

# Part 3



## Feathers

## Introduction

This part of the book provides an introduction to feathers, and includes colour photographs of the wing and tail feathers of 23 species of birds of prey (including the raven as an 'honorary' raptor) which occur regularly in Britain and Ireland, and one further species (the eagle owl) which has recently begun to breed. These photographs have been very kindly supplied by Marian Cieślak, co-author of the excellent field guide *Feathers: Identification for Bird Conservation*, from the Natura Publishing House (Cieślak & Dul, 2006).

The discovery of a feather, whether moulted, found with a kill, or even present in a pellet, provides evidence for the presence of a bird species. Cast feathers can also provide information on: age (for species in which juvenile plumage differs from adults); sex (for sexually dimorphic species); the individual (based on individual patterning or if DNA from the feather can be matched to other samples from a bird); and cause of death (if for example shot-holes are seen in the feather web) (see also Section 5.2.4 of Introduction).

Fieldworkers are most likely to come across wing or tail feathers of their target raptor species as these are the largest and strongest feathers and prove most persistent in field conditions. Such feathers are likely to be lost as part of the moult cycle, as many raptor species begin their moult during the breeding season.

## Wing and tail feathers

The arrangement of wing feathers (remiges) and tail feathers (rectrices) for a bird of prey is shown in Figure 44. The longest wing feathers are the primaries which extend from the carpal ('wrist') joint towards the wing tip. They are assigned the letter 'P' and generally numbered from the carpal joint to the end of the extended wing. This is the descendant numbering system (Ginn & Melville, 1983), although it should be noted that some books and scientific papers use an ascendant system whereby primary feathers are numbered from the wing tip to the carpal joint (and it is therefore important, when referring to primary feather numbering, to indicate which system is being used). The shorter secondary flight feathers grow from the ulna (forewing bone); these are assigned the letter 'S' and always numbered from the carpal joint inwards towards the body. The innermost secondaries are also referred to as tertials or tertiaries, especially for passerine birds such as the raven (Redfern & Clark, 2001). The primaries and secondaries together form the lifting surface of the wing. Tail feathers are assigned the letter 'T' and numbered from the central pair of feathers outwards.

All diurnal raptors, owls and the raven have 10 functional primaries on each wing and 12 tail feathers. A vestigial eleventh primary (P11) is present in most raptor families except the true hawks (Accipiters). The number of secondaries is more variable, increasing with the size of the bird and wing length (for the species featured in this book ranging from 10 (6 secondaries and 4 tertials) in the raven, 11 in falcons, 13-14 in kites, harriers, hawks and buzzards, 17 in the golden eagle to 20-21 in the osprey; Ginn & Melville, 1983).

## Feather morphology

Wing and tail feathers are forms of the contour feathers that make up the visible plumage of adult birds. They comprise a central shaft and a web or vane. There is some variation in the terminology applied to feather structure (Figure 45). In the nomenclature used by Cieślak & Dul (2006), the term shaft is applied to the portion of the axis of the feather that,

in life, protrudes from the skin, and the lower part which penetrates the skin and provides attachment is termed the calamus or quill. The calamus is separated from the shaft by a residual piece of skin termed the collar which is visible and/or detectable by touch. Under alternate terminology, the feather shaft may be divided into the rachis (between the webs) and the calamus at the base, below the web (e.g. Brown *et al.*, 2003). The term quill may also be more loosely applied to the entire feather stem, or to an entire feather, especially a wing or tail feather (Campbell & Lack, 1985).

The webs which form the lifting surfaces of the wing and tail feathers are formed from barbs extending out from the shaft at an angle and lying parallel to each other. The barbs link together by means of hooklets and barbules. This construction ensures the elasticity of the feather web as well as the capacity of the barbs to re-establish linkage if the continuity of the web is interrupted. The part of the feather web on the side nearest the base of the wing or the tail axis is known as the inner web; the outer web lies on the other side of the shaft.

The outer primaries of most birds of prey have characteristic notches in the upper part of the two feather webs (Figure 44), known as emarginations on the outer or leading edge, and notches on the inner web (Redfern & Clark, 2001; Ferguson-Lees & Christie, 2005). Alternatively, the indentation on the inner web may be termed an 'inner emargination', and that on the leading edge the 'outer emargination' (Brown *et al.*, 2003; Cieślak & Dul, 2006). The extent and shape of the two emarginations facilitate the determination of the position of outer primaries on the wing and may also be useful in species identification. The inner primaries are rather uniform in shape. An indication of the place they occupied on the wing may be gained from their size as well as the angle of the upper edge of the inner web (always least sloping on primary 1).

Outer secondaries arch inwards towards the base of the wing; moving towards the wing base, secondaries become progressively straighter and shorter. Inner secondaries/tertiaries may even bend in the opposite direction, towards the wing tip.

The central feathers of the tail are the most symmetrical and may differ from the others in colouration. Moving away from the centre of the tail, the feathers tend to become progressively more asymmetrical in the widths and sometimes the colouration, of the two webs.

## Moult

Moult in birds is the process whereby old feathers are shed and replaced by new ones. In Europe, a wide range of bird species undergo an annual moult during which all body, tail and wing feathers are replaced over a relatively short time (3-4 months). Furthermore, during the period when the primary wing feathers are being replaced, all other wing, tail and body feathers are moulted. Thus, primary moult extends over the full duration of an annual moult period. Primary moult normally commences with the dropping of the innermost primary (P1) and progresses descendantly towards the outermost one (P10), with two or more feathers in moult at the same time. In resident species and short-distant migrants, the moult is timed to begin immediately after breeding in mid-summer and is completed before the onset of winter. Many long-distant migrants delay the start of moult until they reach their winter quarters.

Birds of prey have to maintain hunting and therefore flying efficiency during wing moult. Primary moult is therefore protracted with only one or two primaries in moult simultaneously. Moreover, with the exception of a few long-distance trans-Saharan migrants, moult begins at

the start of the breeding season. Female birds of prey do most if not all of the incubation and brooding of young. Primary moult normally begins during egg laying and this early stage of primary replacement is timed to coincide with the females' period of relative inactivity. Males need to maintain flying skills while they are provisioning incubating females, and start their moult several weeks later. Both sexes may stop moulting (arrest moult) during chick rearing but recommence once the young fledge. Smaller species complete their moult within one year whereas larger species may take two or more years

In most species of diurnal raptors, owls and the raven, the moult of primary feathers follows the standard pattern, commencing with the first primary (P1) and proceeding to the wing tip (P10). There are some exceptions: moult in the falcons generally begins with the fourth primary (P4) and progresses sequentially along the wing inwards (ascendantly) and outwards (descendantly); in the barn owl primary moult begins with P6 and progresses ascendantly and descendantly; and in adult golden and white-tailed eagles primary moult occurs in an apparently irregular sequence. In all species, patterns of moult for secondaries and tail feathers tend to be more variable than for the primary feathers (e.g. see Ginn & Melville, 1983; Baker, 1993).

For the purpose of moult, the diurnal raptors that occur regularly in Britain and Ireland can be separated into three groups: (i) species that have an annual moult that begins at the start of the breeding season; (ii) the summer visitors that moult in winter quarters but may shed the occasional wing or tail feather on their breeding grounds; and (iii) the larger species whose wing moult is protracted and can extend over two, three or more years. Table 9 lists the species in each category. Moulting strategies in owls are slightly different, as shown in Table 10. In the raven the annual moult begins in March/April and is completed by September/October (Ginn & Melville, 1983).

**Table 9.** Primary moult pattern in British and Irish diurnal raptors

Resident and partial migrants with complete primary moult commencing in the breeding season	Migratory species with complete primary moult mainly in winter quarters	Partial primary moult commencing during breeding season, suspended during winter and completed over 2 or more years
Red kite Marsh harrier Hen harrier Goshawk Sparrowhawk Kestrel Merlin Peregrine	Honey-buzzard Montagu's harrier Hobby	White-tailed eagle Buzzard Golden eagle Osprey <sup>1</sup>  <sup>1</sup> moults also in winter quarters, suspends during migration

These species-specific patterns of moulting during the breeding season can provide valuable clues to the observant fieldworker. The presence of one or more freshly moulted inner primaries and/or outer secondaries in suitable habitat during the spring or summer may indicate an active breeding attempt and/or the presence of a nearby nest site. For females incubating or tending small young, these cast feathers will be very close to the nest, below a perch or plucking post. Moulded body feathers and wing coverts may also be present. The presence of moulded wing feathers at or near an empty nest that bears no signs of young being reared will

almost certainly indicate a failed breeding attempt where eggs had been laid. Even during the autumn and sometimes through to the following spring, the largest and strongest primary and tail feathers can still be found and provide useful clues to a previous breeding attempt. However, a few moulted feathers with no other signs may indicate the presence of a non-breeding immature or an adult at some distance from its nest.

**Table 10.** Primary moult pattern in British and Irish owls

Partial primary moult post breeding, completed over 2-3 years or *6-8 years	Complete primary moult commencing in the breeding season	Complete primary moult commencing after breeding
Barn owl Tawny owl Snowy owl Eagle owl *	Little owl	Long-eared owl Short-eared owl

## Introduction to the feather plates

The colour plates show the wing and tail feathers for the adult plumage forms of 23 raptor species, including separate photographs for males and females of sexually dimorphic species.

For each species, the plates show feathers from individuals of typical colouration. Subject to availability, a full set of primaries is included along with 2-5 secondaries, (the outermost, one or more centrally located and inner secondaries). If tail feathers or rectrices differ markedly from each other then a full set from one side of the tail is included; otherwise some rectrices are excluded. Where possible, the feathers are numbered according to the formula shown in Figure 44, to indicate their location on the wing or tail. The positions of 'missing' feathers from a set of primaries or rectrices are marked by matchsticks so that the positions and numbers of remaining feathers can be determined.

In most cases the photographs show the feathers from a single bird. If a set of remiges or rectrices is incomplete and has been augmented by feathers from another bird, this is noted in the figure caption and the quill of the 'odd' feather(s) is marked by a red band.

To give an indication of size, feathers have been photographed against a scale of 2 cm intervals (marked at 10 cm intervals at the side of each plate). It is important to note, however, that measurements from this scale are not precise because the lower 1-4 cm of feather shafts have been inserted into polystyrene bases. For the purposes of identification, the reader is therefore encouraged to seek more precise details of feather dimensions.

## Identification of species

The plates illustrate the feather patterning for the birds of prey that fieldworkers are likely to encounter in Britain and Ireland, and provide a starting point for species identification. The first step in this process is to identify the type of feather which has been found – specifically whether it is a primary, secondary, tail or other feather (a covert or other body feather). For wing and tail feathers suspected to belong to a bird of prey, the size, colour and patterning can be compared with the photographs presented in this book.

To measure a feather accurately, it should be placed on a ruler, ideally with a stop ridge at the zero end (e.g. like the rulers available for wing measurements of birds) with the tip

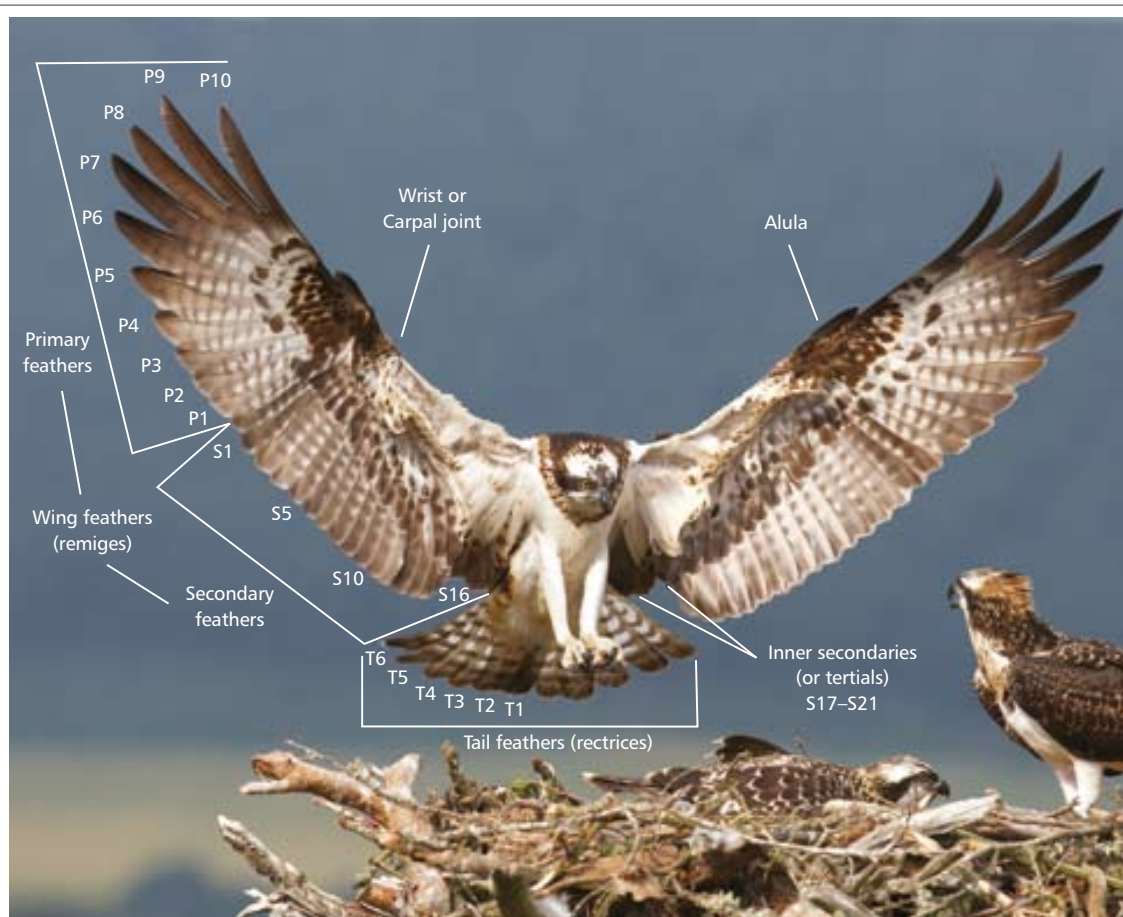
of the calamus on the zero. The feather should then be gently smoothed so it lies flat on the ruler, and the reading taken from the feather tip (Brown *et al.*, 2003). Details of mean, minimum and maximum lengths of wing and tail feathers for diurnal raptor species, together with sample sizes, are provided by Cieślak & Dul (2006). Brown *et al.* (2003) also provide lengths for individual wing and tail feathers for all species for which feather illustrations are provided.

With regard to species identification, caution is required as the barred wing and tail feathers of diurnal birds of prey and owls are similar to each other. In addition, there may be great variation in feather colouration between the different age categories and also, in some species, between individual adults (e.g. buzzard). Raptor feathers can also be easily confused with those of some species of game-birds, particularly pheasant.

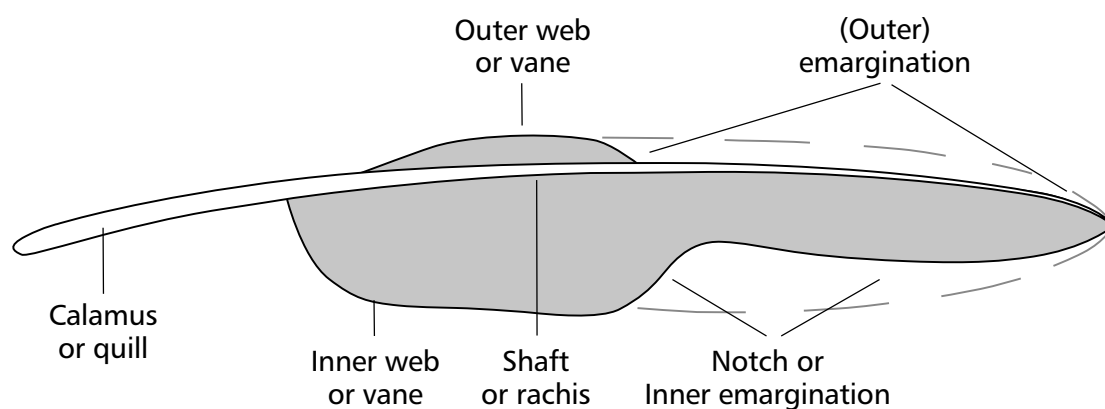
In the space available it has not been possible to provide photographs illustrating juvenile plumages or the range of plumage variation in individual raptor species. For further details of intra-specific feather variability and possible confusion between species, as well as the process of identifying feathers, raptor fieldworkers are encouraged to refer to Cieślak & Dul (2006). Other useful sources of reference include Brown *et al.* (2003), Baker (1993) and two good websites with many photographs of feathers of European bird species, including raptors, at [www.faunoekjmueller-magdeburg.de/FederSlg\\_\\_Ubersicht/federslg\\_\\_ubersicht.html](http://www.faunoekjmueller-magdeburg.de/FederSlg__Ubersicht/federslg__ubersicht.html) (in German) and [www.michelklemann.nl/verensite/start/index.html](http://www.michelklemann.nl/verensite/start/index.html) (an English version of a Dutch website). For some raptors (and other bird species), the latter references and websites provide illustrations or descriptions of other body feathers besides wing and tail feathers. In addition, [www.ibercajalav.net/recursos.php?codopcion=2251&codopcion2=2501](http://www.ibercajalav.net/recursos.php?codopcion=2251&codopcion2=2501) (an English version of a Spanish website) includes close-up photographs of the plumage of raptors and other bird species, illustrating sex and age differences.

In addition to natural variability within a species, exposure to sunlight, water and the rigours of flying and feeding cause feathers to fade and wear, resulting in changes in colour and shape in worn compared to fresh feathers. Furthermore, once a feather is moulted or otherwise lost from a bird's body its appearance is likely to deteriorate due to the exposure to weather, chewing by mammals and insects and/or colonisation by algae and fungi.

In developing feather identification skills, it is recommended that field workers get to know the flight and tail feathers of their study species before progressing to less familiar ones. In addition to the photographic plates of feathers presented in this book and other guides to feather identification, reference collections of feathers compiled from identified remains (e.g. road kills) can be of considerable value (see Section 5.2.4 of Introduction for advice on collecting and storing feathers).

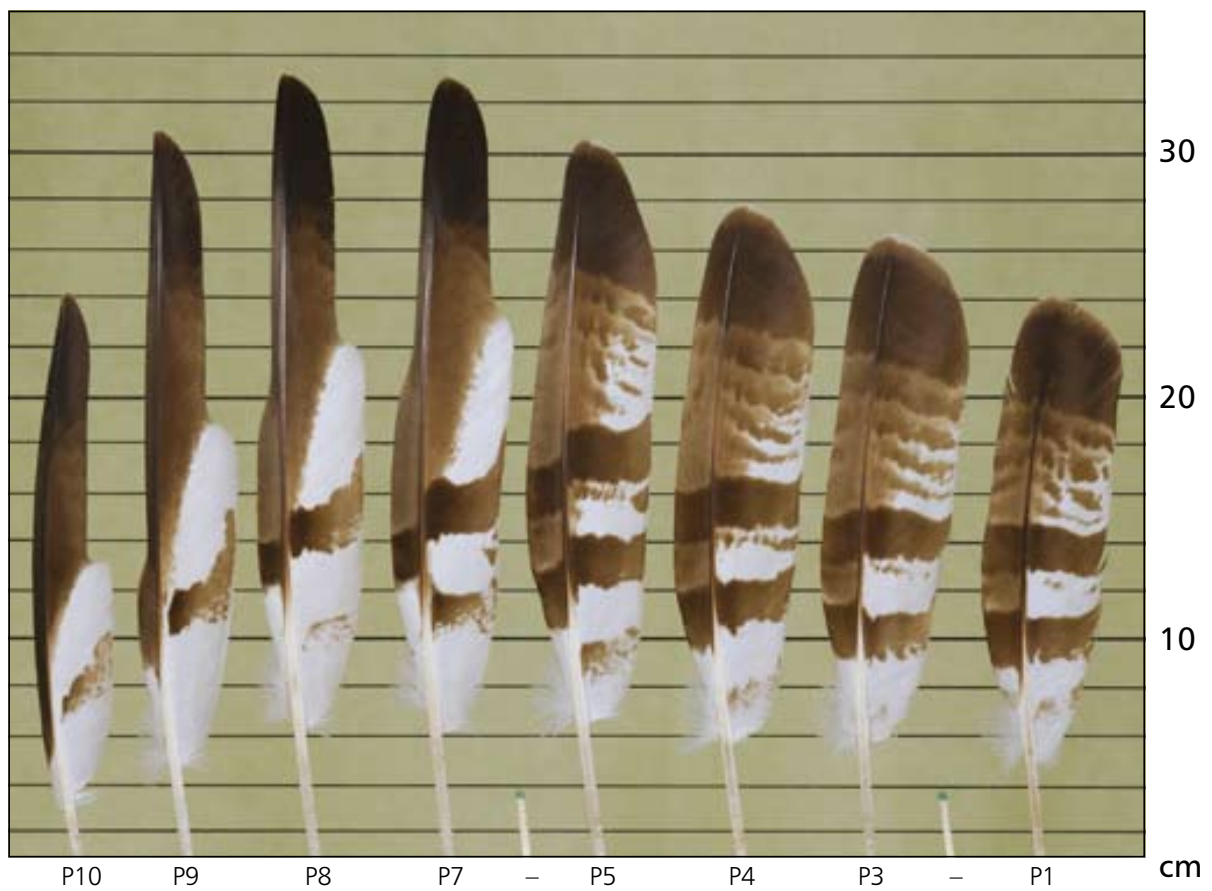


**Figure 44.** Female osprey alighting on nest (photo, Mark Hamblin) illustrating the location and nomenclature of wing and tail feathers. The central tail feather (T1) on the bird's left hand side appears to be missing. Two of the secondaries (S1 and S2) are notably darker and have been recently replaced. Other relatively dark secondaries could have been moulted the previous winter and may be less than 6 months old; whereas those that appear bleached (e.g. S3, S4 and S12 on the right wing) are likely to be much older. Primary and secondary moult in ospreys, as in other very large birds of prey, is a protracted affair that extends over several years (Tables 9 and 10). The alula consists of 3–5 short feathers and functions like the leading edge of an aircraft to provide lift to the wing in unsteady manoeuvres, such as landing.

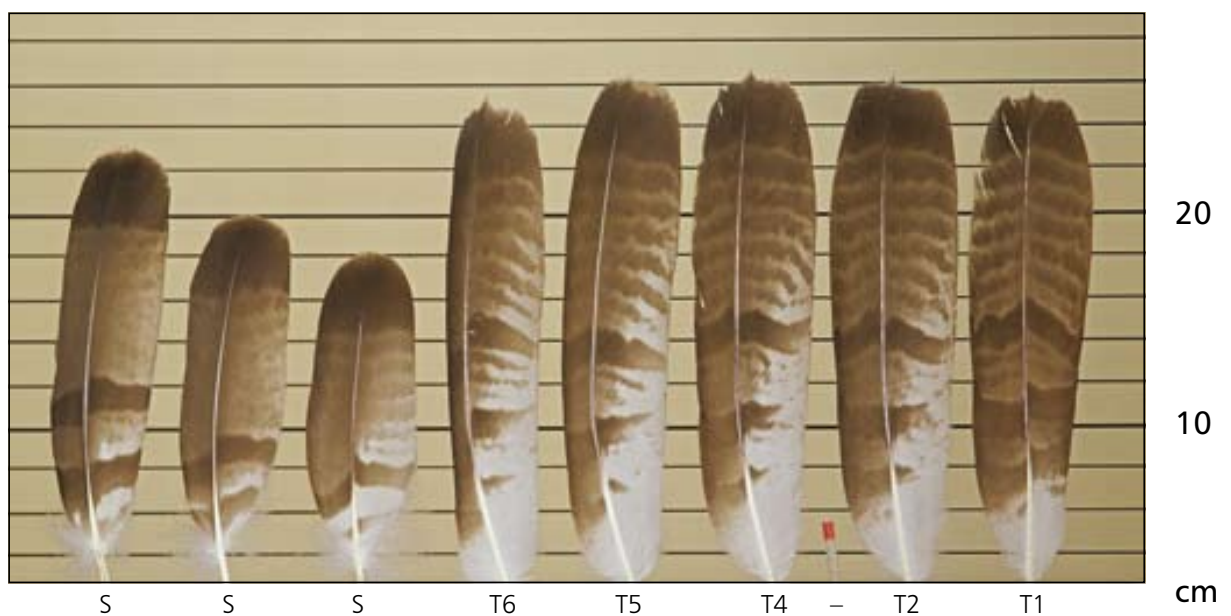


**Figure 45.** Feather morphology (after Cieślak & Dul, 2006).

## Honey-buzzard



**Plate 1.** Primaries of adult male honey-buzzard.



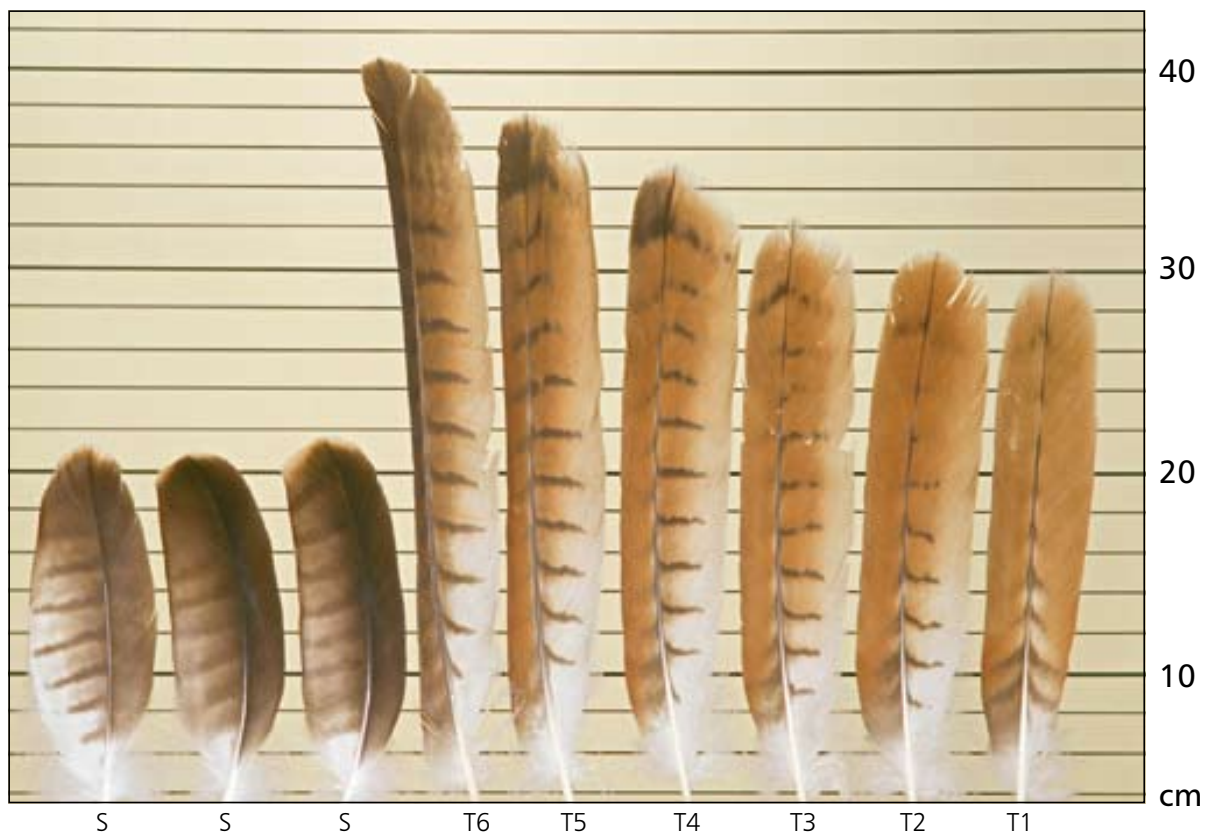
**Plate 2.** Secondaries and tail feathers of adult male honey-buzzard.



## Red kite

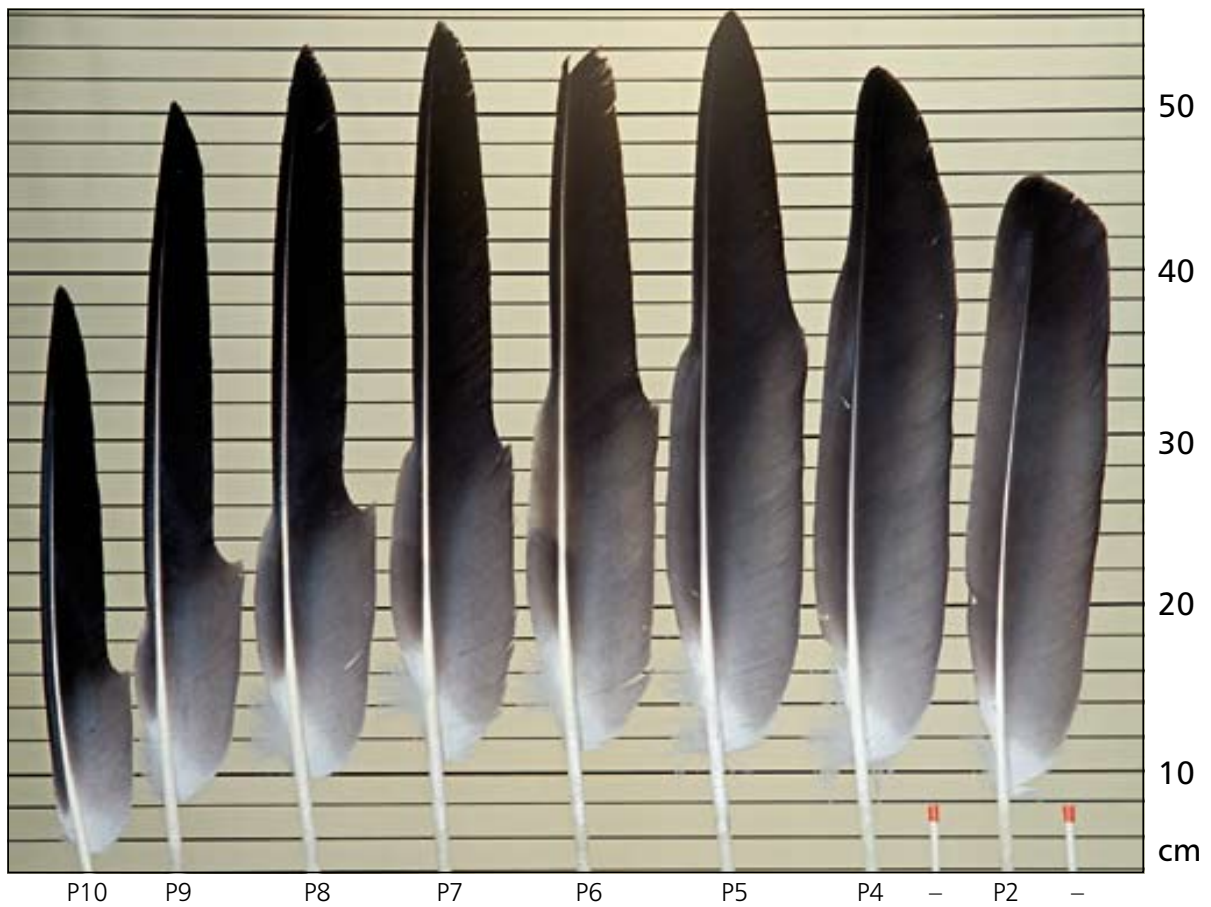


**Plate 3.** Primaries of adult red kite.

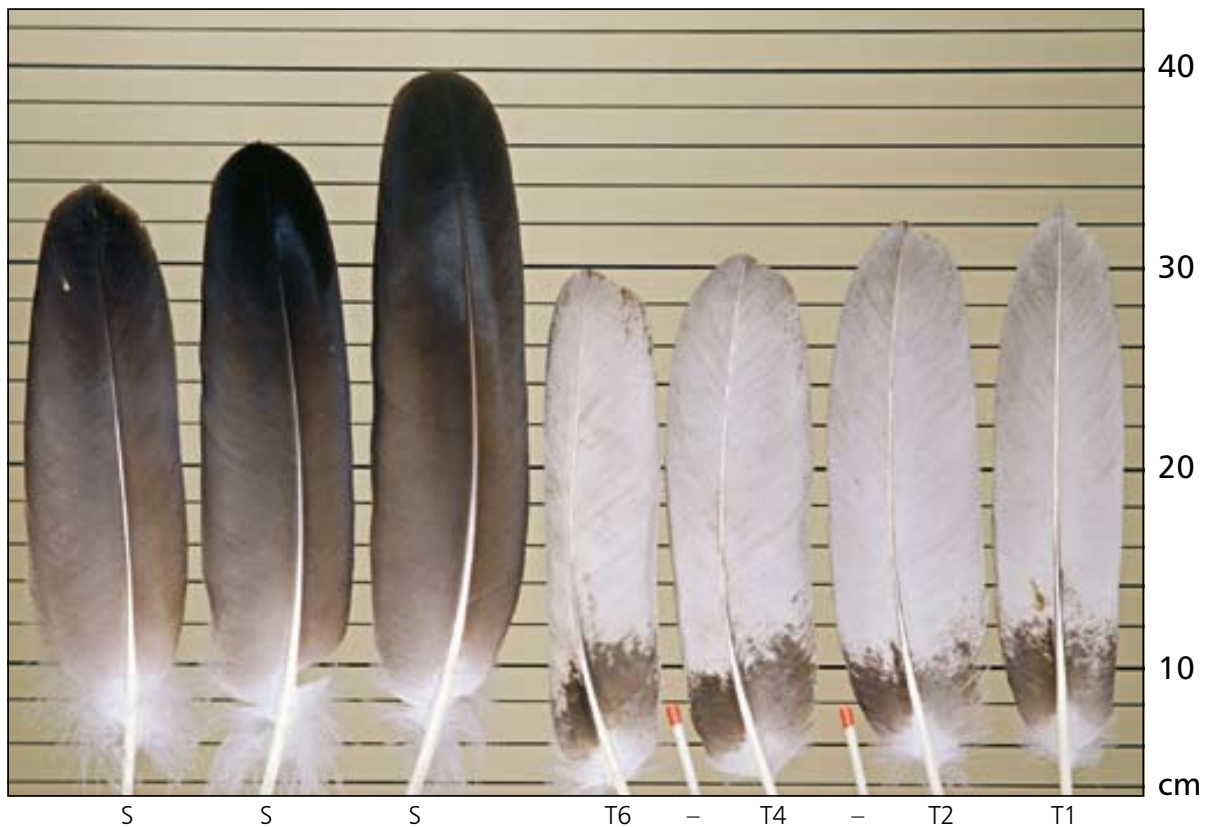


**Plate 4.** Secondaries of juvenile and tail feathers of adult red kite.

## White-tailed eagle



**Plate 5.** Primaries of adult white-tailed eagle.



**Plate 6.** Secondaries and tail feathers of adult white-tailed eagle.

## Marsh harrier



**Plate 7.** Primaries of adult female marsh harrier (with relatively high proportion of rufous).



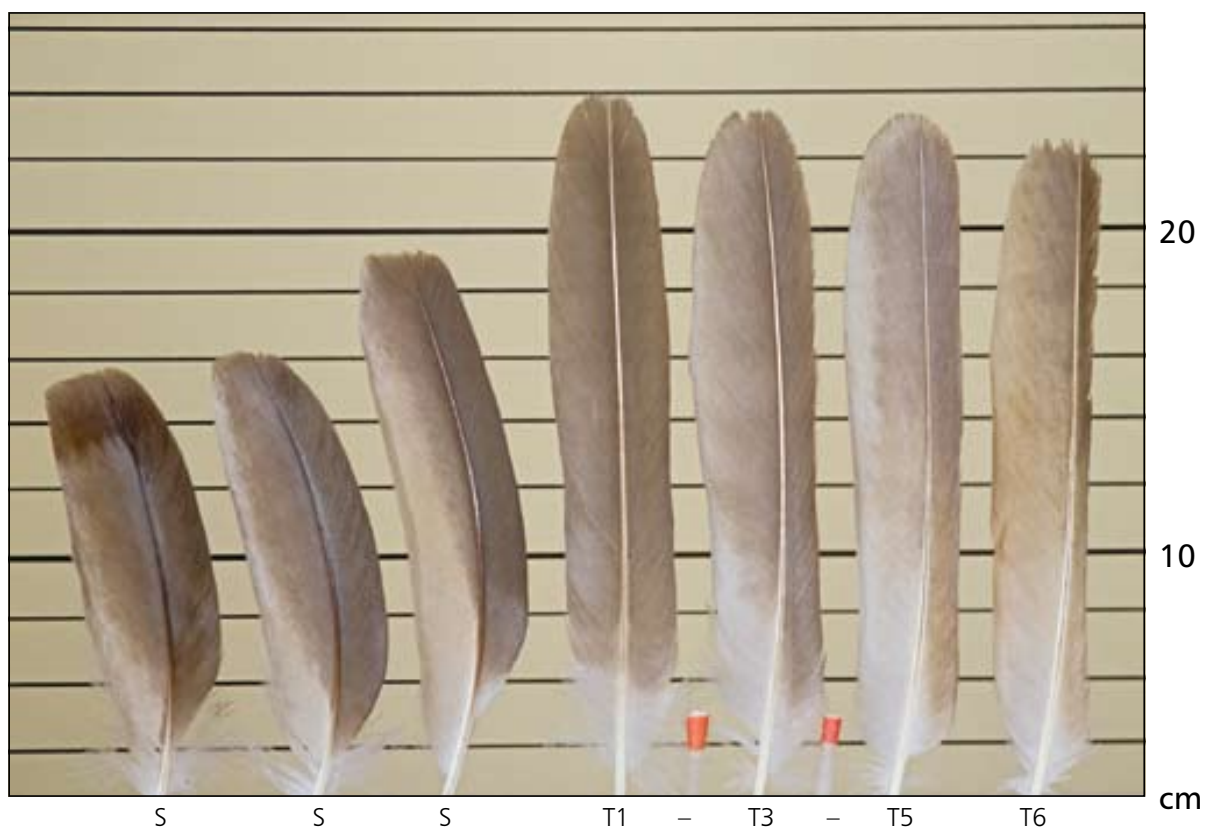
**Plate 8.** Secondaries and tail feathers of adult female marsh harrier.



## Marsh harrier

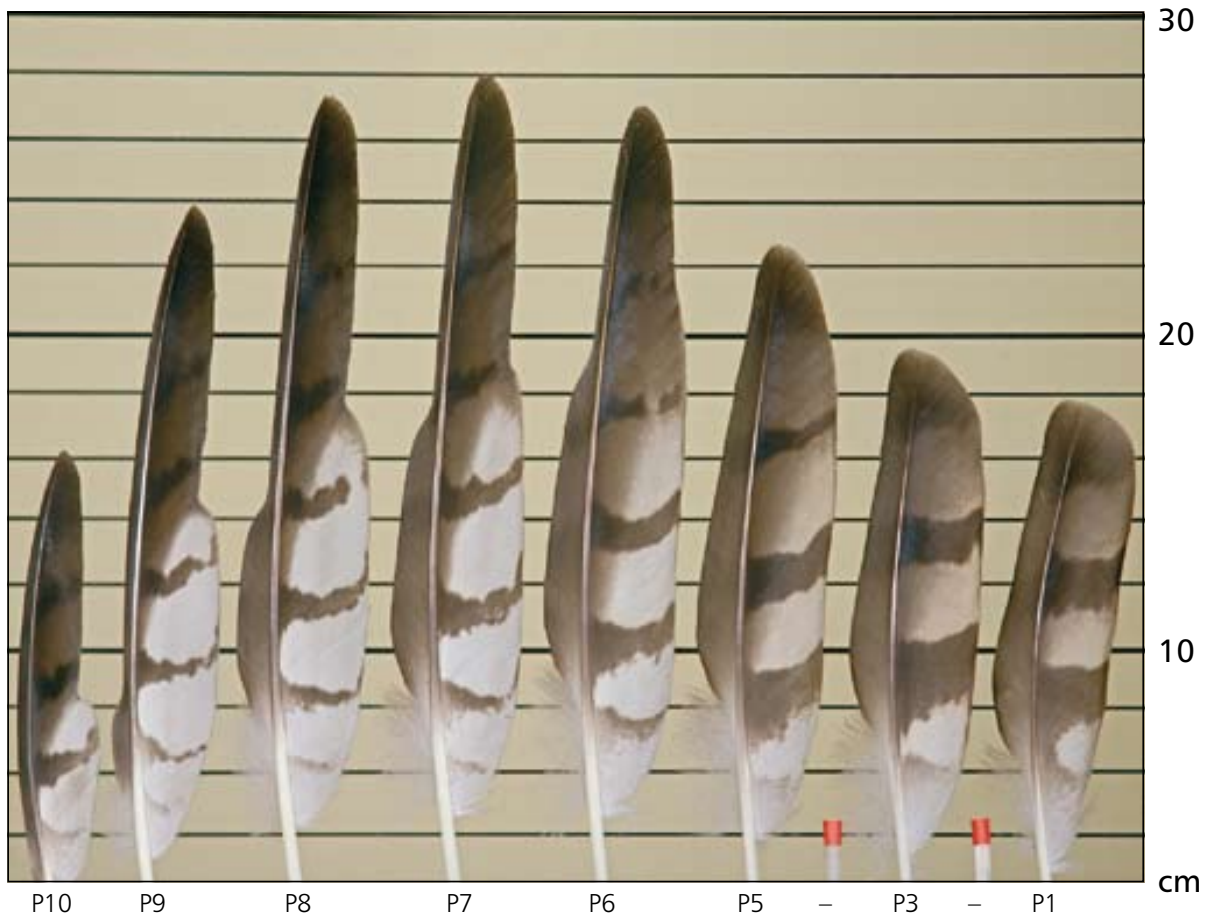


**Plate 9.** Primaries of adult male marsh harrier.



**Plate 10.** Secondaries and tail feathers of adult male marsh harrier.

## Hen harrier



**Plate 11.** Primaries of adult female hen harrier.



**Plate 12.** Secondaries and tail feathers of adult female hen harrier.

## Hen harrier



**Plate 13.** Primaries of adult male hen harrier.



**Plate 14.** Secondaries and tail feathers of adult male hen harrier.



## Montagu's harrier



**Plate 15.** Primaries of adult female Montagu's harrier (p5 and p6 from another juvenile individual).



**Plate 16.** Secondaries and tail feathers of adult female Montagu's harrier.

## Montagu's harrier



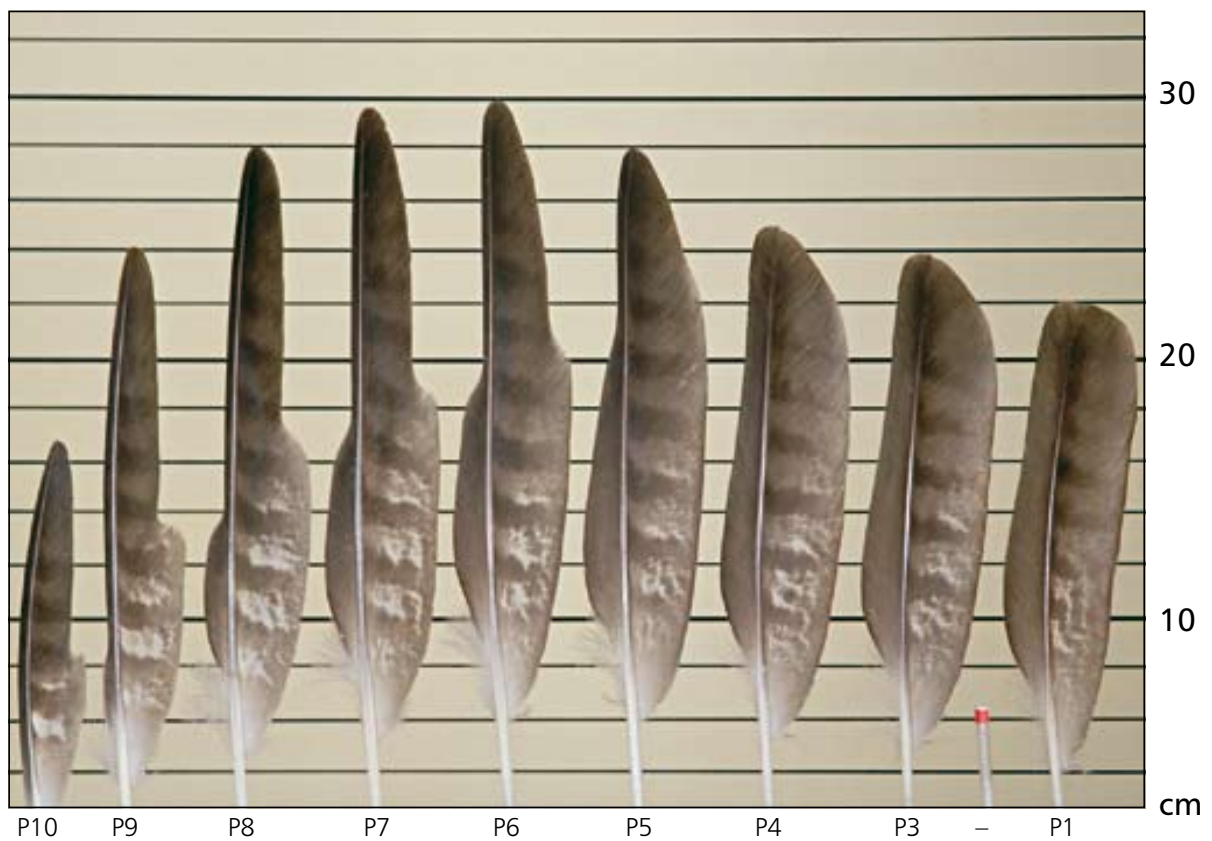
**Plate 17.** Primaries of adult male Montagu's harrier.



**Plate 18.** Secondaries and tail feathers of adult male Montagu's harrier.



## Goshawk

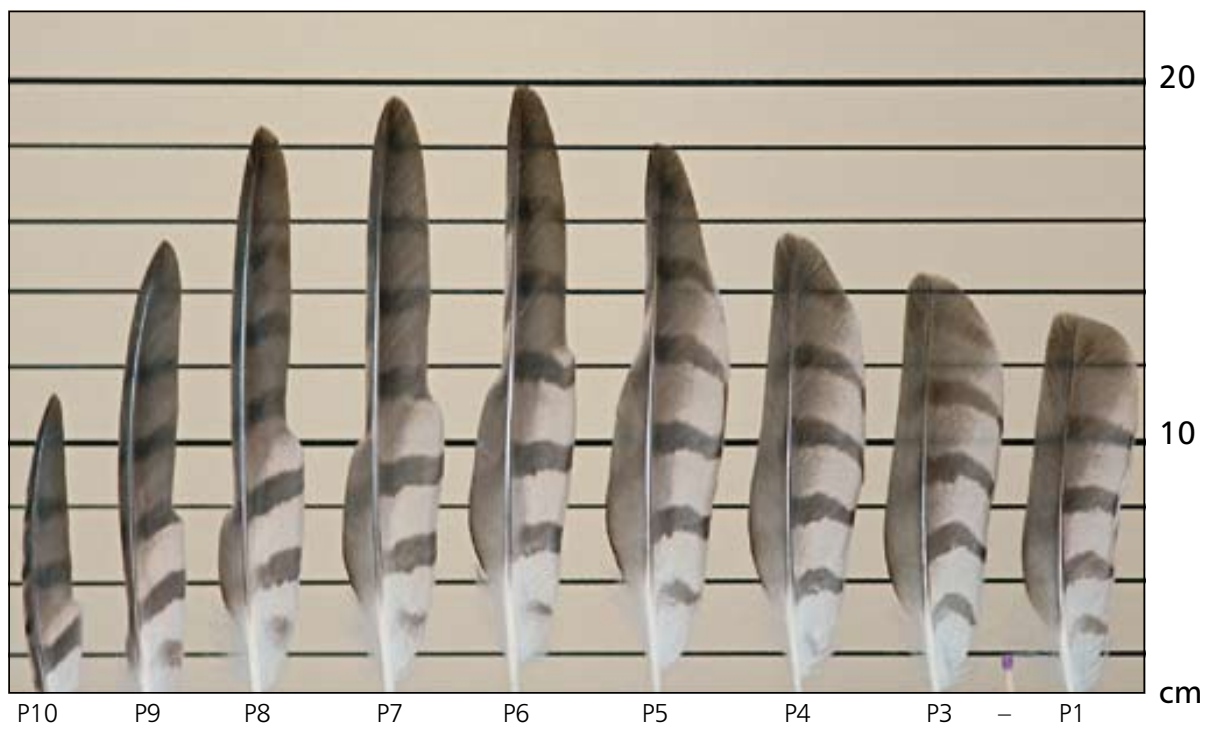


**Plate 19.** Primaries of adult female goshawk.

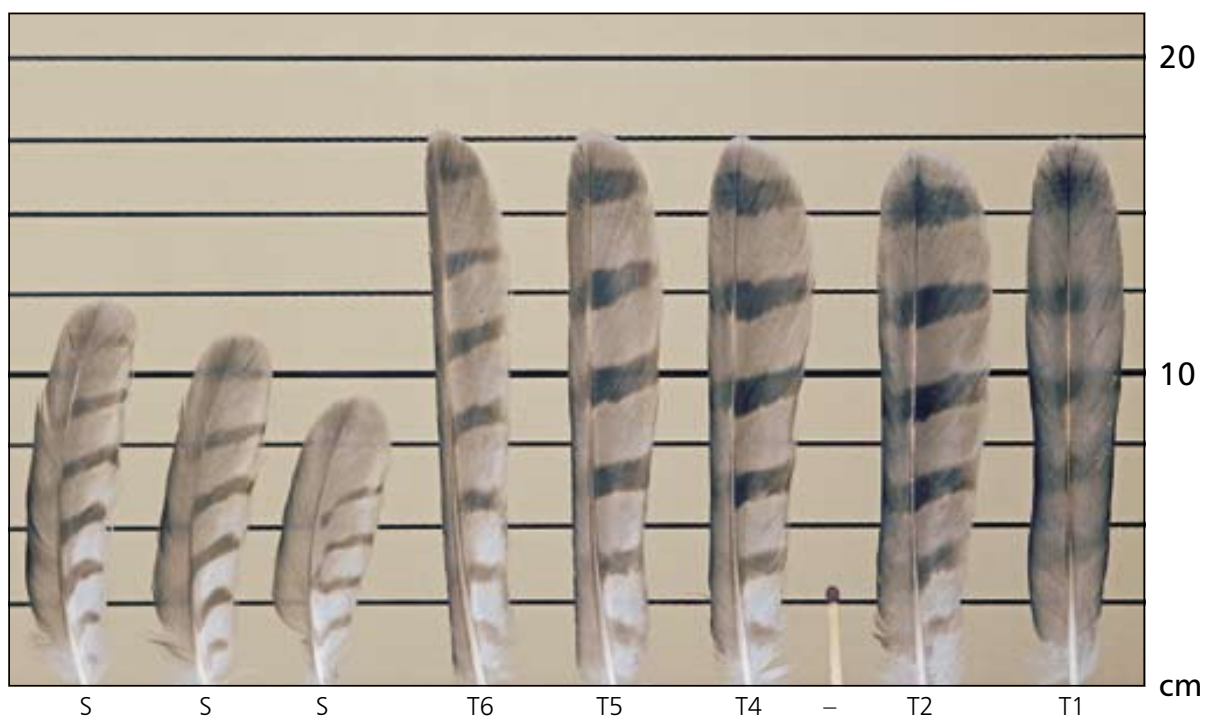


**Plate 20.** Secondaries and tail feathers of adult female goshawk.

## Sparrowhawk



**Plate 21.** Primaries of juvenile female sparrowhawk.

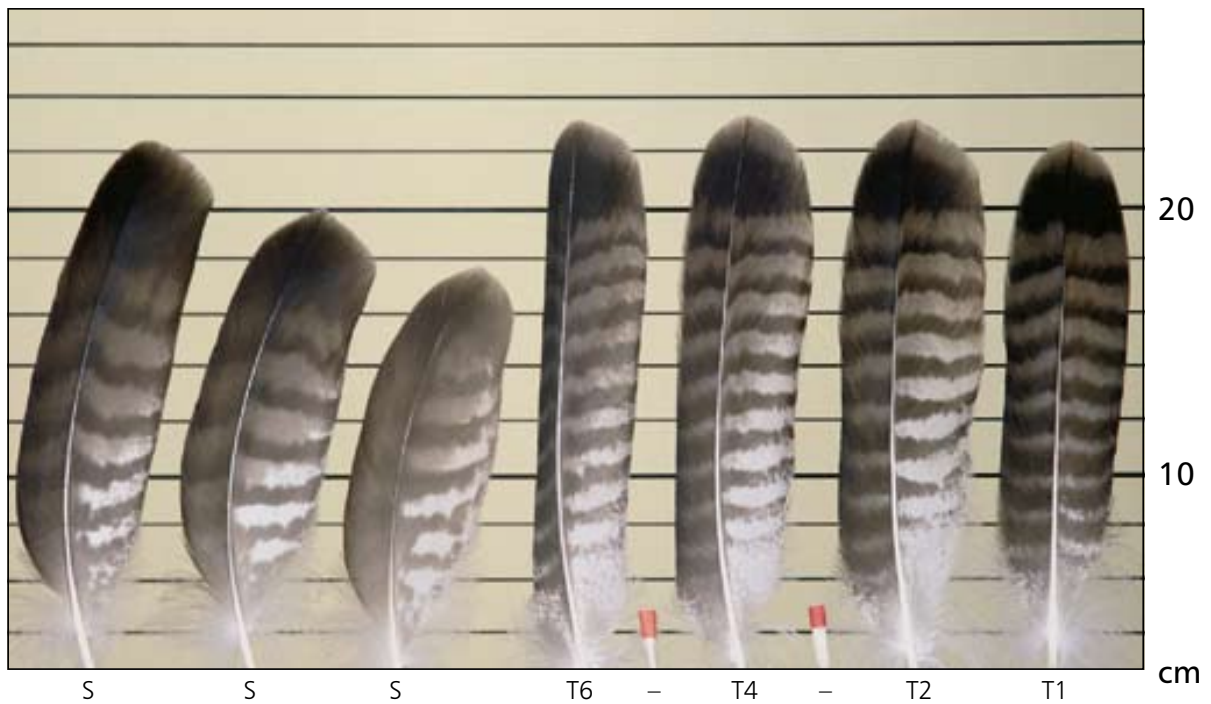


**Plate 22.** Secondaries and tail feathers of male sparrowhawk.

## Buzzard



**Plate 23.** Primaries of adult buzzard.



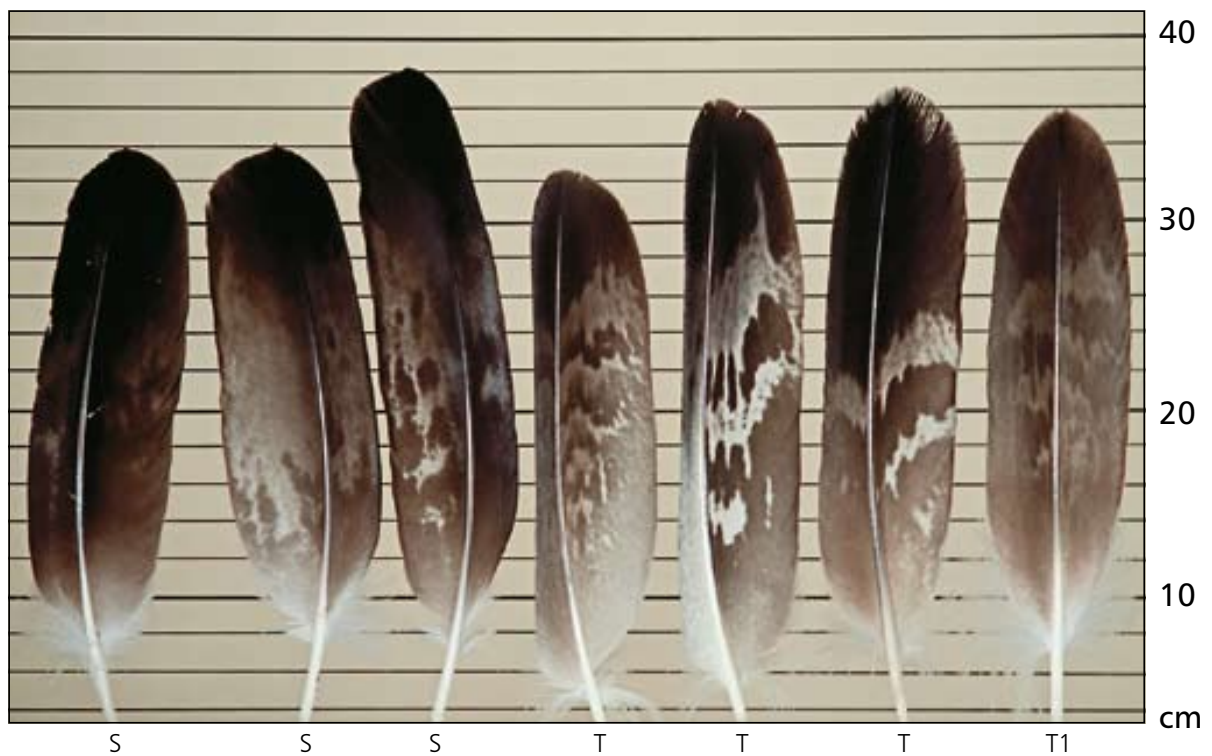
**Plate 24.** Secondaries and tail feathers of adult buzzard.



## Golden eagle

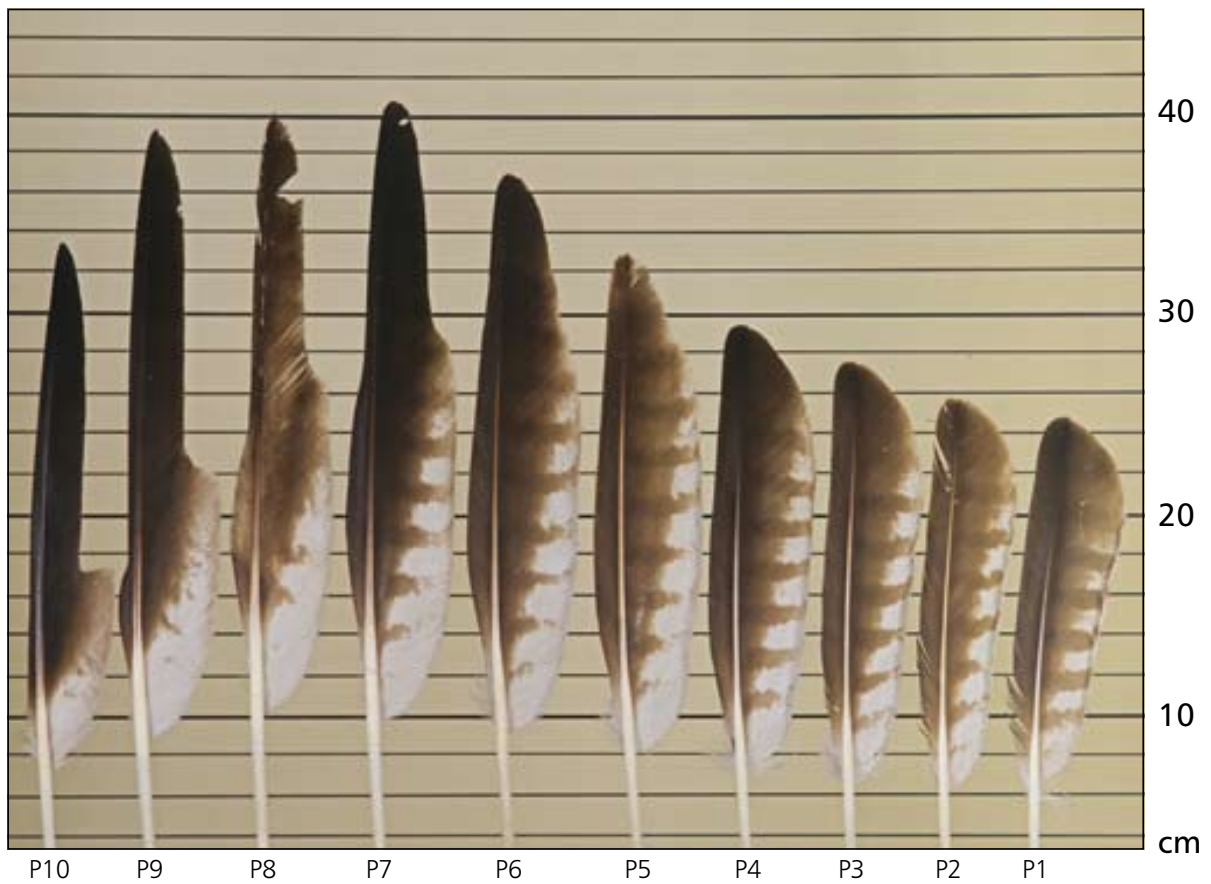


**Plate 25.** Primaries of adult golden eagle (p9 from another individual).



**Plate 26.** Secondaries and tail feathers of various individuals of golden eagle.

## Osprey



**Plate 27.** Primaries of adult osprey (p5 and p8 worn feathers).

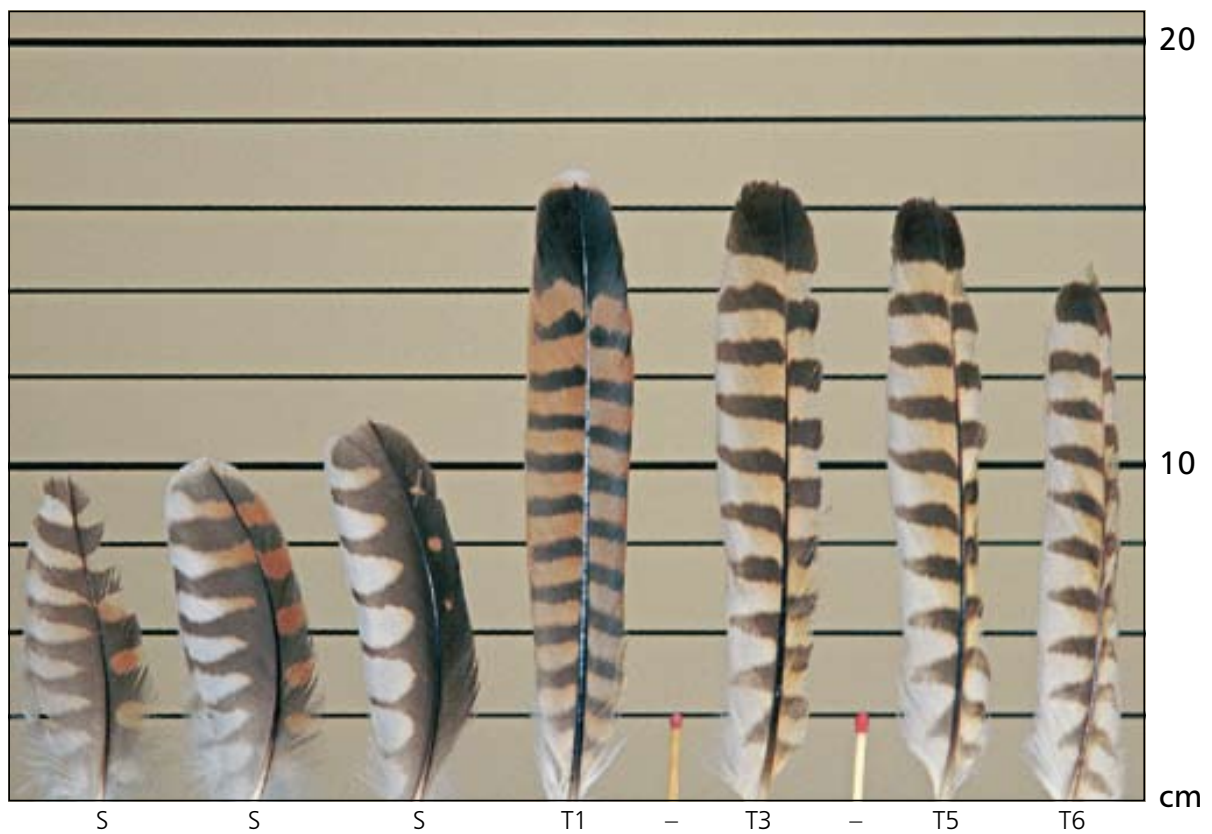


**Plate 28.** Secondaries and tail feathers of adult osprey.

## Kestrel



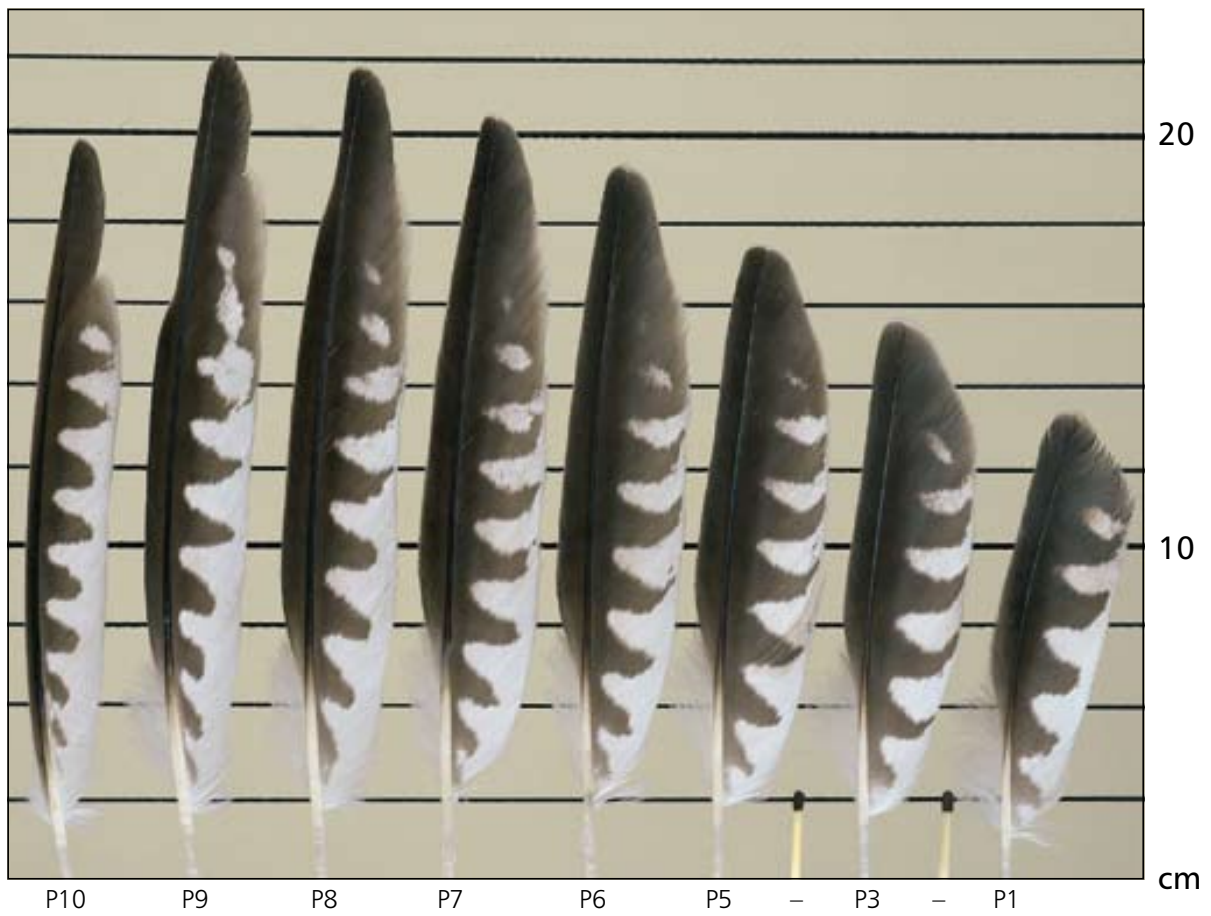
**Plate 29.** Primaries of adult female kestrel.



**Plate 30.** Secondaries and tail feathers of adult female kestrel.



## Kestrel



**Plate 31.** Primaries of adult male kestrel.

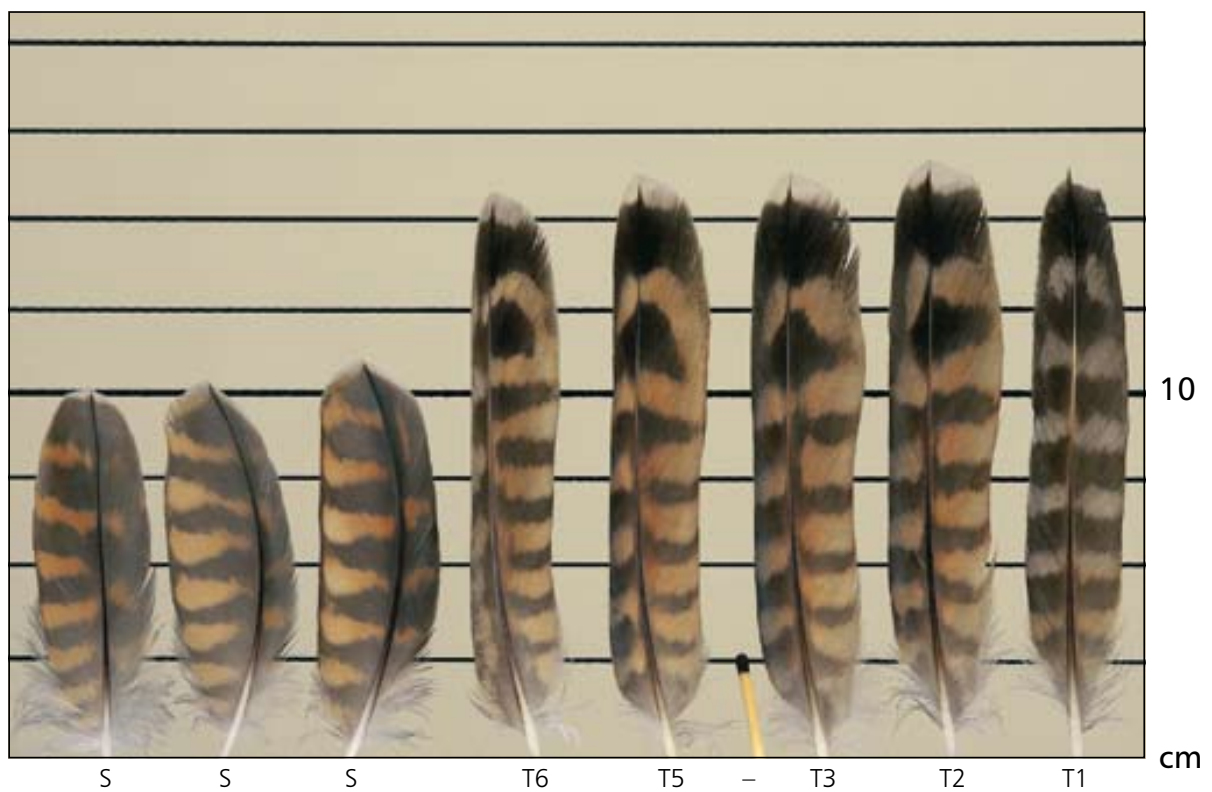


**Plate 32.** Secondaries and tail feathers of adult male kestrel.

## Merlin



**Plate 33.** Primaries of adult female merlin.



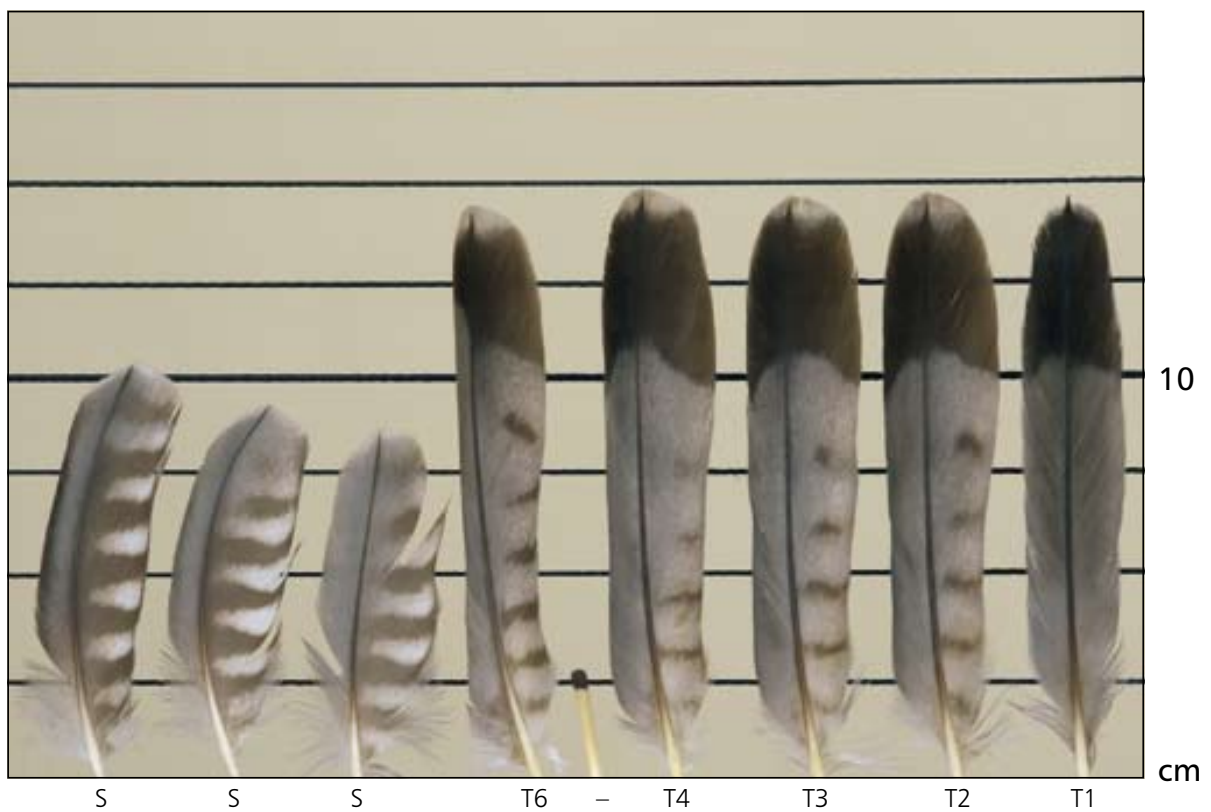
**Plate 34.** Secondaries and tail feathers of adult female merlin.



## Merlin

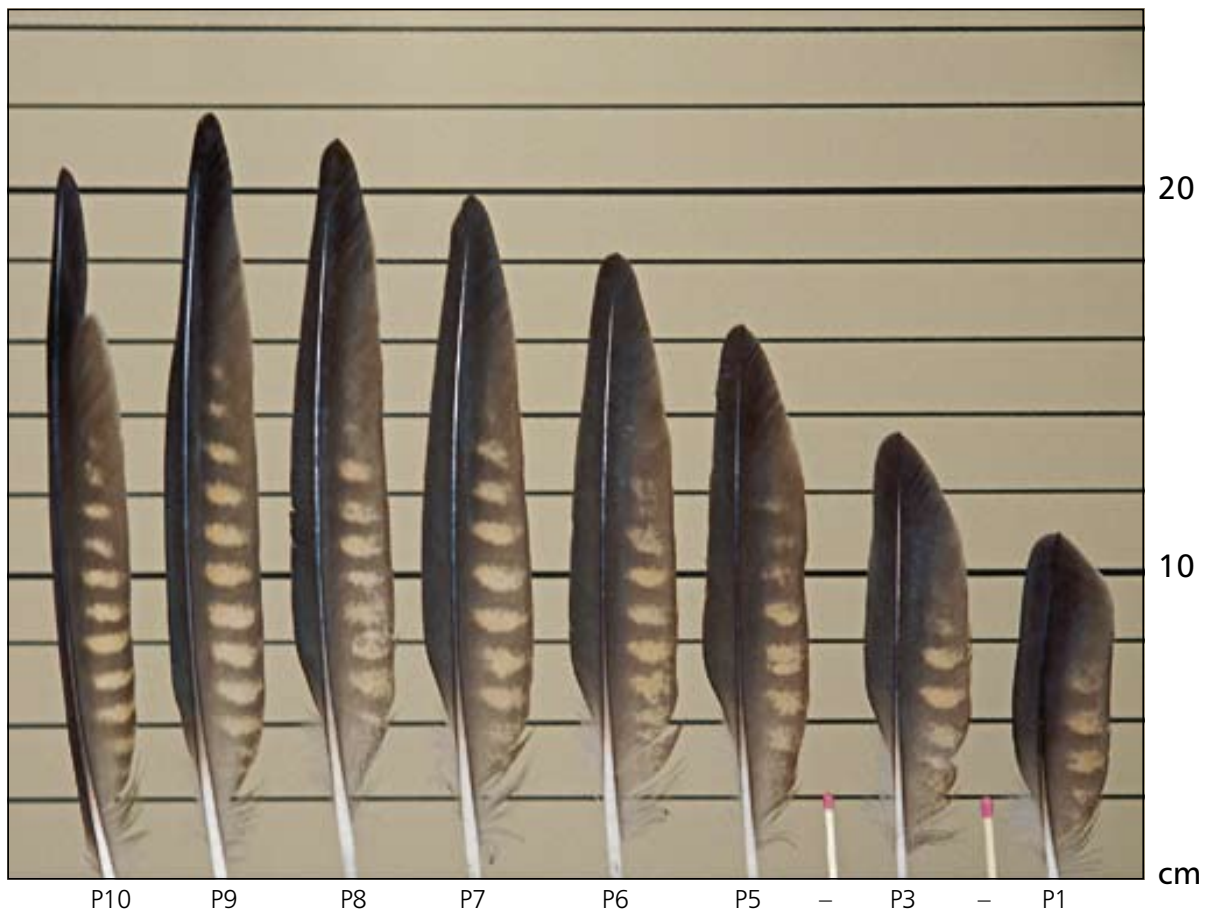


**Plate 35.** Primaries of adult male merlin.



**Plate 36.** Secondaries and tail feathers of adult male merlin.

## Hobby

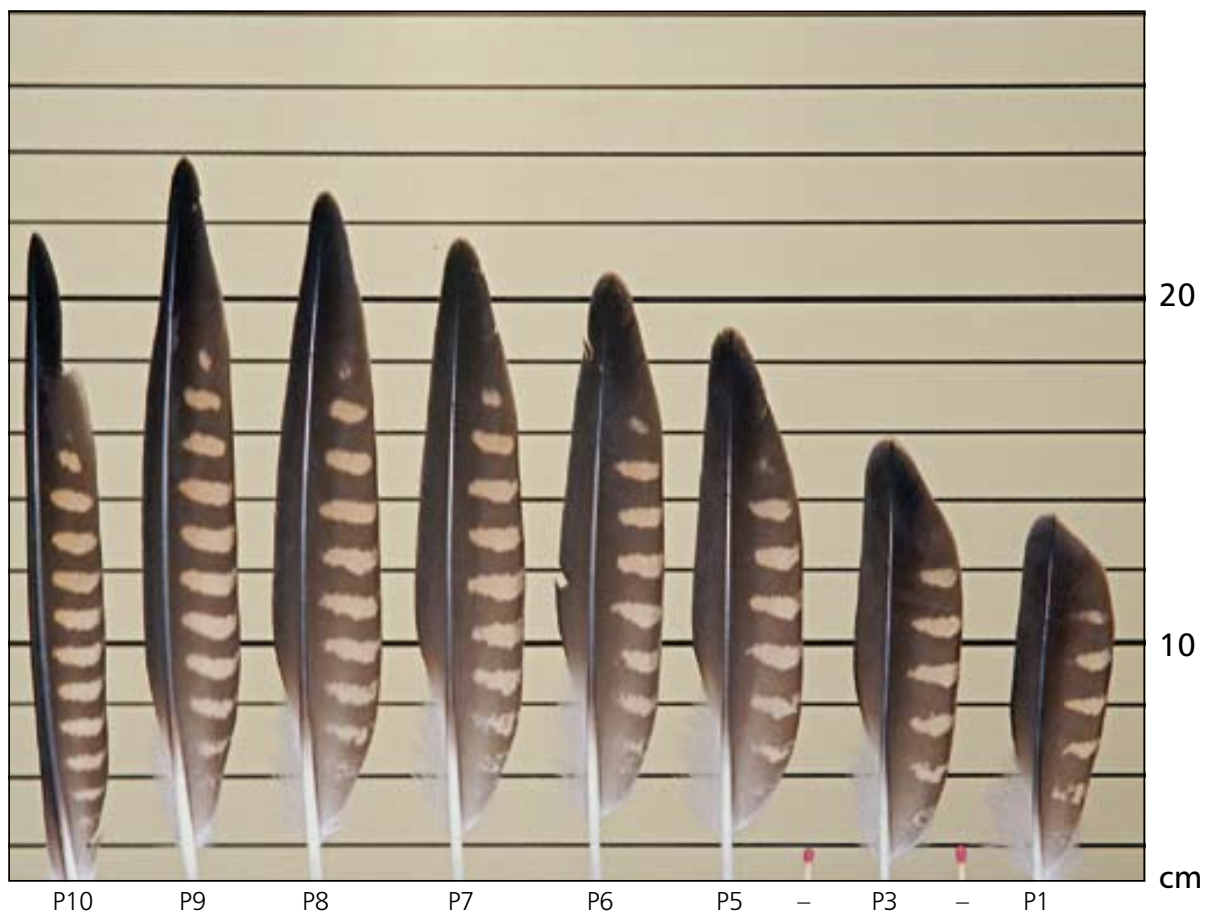


**Plate 37.** Primaries of adult hobby.



**Plate 38.** Secondaries and tail feathers of hobby.

## Peregrine



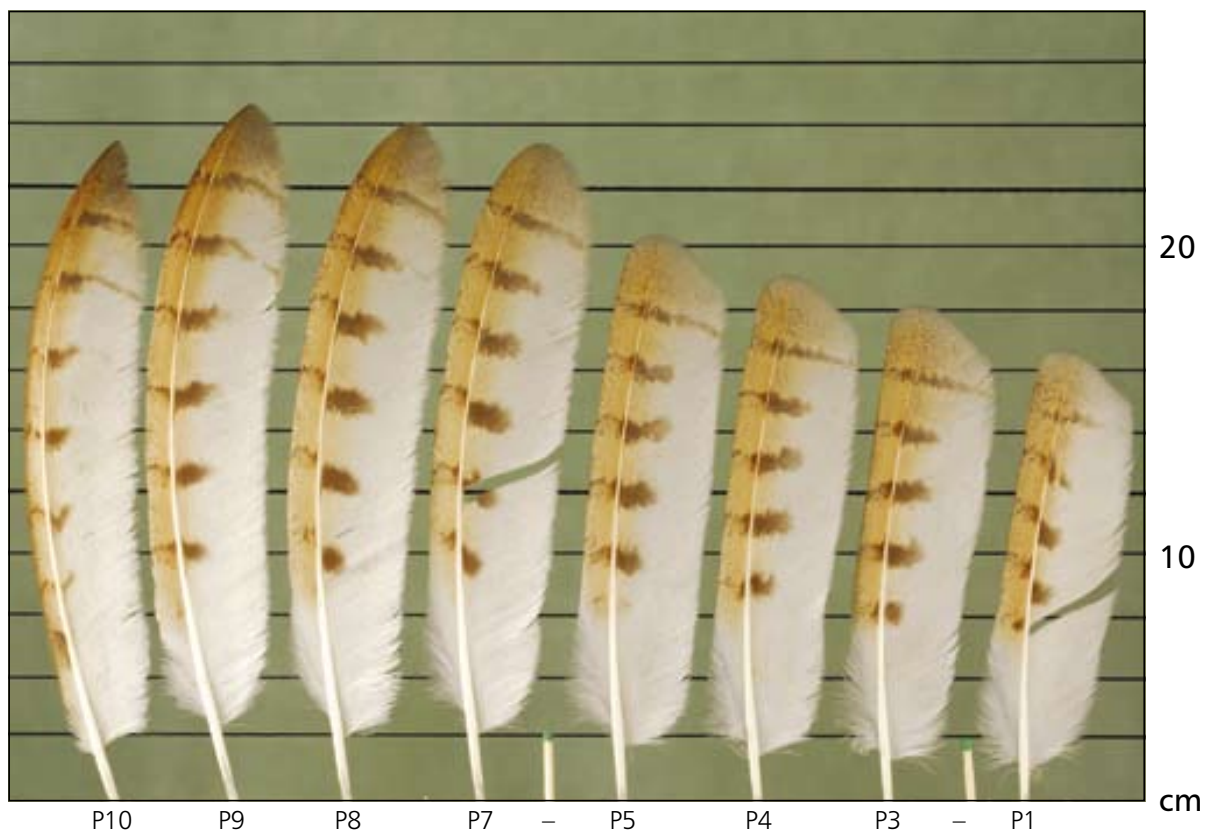
**Plate 39.** Primaries of juvenile male peregrine (from falconry bird).



**Plate 40.** Secondaries and tail feathers of adult female peregrine (from wild bird).



## Barn owl

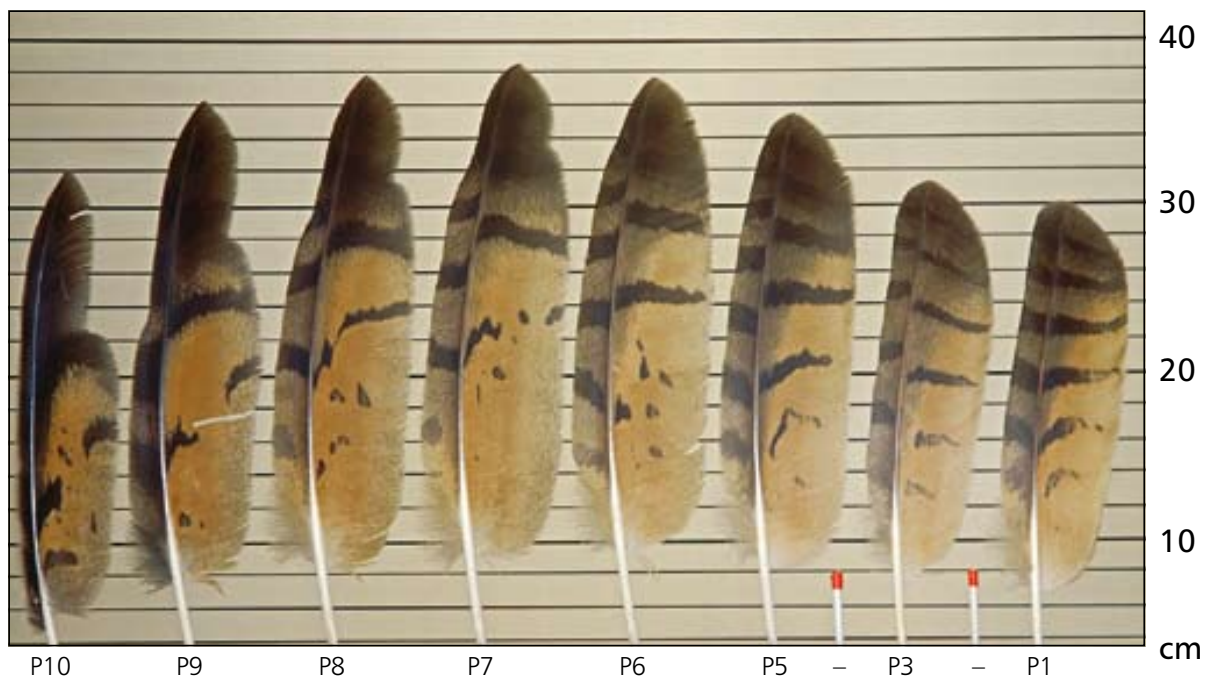


**Plate 41.** Primaries of barn owl.

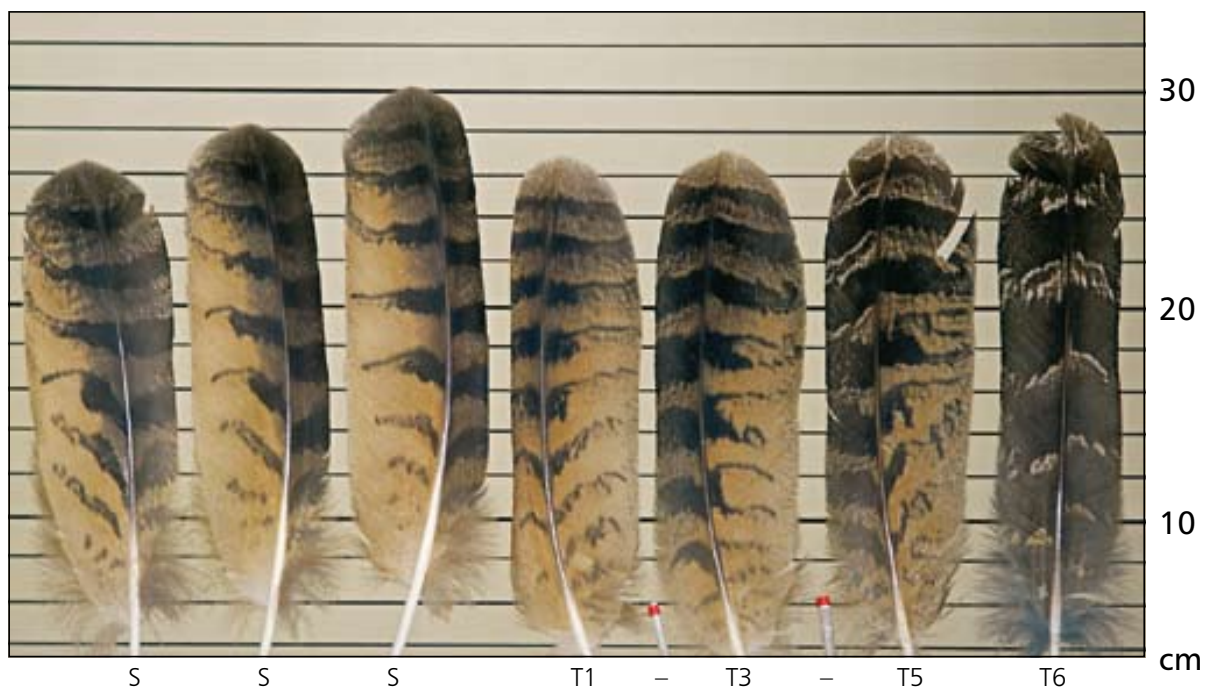


**Plate 42.** Secondaries and tail feathers of barn owl.

## Eagle owl

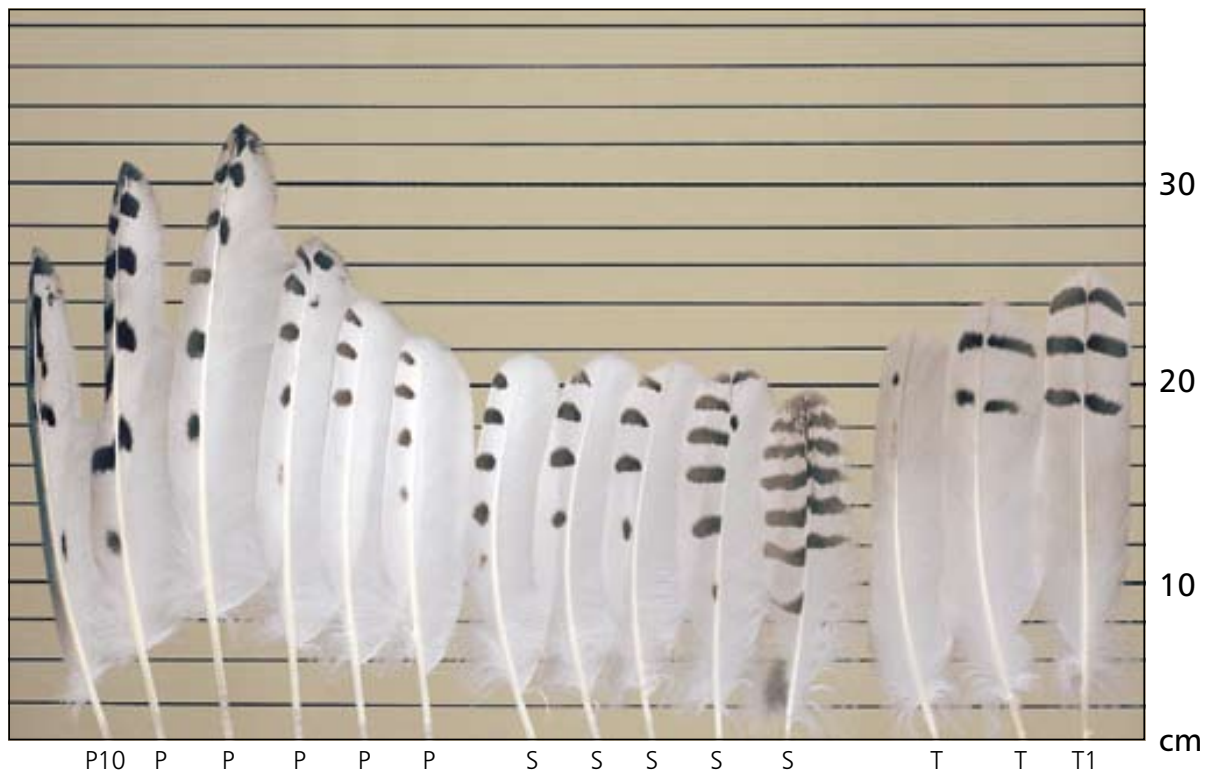


**Plate 43.** Primaries of eagle owl.

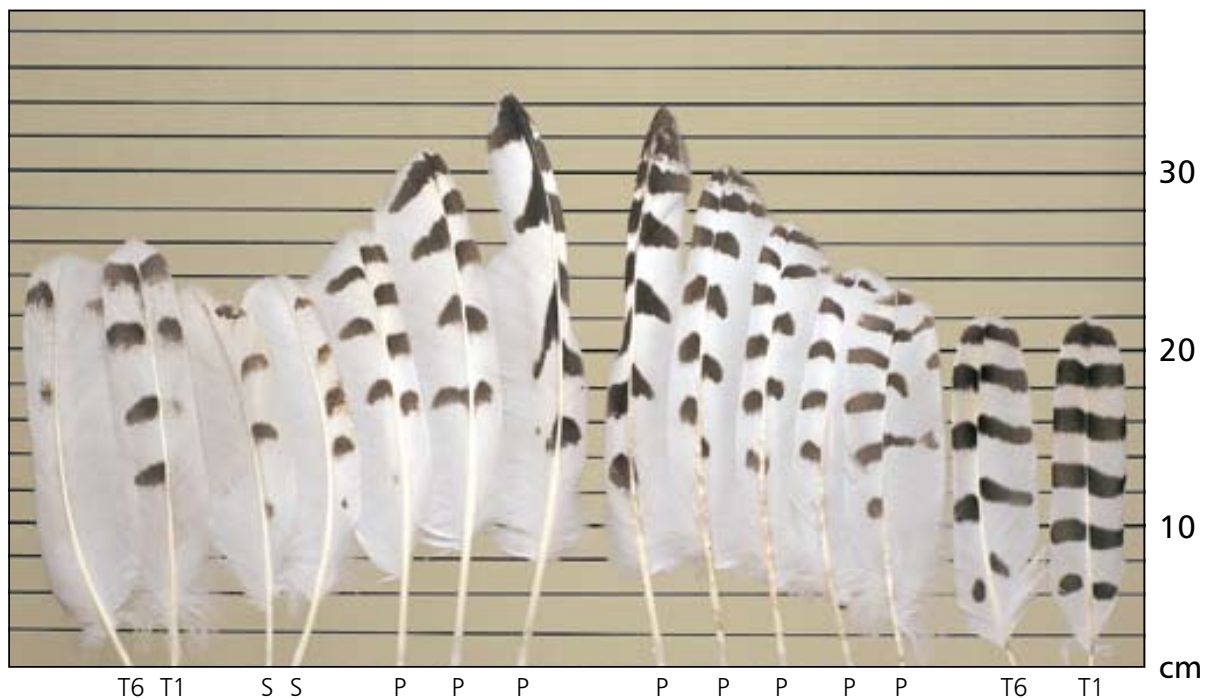


**Plate 44.** Secondaries and tail feathers of eagle owl.

## Snowy owl



**Plate 45.** Selected feathers of juvenile male snowy owl.



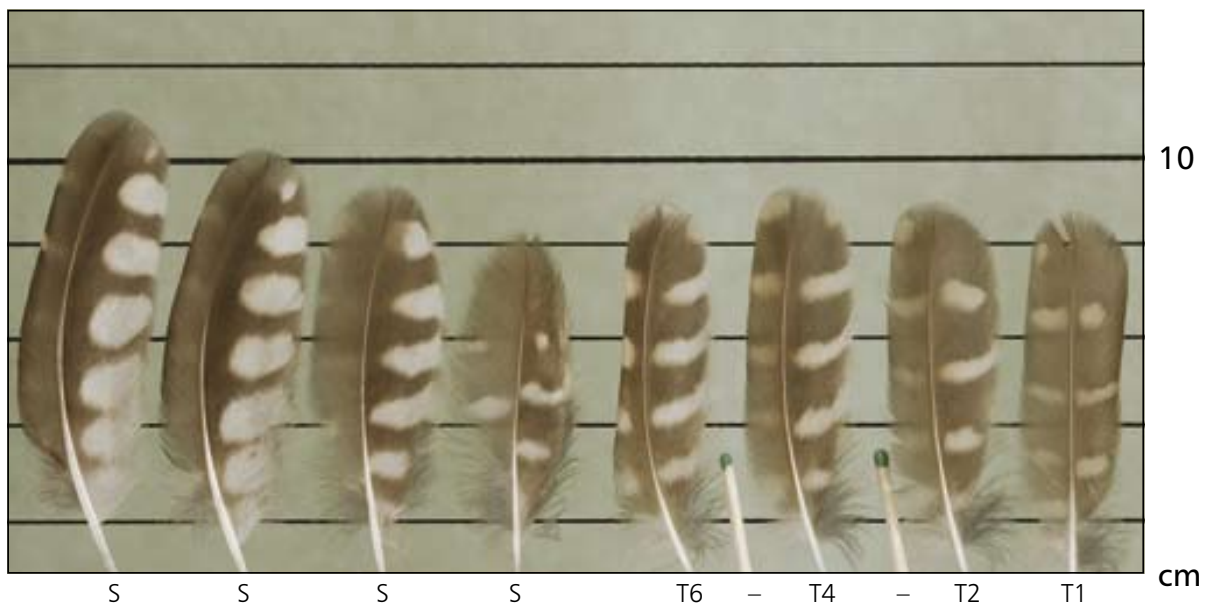
**Plate 46.** Comparison of selected feathers of adult (left) and juvenile female snowy owl.



## Little owl

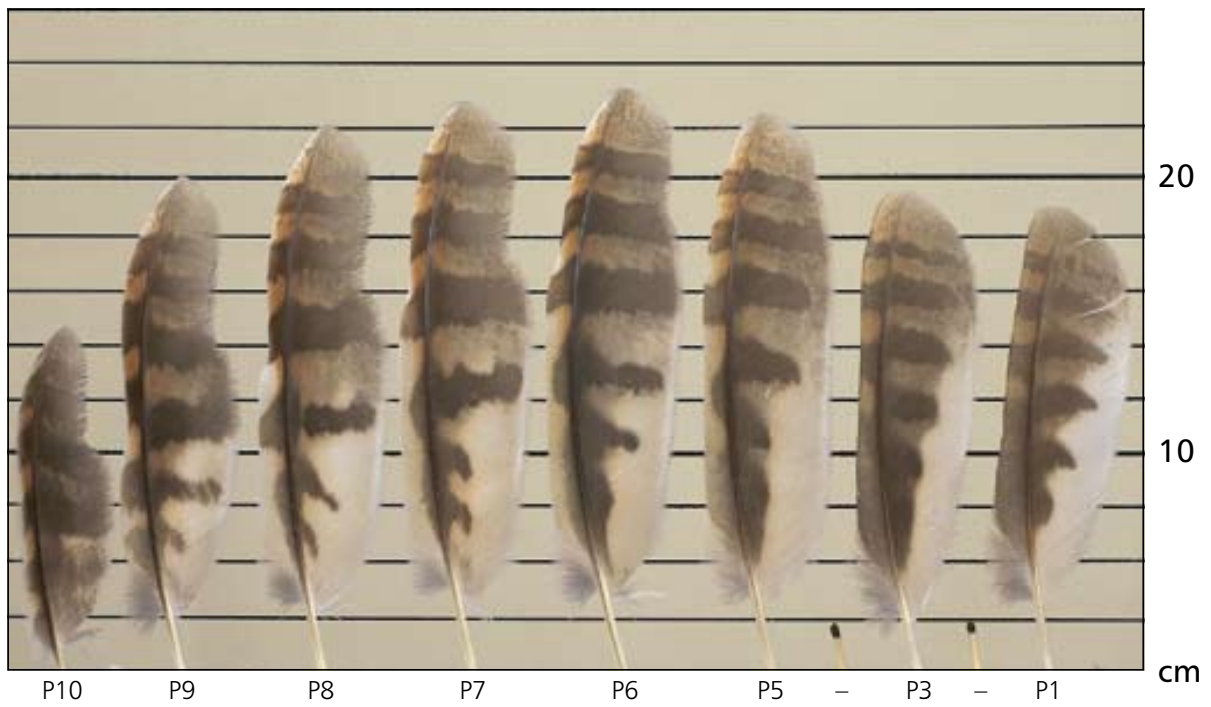


**Plate 47.** Primaries of adult little owl.

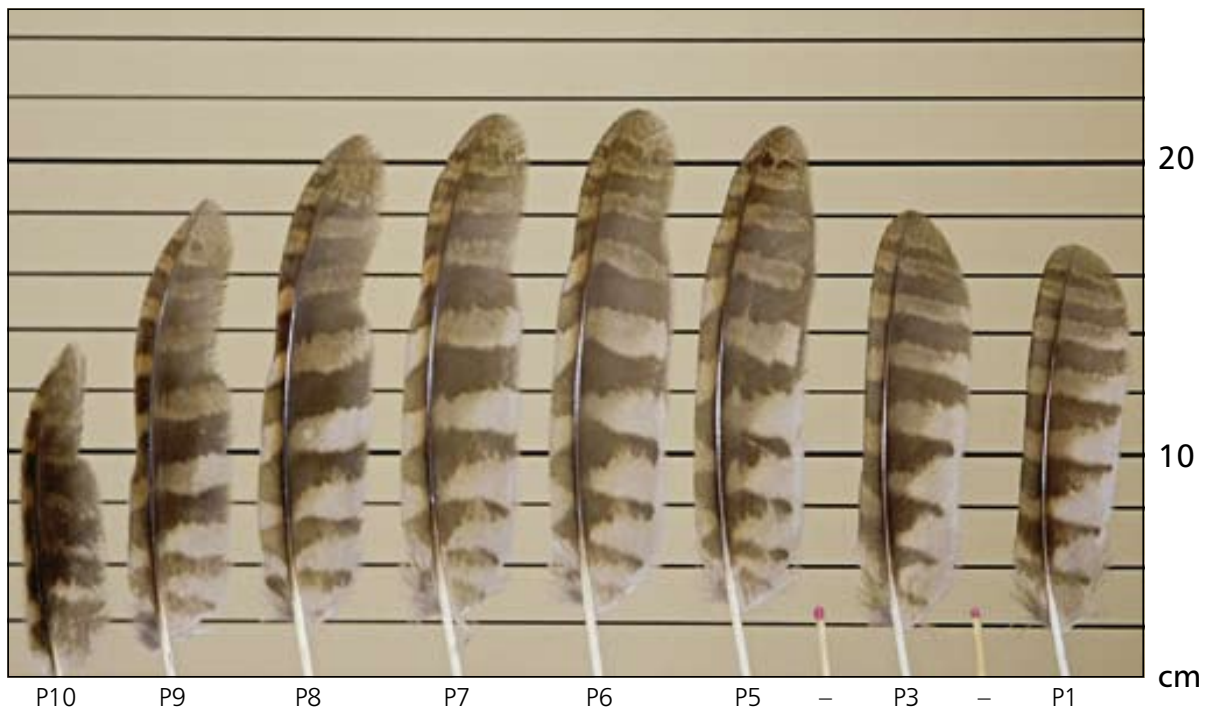


**Plate 48.** Secondaries and tail feathers of adult little owl.

## Tawny owl



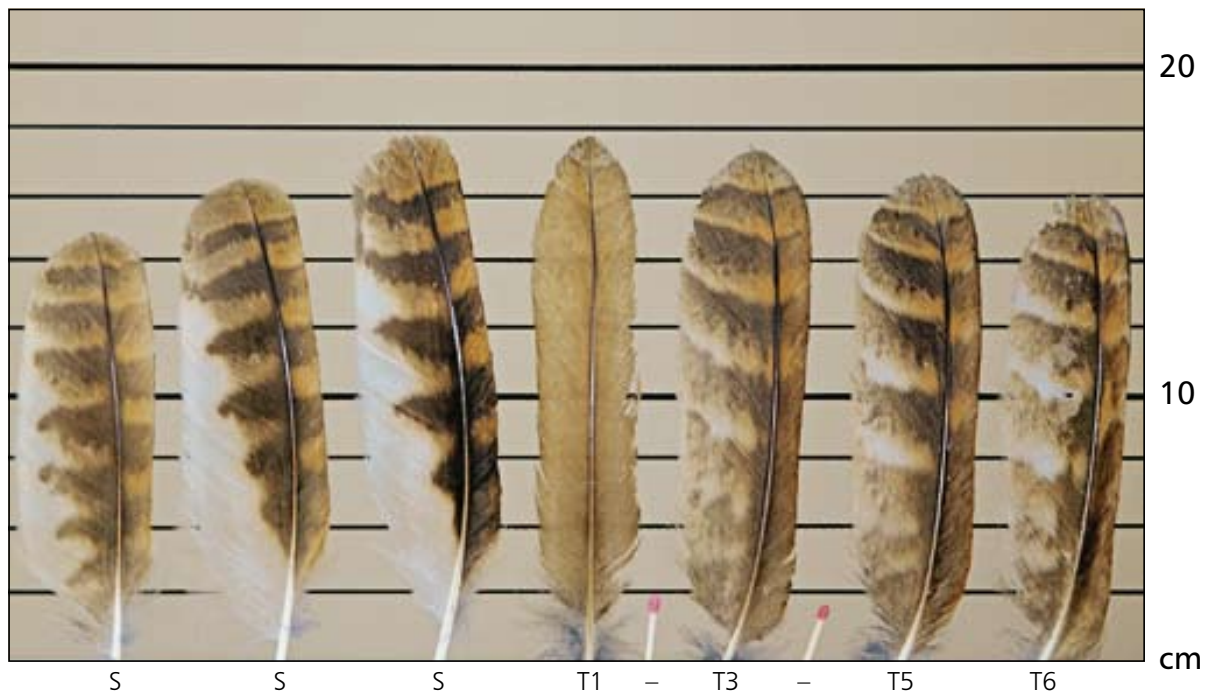
**Plate 49.** Primaries of adult rufous morph of tawny owl.



**Plate 50.** Primaries of juvenile grey morph of tawny owl.



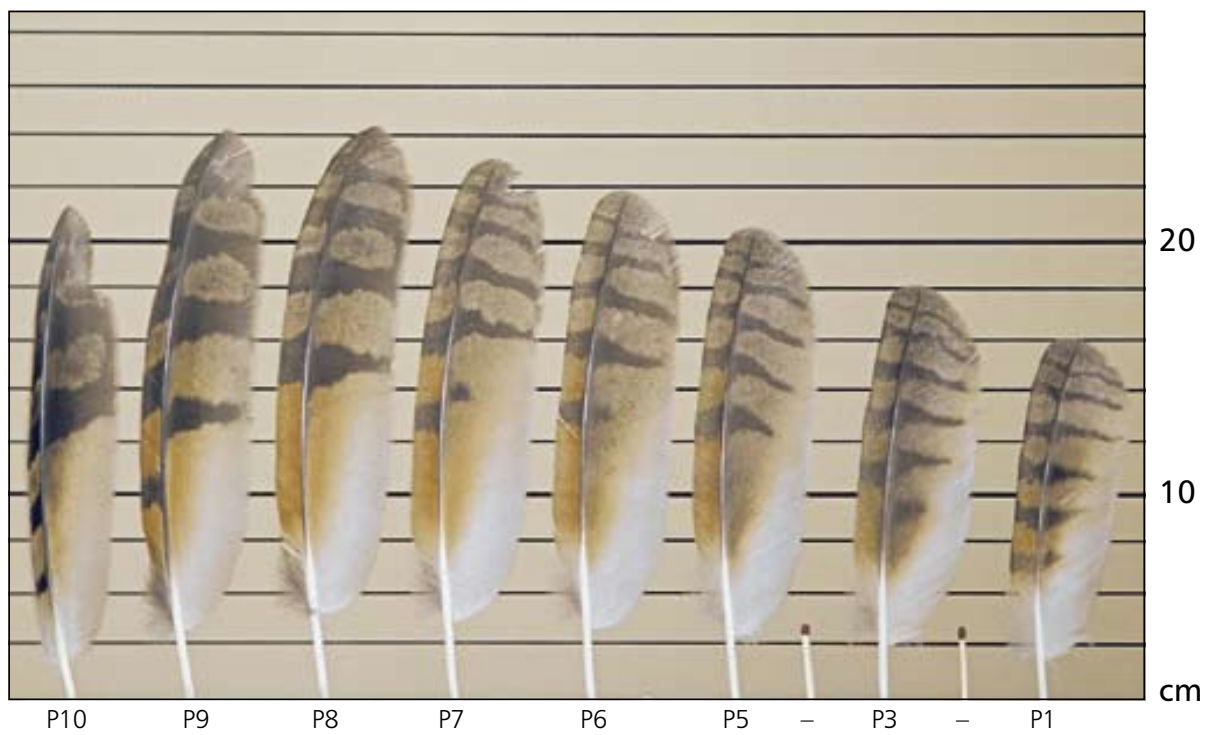
## Tawny owl



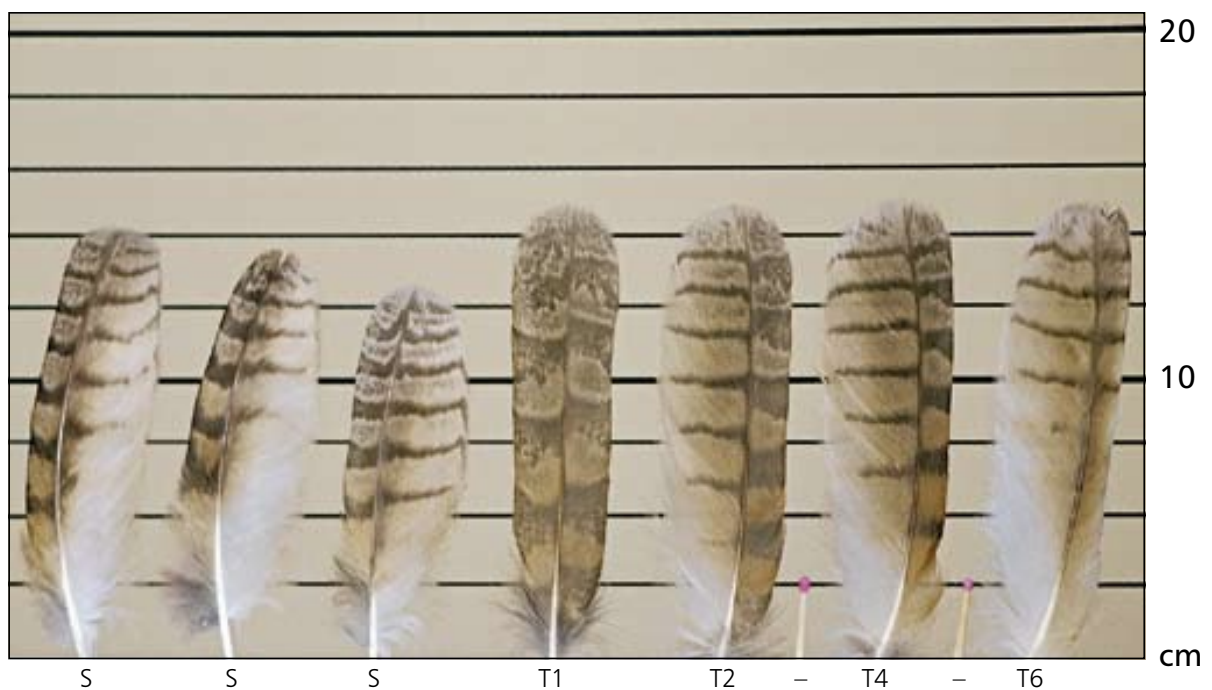
**Plate 51.** Secondaries and tail feathers of adult rufous morph of tawny owl.



## Long-eared owl

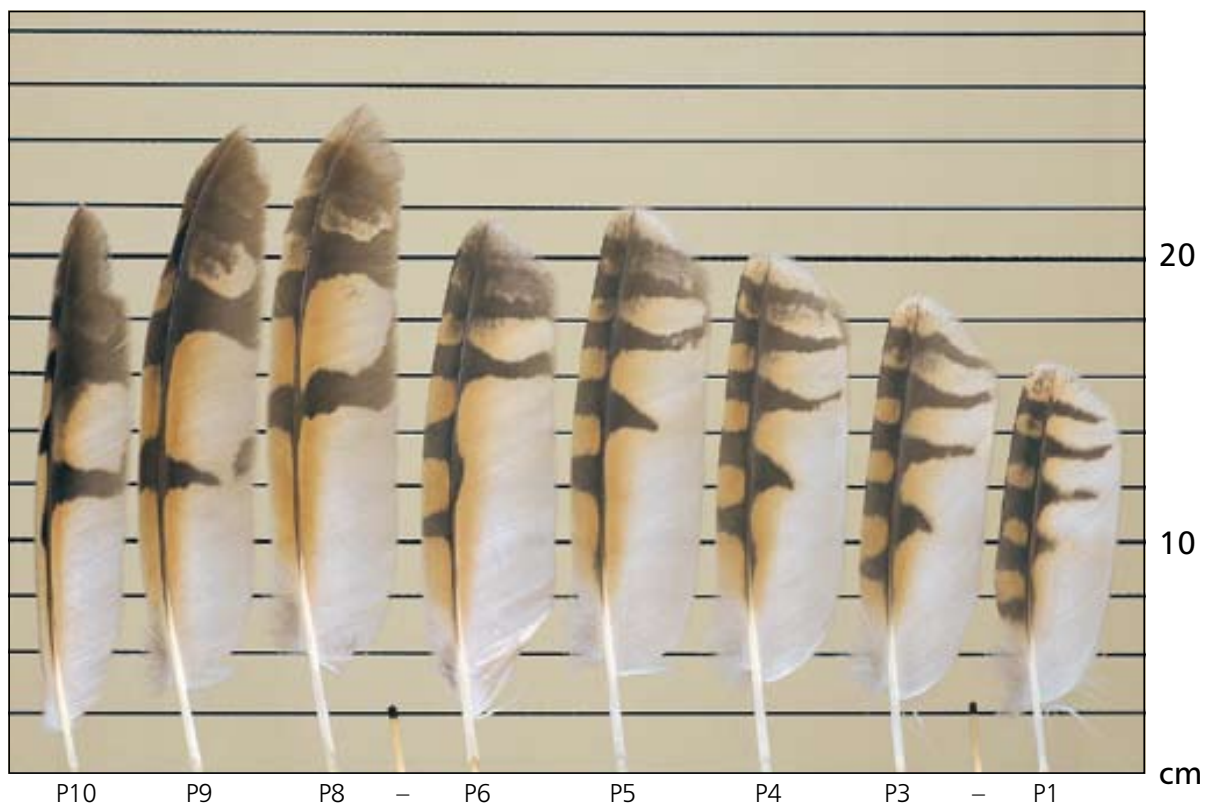


**Plate 52.** Primaries of adult long-eared owl.

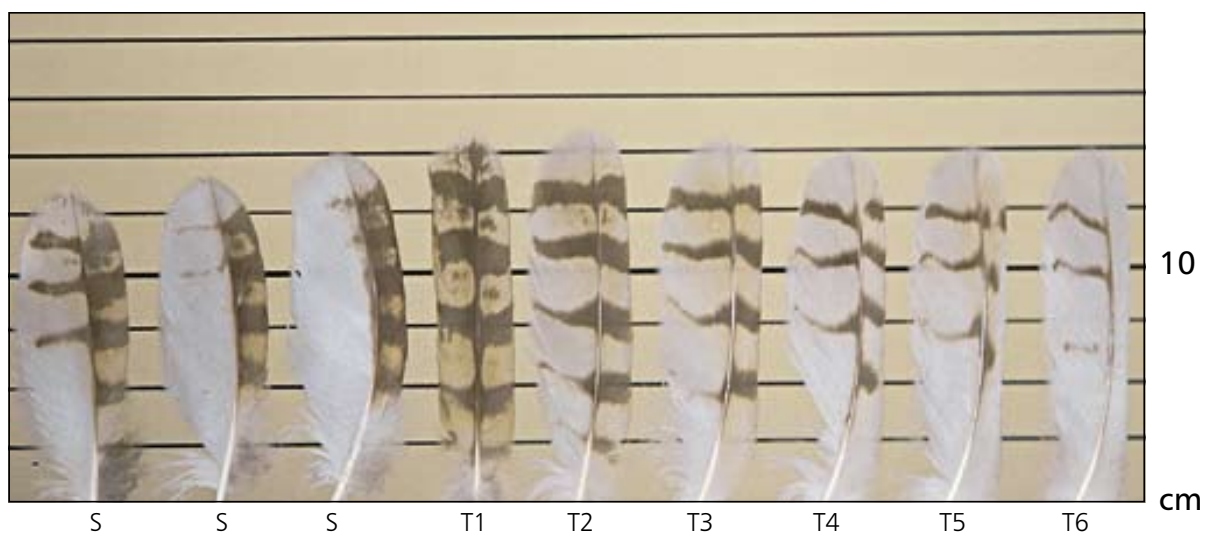


**Plate 53.** Secondaries of juvenile and tail feathers of adult long-eared owl.

## Short-eared owl



**Plate 54.** Primaries of moulting short-eared owl.



**Plate 55.** Secondaries and tail feathers of short-eared owl.



## Raven



**Plate 56.** Primaries of raven.

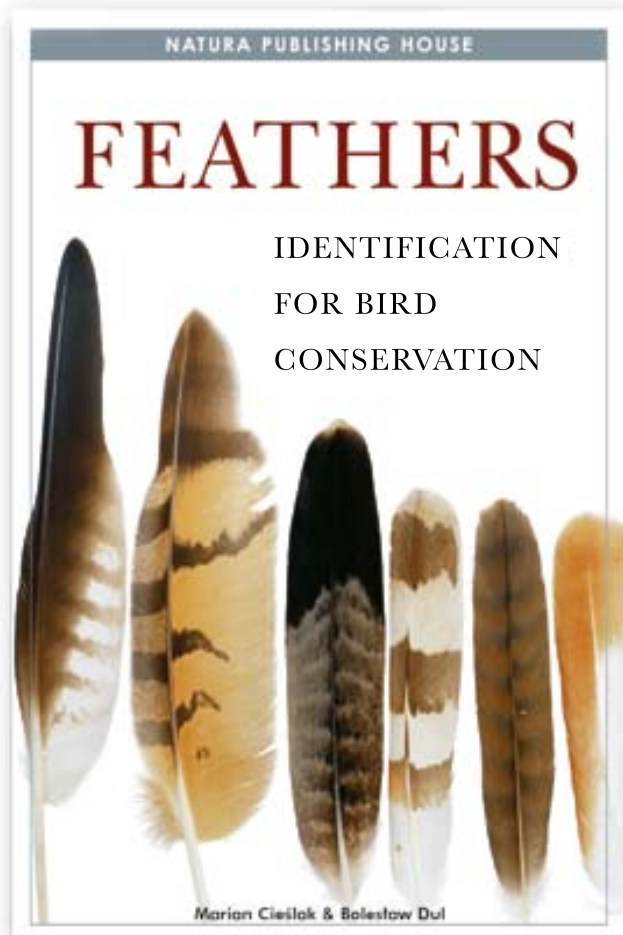


**Plate 57.** Secondaries and tail feathers of raven.

# THE EXCELLENT NEW GUIDE

## **Feathers: Identification for Bird Conservation**

**Marian Cieślak and Bolesław Dul (2006)**



*'I have no doubt that every European ringing station and observatory will want to get their hands on a copy of this book which will become a classic ornithological reference for decades to come.'*

**Fatbirder.com**

320 pp., 240x160 mm,  
259 colour photos,  
19 tables, Hardback,  
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This guide presents the feathers of 60 species of bird, of which 38 are included in Annex I of the European Union's Birds Directive. In EU Member States, these species require enhanced protection, together with their biotopes, within the framework of the NATURA 2000 network of protected areas.

**This book contains extensive scientific information including:**

- basic information on feathers: bird plumage, moulting, feather morphology, feather variability,
- the use of feathers in the conservation and study of birds: faunistic research, bird conservation, research into avian ecology, airport protection and aviation and education in the service of bird conservation,
- the feather identification procedure
- identifying feathers.

