juvenile feathers have been retained.

- **Type 2: juvenile partial moult in summer (Fig 47); adult complete moult in summer (Fig 46.2)**

During summer, birds displaying active moult of median coverts, greater coverts and tertials and/or regular moult of tail feathers but without any sign of moult in remiges are first-year individuals. Nevertheless, in several species, first-year birds may moult innermost secondaries and/or some primaries. Partial primary moult is usually eccentric and does not start from P10 but from a central primary (often P4 to P6) or may atypically concern the innermost primaries. Birds displaying this type of moult may be recognised as first-year because they do not moult primary coverts corresponding to primaries or do so irregularly, whereas moult of primary coverts and primaries is well synchronised in adult.

After the summer moult, the number of feather generation determines the age of birds: only one generation in adults but two (juvenile and postjuvenile) in first-year birds. This holds in the following spring until the summer moult even if it is less visible because of wear.

The position of moult limits within a set of feathers or among various sets may enable ageing of birds according to the extent of the moult (Fig 47).

It is noteworthy that some adults may atypically retain several old feathers or interrupt the moult, which could be confused with a juvenile moult limit. In this case, retained feathers, which are often the last to be moulted (S6, P2 and P1, and alula) are strongly abraded and bleached (contrast more obvious than in first-year birds).

- **Type 3: juvenile partial moult in summer (Fig 47) and in winter; adult complete moult in summer and partial in winter (Fig 46.3)**

Ageing in autumn is possible according to the same criteria as type 2.

Ageing in spring after prebreeding moult:

a – species with a prebreeding moult restricted to body feathers. As in autumn, wings of adults are composed of a single feather generation (postbreeding) whereas second-year birds display 2 generations (juvenile and postjuvenile). Moult limits within the wing are consequently visible although less obvious than in autumn, because of wear.

b – species with a prebreeding moult including some coverts. Both second-year birds and adults display a moult limit in coverts and ageing is consequently usually impossible. An inspection of the feathers which have not been moulted during prebreeding moult (remiges, primary coverts, often outer greater coverts and tertials, occasionally median coverts and lesser coverts) may allow ageing according to their type: juvenile (only in 2Y), postjuvenile or postbreeding. Juvenile feathers are distinct from adult postbreeding feathers by their abraded and bleached appearance. Postjuv retained feathers are generally impossible to distinguish from adult postbreeding feathers. Without juvenile feathers, ageing may be very difficult in some second-year birds. Prebreeding moult may be less extensive than postjuvenile moult, thus 3 feather generations may occur in coverts. This is typical of second-year birds: eg for greater coverts, from inside outwards, prebreeding, postjuvenile and juvenile. The prebreeding moult process may be more complex with irregular sequences and mixed wear stages. In this case, ageing is not reliable, and it remains better to refrain from ageing.

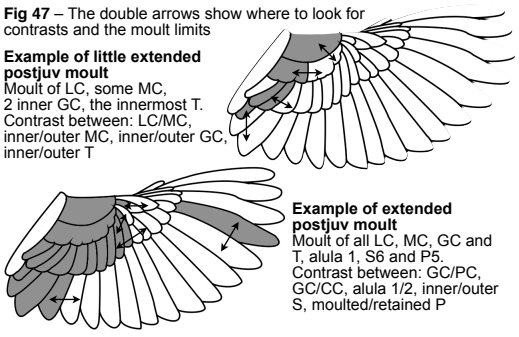


Fig 47 – The double arrows show where to look for contrasts and the moult limits

c – species with a prebreeding moult including some remiges. Some species can interrupt/suspend their postbreeding moult before autumnal migration and thus exhibit a moult limit within the remiges. During winter, adults usually finish the moult of remiges, but immature birds may also moult secondaries or primaries (mostly in an eccentric way). Moult of remiges being highly variable, it does not constitute a reliable feature for ageing. In case of partial moult of primaries, the non-renewal of the corresponding primary coverts usually indicates an immature bird.

- **Type 4: juvenile and adult partial moult in summer and complete in winter (Fig 46.4)**

All species exhibiting this type of moult are long-distance migratory birds wintering in the tropics. Postjuv partial moult is usually restricted to some of the body feathers (sometimes the coverts) or is absent. Postbreeding partial moult is similar, but may include some tertials and tail feathers, occasionally some secondaries or innermost primaries. Ageing in juveniles and adults remains easy before, during and after the partial summer moult because adults exhibit a worn plumage compared to juveniles (it is noteworthy that juveniles born in early spring may exhibit a worn plumage in summer). When a moult limit occurs, it is much more detectable in adults than in first-year birds. Besides, only adults moult the remiges, except in *Hirundinidae.*

Ageing after the complete winter moult remains impossible, except in Woodchat Shrike *Lanius senator* where some second-year birds may retain some primary coverts, some secondaries and the innermost primaries.

It does not apply to Willow Warbler *Phylloscopus trochilus,* or to Brown Shrike *Lanius cristatus,* adults completely moulting both in summer and winter; this also occurs in many Garden Warblers *Sylvia borin* and Pallas's Grasshopper Warblers *Locustella certhiola*.

4.5.2. Sequence of postjuvenile partial moult

The following sequences are the most widespread, even if a large variability occurs. Postjuv partial moult of wing and tail is usually as follows: lesser coverts, median coverts, greater coverts and carpal covert, alula, tertials and tail feathers. Moult of lesser coverts starts from proximal feathers. Lower row moults last and is often retained. Moult of greater coverts starts from GC9 (second after the innermost) and progresses descendantly; GC10 moulting last is often retained. Alula moult starts from the smaller feather. Sequence of tertial moult is highly variable. Moult of tail feathers progresses from inside outwards (except in wagtails, Spotted Flycatcher *Muscicapa striata* and European Goldfinch *Carduelis carduelis*). Usually, juvenile tail feathers are strongly abraded after only a few months or even after a few weeks.

The extent of postjuvenile partial primary moult is asymmetric between wings in approximately 60 % of cases. **During postjuvenile moult, moult of primary coverts does not occur simultaneously with corresponding primaries, which enables distinguishing first-year birds from adults**, even in the case of suspended moult.

Except in some rare species, all juvenile body feathers are renewed during postjuvenile moult.

In Common Starling *Sturnus vulgaris* and Spotless Starling *S. unicolor*, the shape and colour of juvenile tail feathers, throat feathers and mantle feathers differ from those of adult, this distinguishes immature birds from adults despite the complete postjuvenile moult.

4.5.3. Sequence of postjuvenile or postbreeding complete moult

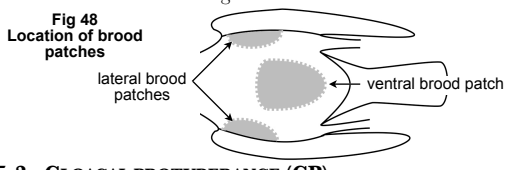
Complete moult starts from the inner primaries. Moult of tail feathers, secondaries and tertials begins after 4 or 5 primaries have been renewed. Tertials and tail feathers stop growing before P3 and P2. The latest feathers to grow are S5 and S6. Moult of greater coverts (except GC10) and carpal covert starts after the beginning of the primary moult, and finishes before (or almost) the beginning of the secondary moult. GC10 is renewed last. Lesser coverts are renewed at the beginning of the primary moult, median coverts during growth of greater coverts, alula and underwing coverts during the second half of the primary moult. Tertials are usually renewed in order T8 - T9 - T7 or T8 - T7 - T9. Body feather moult starts after that of primaries, with the head moulting last.

5. GENERAL SEX CRITERIA

5.1. Brood patch (BP)

Brood patch is a patch of featherless skin that is visible on the underparts, developed just before incubation in most species, usually located in the middle of the belly and/or on each side of the belly (eg waders; Fig 48). Ventral down is lost, revealing a reddish and wrinkled patch of skin with many blood vessels at the surface allowing improved transfer of heat to the eggs during incubation. A few days after hatching, brood patch starts to regress, becoming slightly wrinkled. Then revert to normal unless the species is multi-brooded.

Generally, only females exhibit a clear brood patch (but beware of rare species with reversed breeding roles), even species where brood patch also occurs in males, it remains less obvious than in females. This sexual feature seems to be reliable but, except in Passeriformes and *Anatidae*, information is often lacking and caution is advised.



5.2. Cloacal protuberance (CP)

During the breeding season, the cloaca swells and birds may exhibit a cloacal protuberance. During laying and the following days/weeks, females exhibit a distended cloaca, which is bigger than in males (see European Storm Petrel *Hydrobates pelagicus*). This feature may be useful for sexing, especially in comparing both mates of a pair.

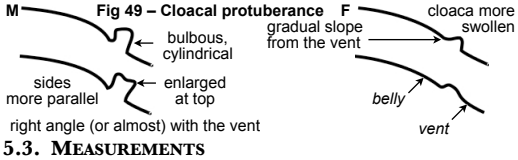
5.2.1. In Anseriformes

Sexing Anseriformes according to the cloacal pattern is reliable, even in juveniles (page 19). However, it requires experience and care because the penis in juvenile males is hard to observe. Adult males exhibit a well-developed penis, measuring 50 to 150 mm compared to ≈ 10 to 20 mm long in juveniles. Observation of the penis involves uncovering the cloaca. In females, the opening of the bursa of Fabricius is observable in juveniles whilst the opening of the oviduct is observable in adults. In juveniles, cloaca is usually translucent but reddish and darker in adults.

To facilitate manipulation, remain seated and keep the bird on its back between your legs, with the head pointed towards you. Open the bird's legs and search for the cloaca with 2 fingers on each hand. Gently press the cloaca to open it and slowly massage from the centre outward until completely uncovered. Usually, this manipulation is quick, but sometimes cloacal examination remains uninformative.

5.2.2. In Passeriformes (Fig 49)

Most passerines can be sexed during breeding season from the shape of the cloacal protuberance. In males, it looks bulbous, cylindrical, at right angle (or almost) with vent. In females, it grows gradually from vent and cloaca is more expanded. Nevertheless, only the most typical birds can be sexed from this feature.



5.3. Measurements

Sexual size dimorphism may sometimes be used to determine sex but it should be used with caution. Available data may come from a small sample size or the overlap may be large; aberrant individuals or migrants from other populations (see Bergmann's and Allen's rules) cannot be excluded. The comparison of both members of a pair should also be used with care, same sex pairs not being unusual. Only extreme measurements far from overlap range should be used for sexing. Moreover, combination of various measurements allows drawing up discriminant functions to classify individuals, eg:

Following formula valid for adults in Spain (3 % error): male if $0.26 \times$ *head and bill* $+ 0.35 \times$ *wing* $- 48.78 > 0$ (implies female if < 0)

Importantly, use of these formulae requires a sufficient sample with known sex and is only valid in a restricted area (eg seabird colonies). A formula should consequently be created for each study area or at least the validity of available formulae should be tested.

5.4. Bare parts

See chapter 6.4.

6. GENERAL AGE CRITERIA

6.1. Terminology

To date there is no universally recognised method to record age, and every commonly used method is open to criticism. Thus, it is advised to use the method which is advocated in the country in which the ringing survey is conducted. In this guide, age is determined following calendar years, ie from birth to 31 of December for the first year (1Y), from 1st of January to following 31 of December for second year (2Y) and so on (chapter 4.1). The EURING age codes (Fig 33 page 11) are added in brackets after the headings of each paragraph of sections 'Moult', 'Sex' and 'Age'. In the 'Moult' section, the EURING age codes 3/5 and 4/6 do not indicate that the birds can be separated into these ages following completion of the winter moult. They are used simply as shorthand to indicate '1Y autumn/2Y spring' and '+1Y autumn/+2Y spring'. For ageing of species see data under the 'Age' section.

The term 'juv' is applied to birds with a complete first plumage, before postjuvenile moult. Depending on the groups, this moult may start before fledging (eg Piciformes) or only during first winter and even following spring-summer (eg some raptors). However, in Passeriformes; it is recognised that a juvenile has not started to migrate, which provides important information about its origin. If in doubt, ageing a juvenile as a first-year bird is advised. The limit between juvenile and first-year stages is recognised when at least 90 % of juvenile feathers which should be renewed during postjuvenile moult are replaced by postjuvenile feathers. The extent of postjuvenile moult is consequently important to consider, and a lot of information is given hereafter on this topic for each species. Some exceptions must be considered: eg during eruptions, the Great Spotted Woodpecker *Dendrocopos major* stops postjuvenile moult during migration, and thus exhibits traces of juvenile plumage for several months.

The term '1st winter' (and following ones) is commonly used as it is not confusing. On the other hand, the term '1st summer' (and following ones), which is applied to birds living in their second calendar year is not used in this guide. Seasons do not correspond to precise periods between fixed dates (eg from 21 of March to 20 of June for spring), but may be defined after the timing of moult if it occurs (Fig 33 page 11).

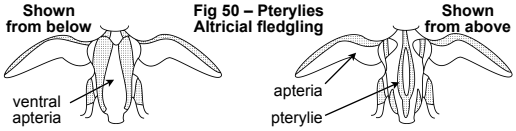
The term 'imm' is applied to every plumage between juvenile and adult stages and is characterised by the presence of juvenile and postjuvenile feathers simultaneously. The term 'sub-ad' is used to describe the stage before adult plumage without precise ageing (species which acquire their adult plumage through several years).

The 'adult' plumage is definitely acquired and does not change the appearance (or only slightly) with age and successive moults, except between seasons: breeding, non-breeding and sometimes eclipse plumages.

The terms 'imm' and 'adult' are not necessarily linked to sexual maturity: in second-year spring, most Passeriformes can reproduce while they still exhibit juvenile feathers; conversely, long-lived species which reproduce later in age (some Procellariiformes or large raptors) may exhibit adult plumage before first breeding.

6.2. Apteria and pterylae (Fig 50)

Feathers do not uniformly cover the birds body but are grouped in pterylae (tracts) separated by apteria (bare skin) covered by downy semiplume feathers. Juvenile apteria are featherless, which is characteristic of this age class. Ventral apteria is obvious in juvenile Passeriformes, which is useful for ageing. Be careful not to mistake it with a brood patch: featherless abdominal skin of juveniles is uniformly smooth while brood patch skin is wrinkled and vascularised (chapter 5.1).



6.3. Moult and feather appearance

6.3.1. Moult limits

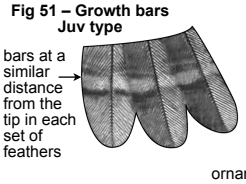
Ageing requires a good understanding of moult sequence (chapter 4). Appearance and wear of feathers, especially remiges, tail feathers and coverts usually allow determining their generation (juvenile, postjuvenile, prebreeding, postbreeding…). A contrast between various feather generations may be very useful for ageing. Postjuvenile feathers are typically brighter, have more contrast and are longer (especially greater coverts) than juvenile corresponding ones. This is easier to distinguish if a moult limit occurs within a set of feathers. Comparison of 2 sets of feathers is sometimes possible (eg postjuvenile greater coverts and juvenile primary coverts; Fig 47 page 14). This contrast is less obvious under direct solar light. Juvenile remiges are shorter, narrower and more pointed than adult ones, except in large species, especially in raptors in which juvenile remiges are far longer than adult ones. During complete moult, S1 is usually renewed while primaries are already half-moulted (chapter 4.5.3), which leads to P1 being slightly more worn than S1 after moulting.

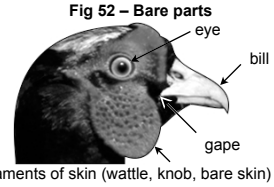
6.3.2. Growth bars (Fig 51)

Feather growth, especially structure and colouration, may be altered by nutritional deficiencies. Irregularities are equally observable on all feathers growing simultaneously within a set. Two distinct types may be distinguished, depending on feather growth rate:

- juvenile type: bars are located at a similar distance from the tip in each set of feathers (remiges, tail feathers and primary coverts), every feather growing simultaneously within a set;
- postjuvenile type: bars are misaligned between feathers within a set, each feather growing sequentially.

Growth bars are obvious on tail feathers, but do not constitute a sufficient age criterion. Moult may occur simultaneously for all tail feathers in adults of some species; besides, unexpected accidental loss of tail feathers may occur. Some bars of postjuvenile type may be considered as an evidence of postjuvenile plumage.





6.4. Bare parts (Fig 52)

Bare parts include all parts of the body which are not covered by feathers, like bill, gapes, eyes, legs, skin ornaments (crest, knob…).The following criteria are often variable and difficult to judge accurately, their use remains tricky. Besides, colour of bare parts may evolve over time. It consequently requires long experience of the species.

6.4.1. Iris colouration

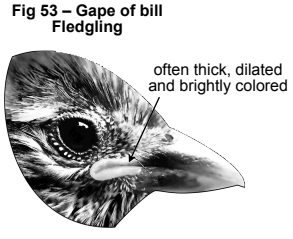
Iris colouration may vary with age, sex or season: generally duller and darker in juveniles than in adults and in females compared to males. Under strong light, pupils contract and iris pigments are consequently more spread, leading to a paler iris. Conversely, under low light, pupil dilation forces pigments to aggregate in a confined circle, leading to a darker and more colourful iris.

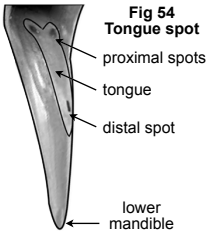
6.4.2. Bill colouration

Bill is generally duller in juveniles than in adult, particularly in species with a brightly coloured bill. Variation may also occur in adults between breeding and non-breeding seasons or according to seasonal diet.

6.4.3. Bill gapes (Fig 53)

In juveniles, bill gapes are usually thick, dilated and may also be brightly coloured. However, this appearance does





not last long after fledging and is consequently only usable for ageing for a short period. Moreover, some species still exhibit a slight gape into adulthood.

6.4.4. Tongue spots (Fig 54)

In several species, dark marks may occur on the juvenile tongue (usually at the base). These marks fade during growth becoming absent in adults. Nevertheless, they may disappear at various rates, and may still occur in some adults.

6.4.5. Mouth colouration

In juveniles, mouth colouration may be different from adults. However, an important inter-individual variability may exist within a given species.

6.4.6. Appearance of the legs

Juvenile legs look soft and swollen; they are harder and thinner in adults, because of shrinkage of the cartilage during tarsus ossification. Juvenile appearance of the legs does not last long after fledging and is consequently usable for ageing for only a short period. Leg colouration may vary during growth but remains difficult to judge. Young of some species may take a different ring size to adults.

6.5. In Anseriformes

6.5.1. Penis size

Males may be aged depending on the appearance and size of their penis (chapter 5.2.1 and page 19).

6.5.2. Shape of the feathers (page 19)

Some new juvenile tail feathers exhibit down on their tip. As it rapidly wears away, a V-shaped notch with bare shaft remains on the tip, this is particularly obvious for central tail feathers. This pattern is typical of juveniles, even though adults may exhibit tail feathers with broken tips (particularly in diving ducks), but in that case, they are without the bare shaft. Adults have wider and larger feathers (especially the coverts) with brighter and more contrasted colours. Juvenile outer coverts and remiges are usually retained until the complete moult occurring in the summer of the second-year.

6.5.3. Tertial coverts

Innermost median coverts and greater coverts may be useful in ageing. They are called 'tertial coverts' (chapter 6.6.1).

6.6. In Waders

6.6.1. Tertial median coverts (Fig 55)

Inner median coverts are the most useful feathers to age waders, other than primaries (chapter 4.4.3). This group designated as 'tertial median coverts' includes the innermost coverts, right in front of the tertials, and sometimes some inner greater coverts.

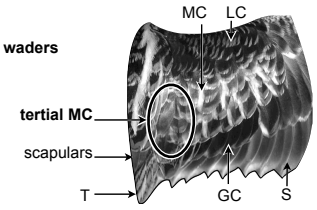


Fig 55
Location of tertial MC in waders

6.6.2. Wear of wing feathers

Coverts, scapulars, tertials and upper feathers often exhibit some pale areas (fringes, bars, marks...), which look buff or yellowish in juveniles but more white in adults. Wear of these pale areas is a reliable feature to distinguish juvenile and first winter birds in many waders. Even if pale marks have been lost, the notches left still reveal the original pattern (Fig 56). A scoring system is used to quantify wear of primaries on 4 levels (Fig 57), allowing estimation of age and discriminates some populations with various moulting rates. Wear is noted as an exponent of the primary number.

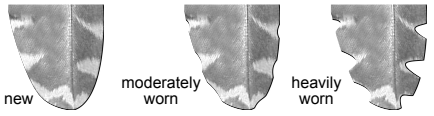
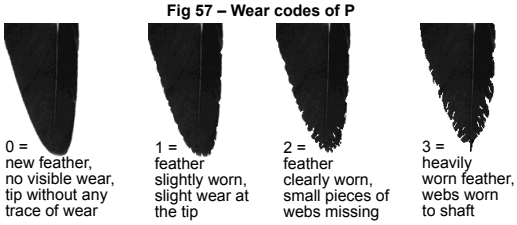


Fig 56
Wear of light areas on the C

Fig 57 – Wear codes of P



Example: $3^3\ 4^2\ 2^1\ 1^0$ =

- the 3 outermost primaries are strongly abraded, code 3
- the 4 following primaries are significantly abraded, code 2
- the 2 following primaries are slightly abraded, code 1
- the innermost primary is new, code 0

In juveniles, because all remiges grow simultaneously, outer primaries and tertials are most vulnerable and consequently most worn. In adults, wear is more uniform because inner primaries grow first and are several weeks older than outer. This is particularly obvious when the moulting process is slow. If moult is suspended, two stages of wear may occur (inner primaries renewed before suspension more abraded than outer ones; Fig 44 page 13).

In spring, there is a risk of confusion between adults which have finished the moult of primaries after having suspended it and immature birds which have renewed only the outer primaries during winter. Indeed, in both cases, outer primaries look newer than inner ones. However, in immature birds, inner primaries are more abraded than in adults, and wear is consequently more contrasted (Fig 44 page 13).

In autumn, before postbreeding moult, some second-year birds may easily be distinguished from first-year and adults (+2Y) by the pronounced wear of juvenile remiges, compared to the new plumage of first-years and stronger feathers of adults. Be careful of adults which have stopped the moult of outer primaries during previous winter and consequently exhibit much abraded feathers.

6.7. In Passeriformes

6.7.1. Skull pneumatisation (after Jenni & Winkler 1994)

Skulls of Passeriforme fledglings comprise a single layer of bone. Later, a second bone layer is formed under the first one, linked by tiny bony struts, with air circulating between both layers. In European Passeriformes, complete skull pneumatisation (also called 'ossification') requires from 2 to 8 months depending on species. Thus, an incomplete pneumatisation is characteristic of juveniles (except in rare species in which adults exhibit incomplete skull pneumatisation like Eurasian Nuthatch *Sitta europea*, several *Hirundinidae* and Yellowhammers *Emberiza citronella*). Unpneumatised parts with only a single bone layer (called 'windows') look pinkish or reddish and rather translucent while pneumatised parts appear milky white and dotted (dots are the points of attachment of the bony struts). Identification is easier if the demarcation line where the two areas meet is visible.

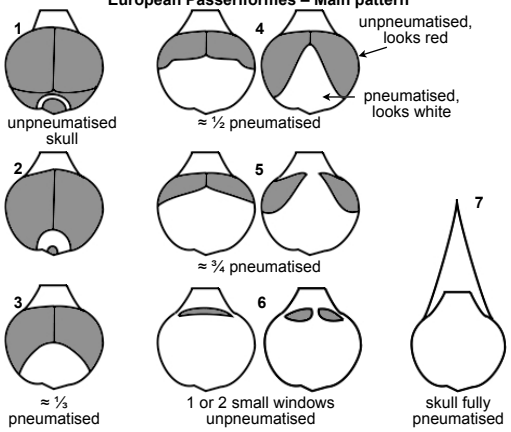
Examination is conducted by keeping the bird in standard ringers grip. With a wetted index finger (using water is better than saliva to preclude risk of infection); the crown feathers of the bird are parted just beside the midline. Blowing on the feathers may help to locate this line and may sometimes be sufficient for visual examination through bare skin but moistened skin is more translucent. Skin can be moved around to locate the demarcation line, but this

should be conducted **with care** to prevent internal bleeding. A strong light source like direct sunlight is required. Examination remains difficult during the moult of skull feathers. In some species like shrikes, *Corvidae*, crossbills and Hawfinch *Coccothraustes coccothraustes*, the demarcation line is impossible to see because the skull is too thick.

Pneumatisation generally starts from the occipital region and finishes in the more frontal part of the head (Fig 58). For most studied species, best dates for usable and reliable criteria are given, even if variability may occur in the progress of pneumatisation among individuals or depending on extrinsic factors (in regions where laying dates are earlier, pneumatisation may be complete before cited dates). Thus it is advised to only identify immature birds unless well experienced. Seven stages of pneumatisation are recognised (Fig 58), from stage 1 which denotes the unpneumatised skull roof to stage 7 which denotes the fully pneumatised skull roof. Further details are given for most species. 'Reliable' means that no first-year bird exhibits a fully pneumatised skull roof at indicated date. 'Useful' or 'usable' mean that if skull roof is not yet fully pneumatised at indicated date then this is a first-year bird. If skull roof is fully pneumatised, it may be a first-year bird or an adult. The progress of pneumatisation may vary; figure 58 shows the most widespread sequence.

Other orders have been poorly studied. In some cases, as it occurs in *Phalacrocoracidae*, pneumatisation is not age related but depends on skull size.

Fig 58 – The 7 stages of the pneumatisation of the skull in European Passeriformes – Main pattern



6.7.2. Characteristics of juvenile plumage

Sexing and ageing correctly require that the bird has already conducted postjuvenile moult. For example, a juvenile Eurasian Blackcap *Sylvia atricapilla* may easily be mistaken for adult female: brown crown, no clear contrast in wing, new plumage. The juvenile plumage characteristics are given below:

• *body feathers*: juveniles shortly after fledging exhibit an incomplete plumage (pterylae are less developed and featherless areas occur for a long time), particularly in the belly (which looks like a smooth brood patch; chapter 6.2) and underwing.

• *feather structure*: juvenile body feathers are softer, more loosely textured, less structured and less pigmented than postjuvenile ones. They have fewer and more widely spaced barbs and barbules, especially on the feathers of the neck, the mantle and the undertail coverts and the flanks. In a few species, juvenile body feathers are of relatively firmer structure.

• *general colouration*: head, nape, mantle and belly are buff or yellowish coloured with poorly pigmented dark colours (remiges and tail feathers obviously darker and brighter in adults).

• *bare parts*: the appearance of bare parts may also help to discriminate, especially iris colouration, tongue spots, bill gape flanges (chapter 6.4).

Juvenile feathers are easiest to find in undertail coverts and nape. The last body feathers to be moulted are located in the vent, flanks and head, which are priority areas to detect juvenile signs.

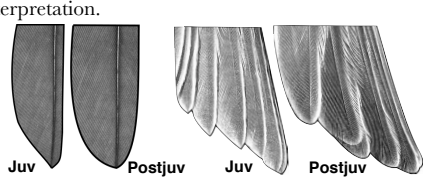
6.7.3. Moult contrast

A contrast between the various feather generations may be useful for ageing (chapter 4 and 6.3).

6.7.4. Shape of remiges, tail feathers and primary coverts

Juvenile tail feathers and primaries are usually narrower, more pointed and less pigmented than adult ones (Fig 59). Juvenile remiges and tail feathers are shorter, except P1 which may sometimes be longer than in adult. Juvenile primary coverts are also narrower, more pointed, more loosely structured and less brightly coloured than postjuvenile ones. As primary coverts are generally retained during partial postjuvenile moult, they may be useful for ageing. Variations being subtle, it requires experience and care in interpretation.

Fig 59 Examples of TF shapes according to age



juv TF narrower and more pointed, less pigmented, wearing more easily

6.7.5. Wear of flight feathers

In species where a postjuvenile partial moult and a postbreeding complete moult occur, wear of tail feathers may be used for ageing, as juvenile feathers wear out more quickly than adult ones. Nevertheless, because all or some of the tail feathers may be renewed during postjuvenile partial moult, an adult appearance does not constitute a reliable age feature. An examination of the outer primary tip remains better: usually kept in good shape in adults (wear score 0; Fig 57 page 17) until at least mid-winter, while already worn (score 1 or 2) by the end of autumn in immature birds. Using this feature requires experience.

7. REFERENCES

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