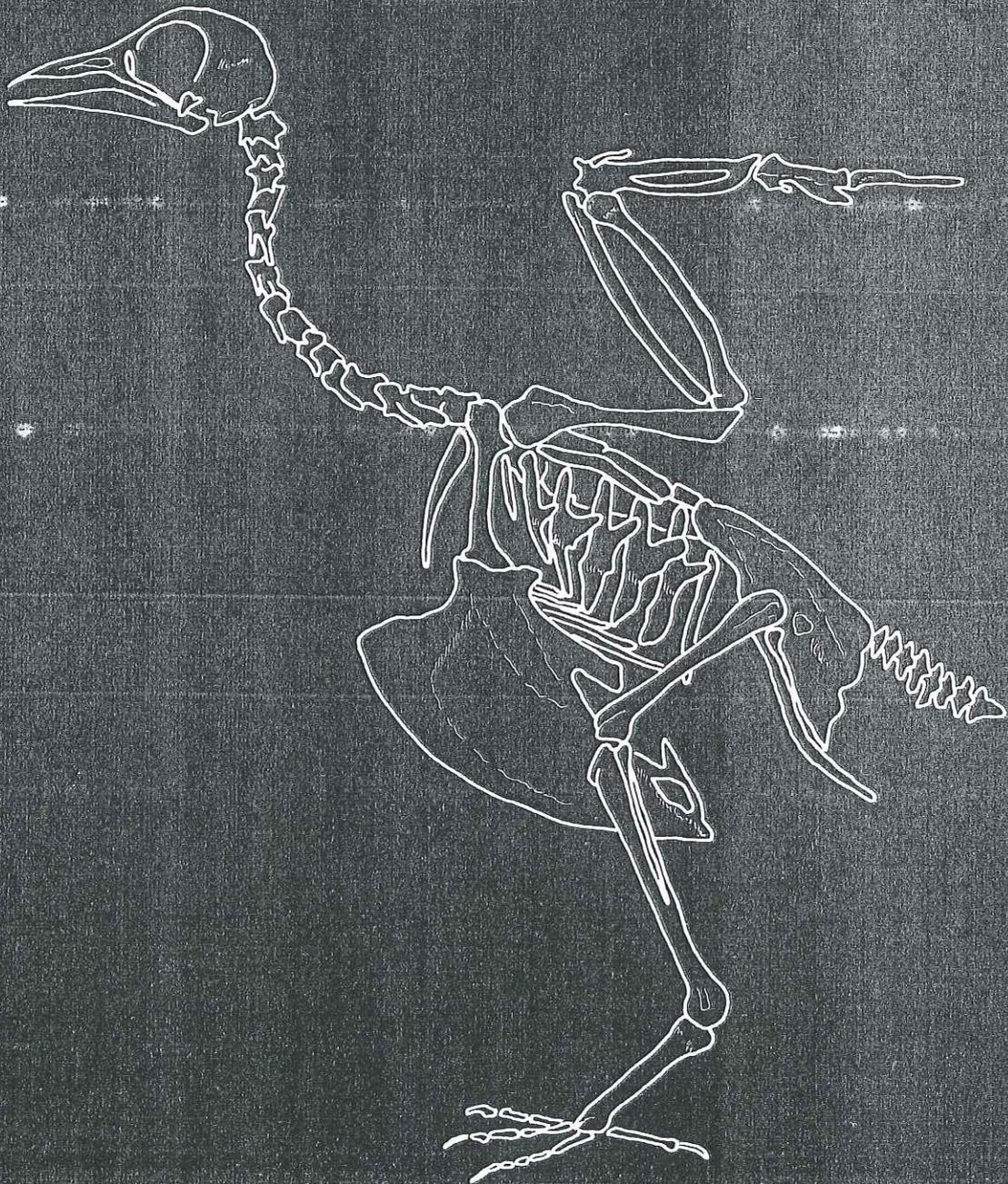


*A manual for the
identification of*
**BIRD BONES FROM
ARCHAEOLOGICAL SITES**
REVISED EDITION



Alan Cohen & Dale Serjeantson

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1996

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PREFACE

The identification of the bones of common domestic and the larger wild mammals at European archaeological sites is relatively straightforward; the number of species is small, and the nature of bone survival is such that we usually find a range of common bones forming the bulk of the collection. When mammal bones are studied in the field, most can be identified with confidence without the immediate use of a reference collection. With bird bones, the problems are more complex. The number of species is potentially very large and material recovered from most prehistoric sites seldom has many bird bones. Even from later sites, where domestic birds may be found, the bird bones are usually a small proportion of the whole collection. Consequently the form of the bones in most species is unfamiliar and, unless the archaeozoologist has specialised in bird remains, even a preliminary identification is problematic.

This book offers a concise guide to the basic anatomy of birds, and provides a guide to the identification of bones from familiar British species. Besides its potential for use in the field, it will allow time to be saved; bird bones can be given a preliminary sort before they are taken to a reference collection. It is not the authors' intention that the guide should be used for final identifications.

This book has developed from the work of teaching staff and students in archaeology courses at the Centre, and I am pleased to see it appearing in a revised edition.

A.J. Legge

Reader in Environmental Archaeology
Birkbeck College
Centre for Extra-Mural Studies

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ACKNOWLEDGEMENTS

We would like to thank those whose specimens we have drawn: Peter Rowley-Conwy, Tony Legge, Myrtle Kyllø and Pat Nicolaysen for specimens at the Centre for Extra-Mural Studies; Roger Jones for the Peregrine Falcon; the British Museum (Natural History) for access to the skeleton collection to draw the White-tailed Eagle; and Miss E. Allen, Curator of the Hunterian Museum, the Royal College of Surgeons of England, for access to their Great Auk skeleton. We also thank Dr M. Northcote and Mr R. Symonds, Department of Zoology, University of Cambridge, for permission to draw the Crane and the Golden Plover.

We are grateful to colleagues at the Centre

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FORWARD TO REVISED EDITION

Since the first edition was published in 1986 there has continued to be a demand for the manual as an aid to teaching and in the preliminary stages of bone analysis. This edition includes a number of new features which are intended as aids to the student and zooarchaeologist. We have taken the opportunity to add to the number of illustrations and make some alterations to the labelling. Five new species have been drawn: the Crane, *Grus grus*, Coot, *Fulica atra*, Golden Plover, *Pluvialis apricaria*, Lapwing, *Vanellus vanellus*, and Woodcock, *Scolopax rusticola*. One bone has been added: the proximal (first) phalanx of the major digit of the wing and the sternum is shown of each of

the species included. We also show examples of various other bones in the bird skeleton, illustrated from the Mute Swan. Revisions have been made to the directional labelling and the anatomical terminology to conform more closely to the terms used in *Nomina Anatomica Avium* (Baumel 1979).

A concordance in French, German, Italian and Spanish is included of the common names of the birds illustrated. There are also outlines of the principle bones, showing the measurement points in common use. An account is given of the method of recording bone fragmentation which is in use at the Faunal Remains Unit, University of Southampton.

INTRODUCTION

Archaeologists are increasingly concerned with careful retrieval of plant and animal remains from excavations, and consequently bird bones are being found in increasing numbers. This manual has been compiled for students and archaeologists who wish to identify the bird bones among the faunal assemblages which they are studying. In the Post-Diploma classes of the Centre for Extra-Mural Studies, Birkbeck College, students and researchers work on animal remains from archaeological sites, which usually include some bird bones, and it became clear that an atlas was needed for their identification on the lines of those for the identification of mammal bone such as Schmid (1972) and Pales & Lambert (1971). Existing bird bone atlases are inadequate for European birds or are not widely available (eg Olsen 1979; Gilbert, Martin & Savage 1981; Bacher 1967; Erbersdobler 1968; Otto 1981; Schmidt-Burger 1982; Kellner 1986). Some individual species have been illustrated by earlier authors: the Great Auk, *Alca impennis*, has been illustrated by Grieve (1875), the Golden Eagle, *Aquila chrysaetos*, by Howard (1929), and the Great Northern Diver, *Gavia immer*, by Eastham (1975).

Accurate identification of bird bones presents considerable problems as the number of species which may be found is very much greater than of mammals: many species closely related in size and morphology may be present in a particular range. It is not always made clear to the non-specialist that specific identification is often impossible with closely related species (Morales Muniz 1993).

The manual is intended to be used as a preliminary guide only. For the bones illustrated it can show which families or species may be ruled out and suggest which groups of reference specimens need to be consulted or which bones need to be referred to a specialist.

This edition illustrates 32 species from 18 families (Table 1). The geographical scope is of birds recorded in the British Isles in the post-glacial period. A concordance in French, German, Spanish and Italian to the species illustrated is given in Table 2.

The following bones have been illustrated:

- coracoid
- scapula
- humerus
- ulna
- radius
- carpo-metacarpus
- femur
- tibio-tarsus
- tarso-metatarsus
- synsacrum and pelvis
- sternum
- proximal phalanx (wing)

The principal bones are labelled in the illustration of a pigeon skeleton (Fig. 1).

All bones have been drawn at actual size. Each limb bone, except the ulna, is illustrated in two views. In each pair of illustrations, that on the left shows the left hand bone and that on the right shows the right hand bone. Two views of the right tarso-metatarsus are shown.

For each bone, the Mute Swan, *Cygnus olor*, is illustrated first, and the principal anatomical features are labelled on this. On the other species some diagnostic features which assist identification are arrowed and briefly annotated. For the terminology of avian anatomy in this edition we have followed the *Nomina Anatomica Avium* (Baumel 1979), but have anglicised some of the terms. The directional nomenclature now follows Baumel, with the upper surface of the wing designated as dorsal and the under surface as ventral.

Choice of species for illustration was governed by two criteria. The first is that the bones could be drawn at 1:1 scale, while still retaining clarity of detail. For this reason no species smaller than the Snipe, *Gallinago gallinago*, with a length of 26cm, has been included. Experience of using other manuals showed that it is helpful to the user when all the bones are illustrated at the same scale, and particularly if they can be drawn life size. An additional justification for restricting this guide to the larger birds is that in general it is the bones of the larger

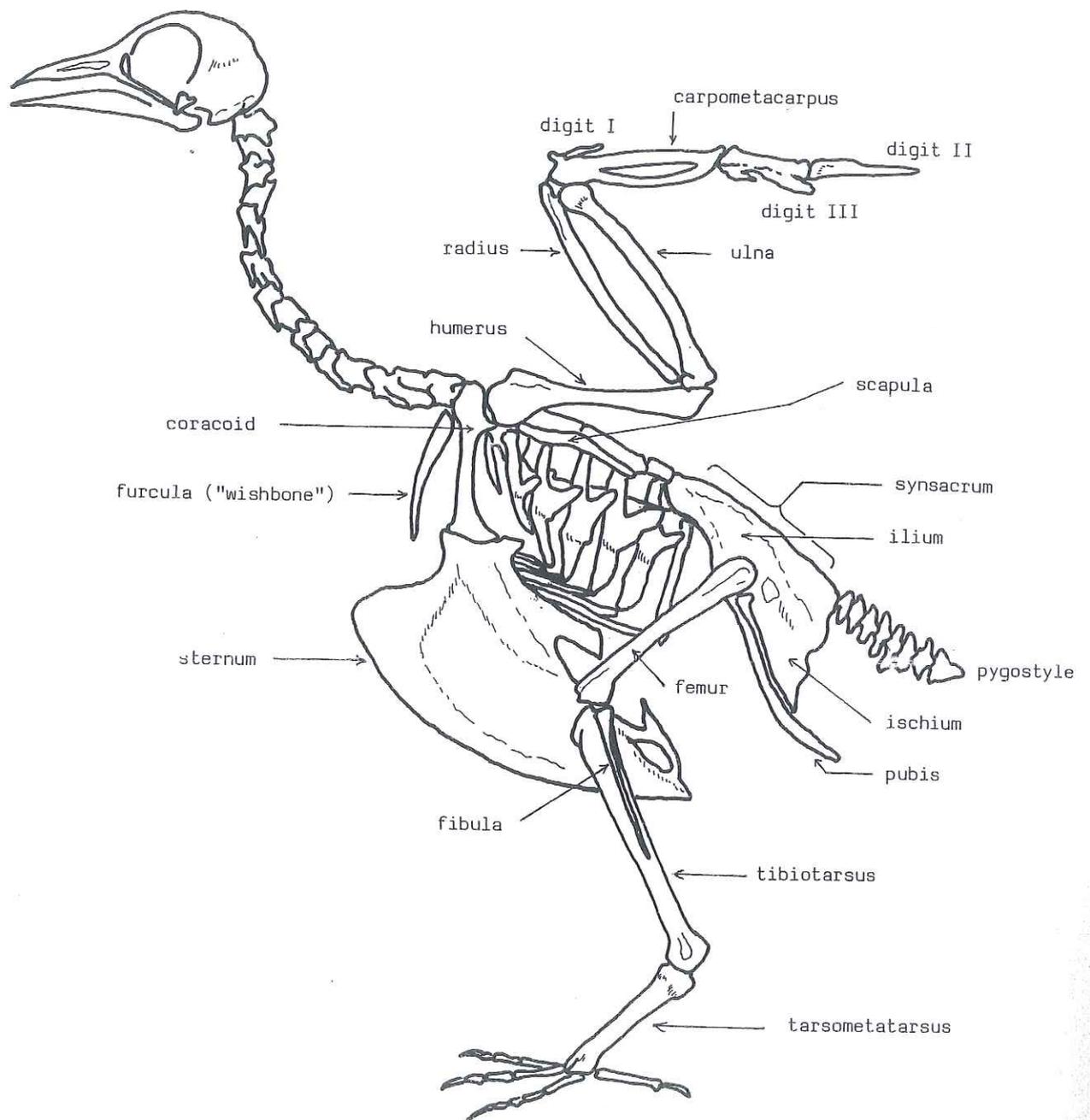


Figure 1 Skeleton of the Pigeon *Columba* after Young 1950

birds which have been found on excavations. This is not only because bones of the smaller birds tend to get overlooked in excavations where the deposits are not sieved, but also because where birds were of economic importance as a source of food, eggs, feathers and other products, larger birds were more commonly selected.

Secondly we have aimed to illustrate at least one example of each family of the species more commonly found in archaeological assemblages. It is not always the species common today which were exploited by man in the past. The White-tailed Eagle, *Haliaeetus albicilla*, for instance, is more often found than the Golden Eagle. The Great Auk, extinct today, is often found in prehistoric coastal sites in Scotland, whereas the Kittiwake, *Rissa tridactyla*, common today, is infrequently found at such sites.

Where more than one species within a family has been illustrated, as with the ducks and the waders, we have chosen species of different sizes so that the user gets some indication of the possible range of sizes within the family. We have drawn the largest common Dabbling Duck, the Mallard, *Anas platyrhynchos*, and the smallest, the Teal, *Anas crecca*. Among the waders the largest, the Curlew, *Numenius arquata*, and intermediate sized species have been drawn. We have also illustrated domestic fowls of two different sizes, a Bantam hen and a middle sized modern fowl. These correspond approximately with the smallest and the largest fowl bones likely to be found among archaeological material.

THE BIRD SKELETON

The skeletons of birds and mammals show major differences resulting from their disparate evolutionary pathways and ecological adaptations. The bird skeleton reflects its adaptation to flight and to running on the hind legs. In addition it has been lightened by thinning of the bone cortex and pneumatisation of some of the bones by means of air sacs, and by the loss of teeth.

Fragmentary bones of birds can be distinguished from mammals by these features as much as by bone morphology. Pneumatisation is an adaptation in which many of the bones are hollow and contain air sacs lined with epithelium which is continuous with that of the nasal sacs, the lining of the tympanic membranes or the bronchial system. The degree of pneumatisation varies between species.

Axial skeleton

The skull (Fig. 2) is thin walled with a large orbit and, like the reptile skull, has a quadrate bone from which the mandible or lower bill is suspended. The number of cervical vertebrae varies from 8 to 25. The upper thoracic vertebrae together form the notarium and the lower fuse to the lumbar vertebrae to form part of the synsacrum. The synsacrum comprises these together with the sacral and anterior caudal vertebrae (p.84-91). The pelvis becomes ankylosed (fused) to the synsacrum in the mature bird. There are five to eight caudal vertebrae and the vertebral column terminates with the pygostyle, to which the main tail feathers are attached. The thoracic ribs are in two parts connected by a movable joint. The dorsal part is two headed and bears a backward pointing uncinat process, a feature which distinguishes bird ribs from small mammals. The sternum (p. 92-100) is a triangular bone with a deep keel.

Appendicular skeleton

The coracoid (p. 12-19), the scapula (p. 20-27), and the pair of clavicles which united form the furcula or "wishbone" (p.104), make up the pectoral girdle (Fig. 3). The forearm or wing (Fig. 4) comprises a humerus (p. 28-35), ulna (p. 36-43), which is a stouter bone than the radius in birds, a radius (p. 44-51) and a carpo-metacarpus (p. 52-59). There are two carpal bones and a variable number of wing phalanges, of which the largest is the first phalanx of the major digit (p. 102-103).

In the hind limb is the femur (p. 60-67) with a patella in the groove between the epicondyles; the tibio-tarsus (p. 68-75), which consists of the tibia fused to the proximal

Table 1 Species illustrated in this manual

Procellariiformes

Procellariidae
 MANX SHEARWATER *Puffinus puffinus*
 Rhum. FRU, DS105

Pelecaniformes

Sulidae
 GANNET *Sula bassana*
 Firth of Forth. FRU, DS4

Phalacrocoracidae
 CORMORANT *Phalacrocorax carbo*
 Denmark. CEMS, P8.1

Ciconiiformes

Ardeidae
 GREY HERON *Ardea cinerea*
 Cambridgeshire. CEMS, H1

Anseriformes

Anatidae
 MUTE SWAN *Cygnus olor*
 Denmark. CEMS, P3.1 female
 DOMESTIC GOOSE *Anser anser*
 Raised in Buckinghamshire. FRU, DS25
 BRENT GOOSE *Branta bernicla*
 Denmark. CEMS, P4.1 male
 TEAL *Anas crecca*
 North Wales. CEMS, P15.2 male
 MALLARD *Anas platyrhynchos*
 North Wales. CEMS, P15.1 female

Falconiformes

Accipitridae
 WHITE-TAILED EAGLE *Haliaeetus albicilla*
 British Museum (Natural History)
 Falconidae
 PEREGRINE FALCON *Falco peregrinus*
 Ancient Monuments Laboratory, English Heritage

Galliformes

Tetraonidae
 RED GROUSE *Lagopus lagopus*
 FRU, DS69
 Phasianidae
 RED-LEGGED PARTRIDGE *Alectoris rufa*
 Cambridgeshire. CEMS, RLP1
 COMMON PARTRIDGE *Perdix perdix*
 Cambridgeshire. CEMS, P1.1
 PHEASANT *Phasianus colchicus*
 North Wales. CEMS, P1.2 male
 DOMESTIC FOWL *Gallus gallus*
 CEMS, MK female.
 The tarso-metatarsus is an archaeological example
 showing a spur
 DOMESTIC FOWL (BANTAM) *Gallus gallus*
 Free range. CEMS, BH1 female

Gruiformes

Gruidae
 CRANE *Grus grus*
 UMZC, BAC and 344S

Rallidae
 COOT *Fulica atra*
 CEMS, P11.1

Charadriiformes

Charadriidae
 LAPWING *Vanellus vanellus*
 FRU, DS95

GOLDEN PLOVER *Pluvialis apricaria*
 UMZC 1031

Scolopacidae
 CURLEW *Numenius arquata*
 Orkney. FRU, DS77

BAR-TAILED GODWIT *Limosa lapponica*
 Denmark. CEMS, P13.1 female

SNIBE *Gallinago gallinago*
 Cambridgeshire. CEMS, AA

WOODCOCK *Scolopax rusticola*
 CEMS, WC1

Laridae
 HERRING GULL *Larus argentatus*
 Firth of Forth. FRU, DS5

KITTIWAKE *Rissa tridactyla*
 Firth of Forth. FRU, DS6

Alcidae
 GREAT AUK *Alca impennis*
 Hunterian Museum and archaeological specimens

GUILLEMOT *Uria aalge*
 Firth of Forth. FRU, DS3

PUFFIN *Fratercula arctica*
 Northumberland. FRU, DS52

Columbiformes

Columbidae
 WOOD PIGEON *Columba palumbus*
 Cambridgeshire. CEMS, WP1

Strigiformes

Strigidae
 TAWNY OWL *Strix aluco*
 Surrey. FRU, DS43

Passeriformes

Corvidae
 CARRION CROW *Corvus corone*
 Buckinghamshire. FRU, DS40

CEMS Centre for Extra-Mural Studies, Birkbeck
 College, London
 FRU Faunal Remains Unit, University of Southampton
 UMZC University Museum of Zoology, Cambridge

row of tarsals; and the fibula, a reduced splint like bone. The distal row of tarsals has fused to metatarsals II, III and IV to form the tarso-metatarsus (p. 76-83). The articular ends of the distal tibio-tarsus and the proximal tarso-metatarsus are unfused or cartilaginous in immature birds. Digits II, III and IV articulate with the trochleas of the tarso-metatarsus and point forward in most species and the first hind digit points backwards (Fig. 5). The number of foot phalanges varies.

SEXING BIRD BONES

Three methods have been used to sex bird bones: size distinctions, the presence of a spur on the tarso-metatarsus of domestic fowl and some of the other Galliformes, and the presence of medullary bone.

Measurements used to investigate sexual dimorphism in bird bones necessarily depend on which bones or bone ends are most often found: the length and distal width of the femur and the tibio-tarsus have been used (Bourdillon & Coy 1980, Coy 1983).

Fully mature males of some of the Galliformes have a spur on the medial side of the tarso-metatarsus. However, this is not an infallible indication of sex, as some domestic hens have rudimentary spurs and spurs are lacking in the males of some breeds (Sadler 1991).

Medullary bone is a granular tissue which fills the marrow cavity of some of the long bones of female birds prior to lay: it has been found in bones of wild and domestic birds from archaeological sites (Driver 1982, Coy 1983). It consists of short thick spicules of bone, which extend round the endosteal lining, and may entirely fill the bone cavity. Most of the research into medullary bone has been with domestic fowl. Some observations have been made on its presence in pigeons; there is little evidence for how long it persists in other species, but it is present for a shorter period in other species compared to domestic fowl because the latter has a very extended period of lay. In domestic fowl medullary bone develops over the 10-14 days before the first egg is laid.

For eggshell production calcium is withdrawn from the blood into the gut, drawing on reserves in the skeleton, and the medullary cavity of the main limb bones acts as a buffer. The amount of medullary bone varies from bird to bird and fluctuates during the period of laying (Taylor 1962; Taylor, Simkiss & Stringer 1971). It is most common in the femur and tibio-tarsus, but has been observed in other bones.

BIRD BONE MATURATION

Ornithologists define birds as juvenile until they attain adult plumage. The bones however reach adult form before the plumage, and it is important not to confuse immaturity in the bones with immaturity in plumage or behaviour. Immature bones are most often seen archaeologically in domestic fowl but are sometimes seen in other birds recovered from archaeological excavations. Other than a recent paper by Starck (1994), there has been little scientific work on the development of the skeletal elements between hatching and maturity, even in domestic fowl (Serjeantson 1995). Though the long bones do not have epiphyses at the ends, several parts of the skeleton are unfused at hatching and fuse or ankylose later. The rate of bone calcification varies between precocial birds, which walk or swim soon after hatching but grow slowly, and altricial birds, which remain inactive at the nest site for a long period and grow rapidly (Starck 1994). Domestic fowls fall into the first group.

The following account of bone maturation is based on data from Baumel (1979), Sadler (1991), Starck (1994) and personal observation. Early in the post natal development the bones of the pelvis or os coxae unite. The "processes of the ilium ankylose with the ischium and pubis forming a complete acetabular ring of bone" (Baumel, 1979, 102). The first of the limb bones to unite is the carpo-metacarpus. "Certain of the fetal *Ossa carpi centralia* and *Ossa carpi distalia* ankylose with the proximal ends of the metacarpals [ie metacarpals II and III] in early postnatal life to produce the compound

bone, the Carpo-metacarpus" (Baumel 1979, 100). Later, the proximal part of the tibio-tarsus, fuses to the body of the bone. The last limb bone to fuse is the tarso-metatarsus: the hypotarsus fuses to metatarsi II, III and IV, which have united before hatching. In one study of a traditional breed of domestic fowl, the Leghorn (quoted in Sadler 1991), the earliest age at which the fusion line had completely disappeared was 139 days for females and 195 days for males. In Galliformes, the spur, where present, begins to ossify separately from the bone. It fuses to the tarso-metatarsus between seven and eight months in fast maturing birds, and later in older types of fowl. The synsacral vertebrae unite with each other before the whole ankyloses with the pelvis. In some species the ligaments and tendons of thoracic vertebrae 2 - 5 ossify to form the rigid notarium. The articular ends of other parts of the skeleton are porous and unformed in young birds.

Table 2. Concordance: German, French, Spanish and Italian

ENGLISH	LATIN	GERMAN	FRENCH	SPANISH	ITALIAN
Manx Shearwater	<i>Puffinus puffinus</i>	Schwarzschnabel- sturmtaucher	Puffin des anglais	Pardela pichoneta	Berta minore
Gannet	<i>Sula bassana</i>	Basstölpel	Fou de bassan	Alcatraz	Sula
Cormorant	<i>Phalacrocorax carbo</i>	Kormoran	Grand cormoran	Cormorán grande	Marangone
Grey Heron	<i>Ardea cinerea</i>	Fischreiher	Héron cendré	Garza real	Airone cenerino
Mute Swan	<i>Cygnus olor</i>	Höckerschwan	Cygne tubercule	Cisne vulgar	Cigno reale
Domestic Goose	<i>Anser anser</i>	Graugans	Oie cendrée	Ansar común	Oca selvatica
Brent Goose	<i>Branta bernicla</i>	Ringelgans	Bernache cravant	Barnacla carinegra	Oca colombaccio
Teal	<i>Anas crecca</i>	Krickente	Sarcelle	Cerceta común	Alzavola
Mallard	<i>Anas platyrhynchos</i>	Stockente	Canard colvert	Anade real	Germano reale
White-tailed Eagle	<i>Haliaeetus albicilla</i>	Secadler	Pygargue à queue blanche	Pigargo	Aquila di mare
Peregrine Falcon	<i>Falco peregrinus</i>	Wanderfalke	Faucon pèlerin	Halcon común	Falco pellegrino
Red Grouse	<i>Lagopus lagopus</i>	Moorschneehuhn	Lagopède d'Écosse	Lagopodo	Pernice bianca nordica
Red-legged Partridge	<i>Alectoris rufa</i>	Rothuhn	Perdrix rouge	Perdiz roja	Pernice rossa
Common Partridge	<i>Perdix perdix</i>	Rebhuhn	Perdrix grise	Perdiz pardilla	Starna
Pheasant	<i>Phasianus colchicus</i>	Jagdfasan	Faisan de colchide	Faisan vulgar	Fagiano
Domestic Fowl	<i>Gallus gallus</i>	Huhn	Poulet	Pollo	Pollo
Crane	<i>Grus grus</i>	Kranich	Grue cendrée	Grulla común	Gru
Coot	<i>Fulica atra</i>	Blässhuhn	Foulque macroule	Focha común	Folaga
Lapwing	<i>Vanellus vanellus</i>	Kiebitz	Vanneau huppé	Avefria	Pavoncella
Golden Plover	<i>Pluvialis apricaria</i>	Goldregenpfeifer	Pluvier doré	Chorlito dorado	Piviere dorato
Curlew	<i>Numenius arquata</i>	Grosser Brachvogel	Courlis cendré	Zarapito real	Chiurlo maggiore
Bar-tailed Godwit	<i>Limosa lapponica</i>	Pfuhlschnepfe	Barge rousse	Aguja colipinta	Pittima minore
Snipe	<i>Gallinago gallinago</i>	Bekassine	Bécassine des marais	Agachadiza común	Beccacino
Woodcock	<i>Scolapax rusticola</i>	Waldschnepfe	Bécasse des bois	Choca perdiz	Beccaccia
Herring Gull	<i>Larus argentatus</i>	Silbermöwe	Goéland argenté	Gaviota argentea	Gabbiano reale
Kittiwake	<i>Rissa tridactyla</i>	Dreizehenmöwe	Mouette tridactyle	Gaviota tridactila	Gabbiano tridattilo
Great Auk	<i>Alca impennis</i>	Riesenalk	Grand pingouin	Alca gigante	Alca impenne
Guillemot	<i>Uria aalge</i>	Trottellunne	Guillemot de troil	Arao común	Uria
Puffin	<i>Fratercula arctica</i>	Papageitaucher	Macareux moine	Frailecillo	Pulcinella di mare
Wood Pigeon	<i>Columba palumbus</i>	Ringeltaube	Pigeon ramier	Paloma torcaz	Colombaccio
Tawny Owl	<i>Strix aluco</i>	Waldkauz	Chouette hulotte	Carabo	Allocco
Crow	<i>Corvus corone</i>	Krähé	Corneille	Coneja	Cornacchia

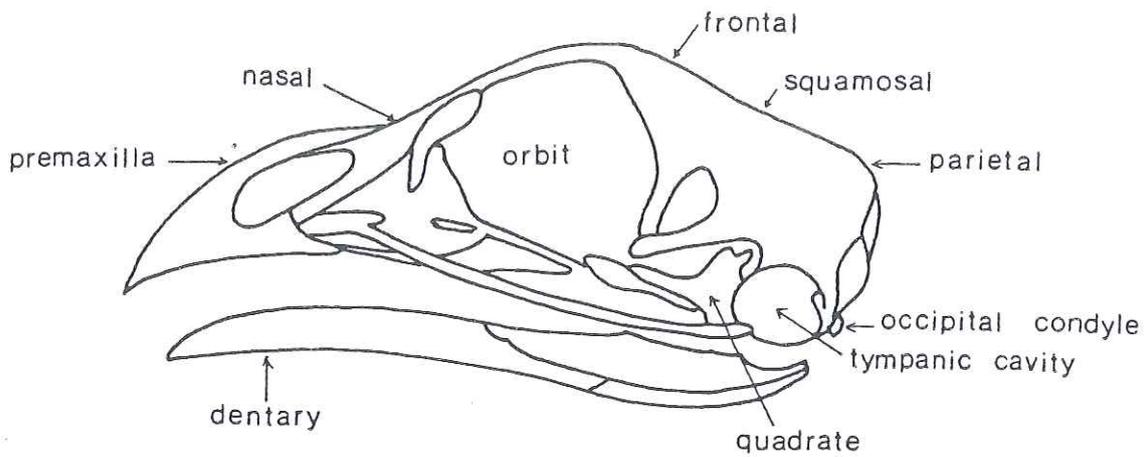


Figure 2 Skull of domestic fowl

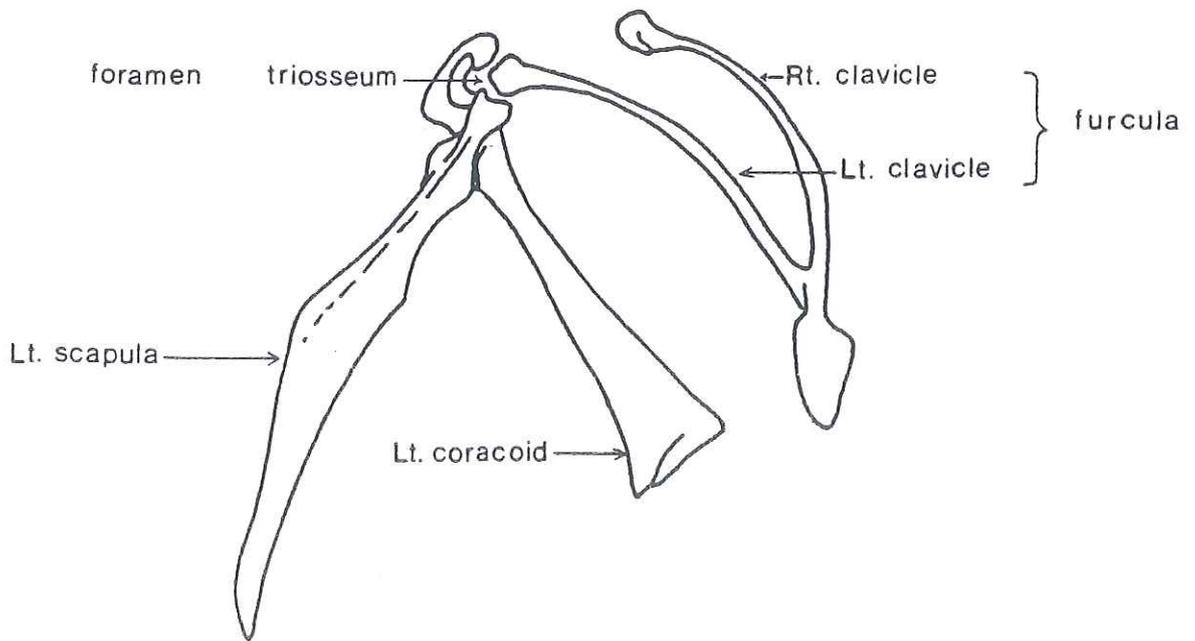


Figure 3 Pectoral girdle of domestic fowl

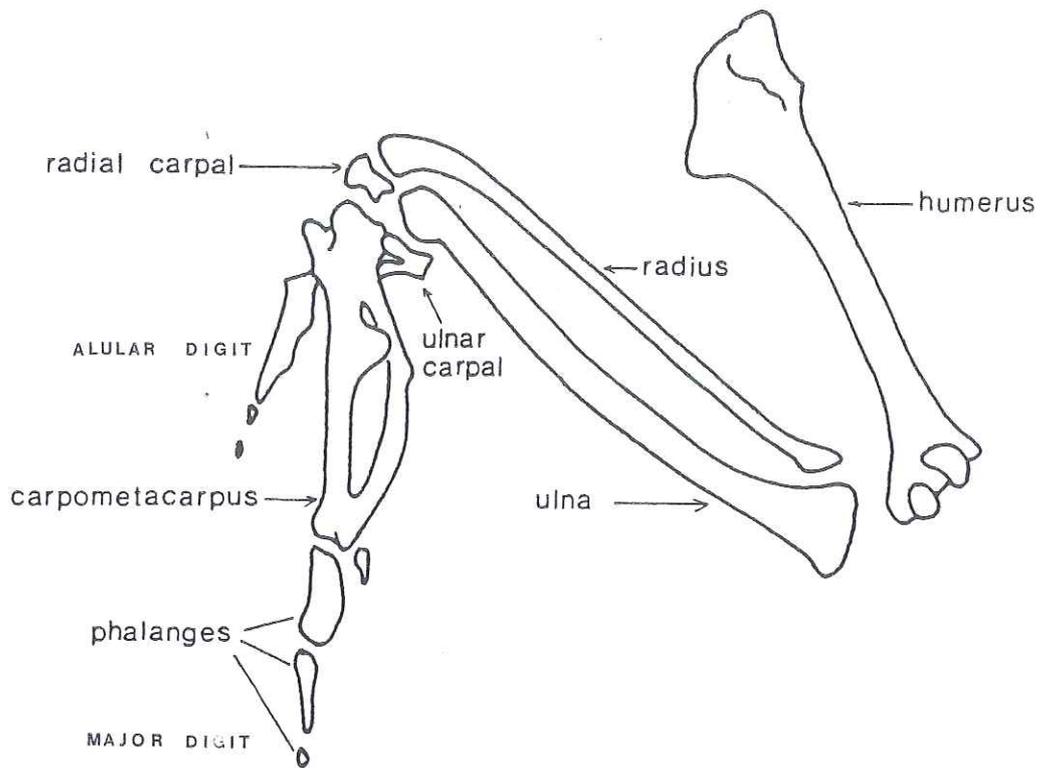


Figure 4 Bones of the wing of domestic fowl

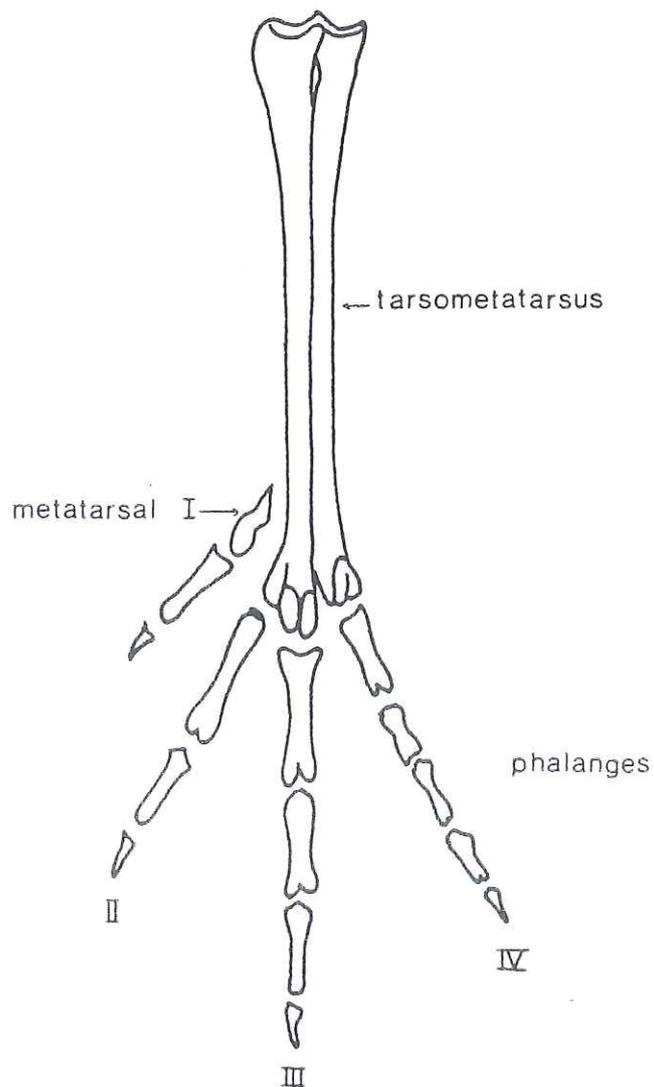
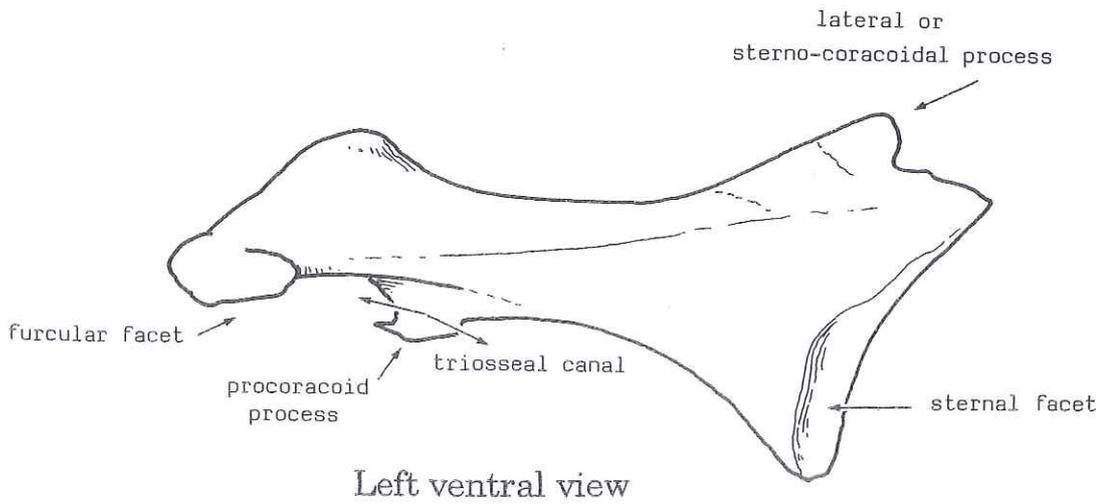
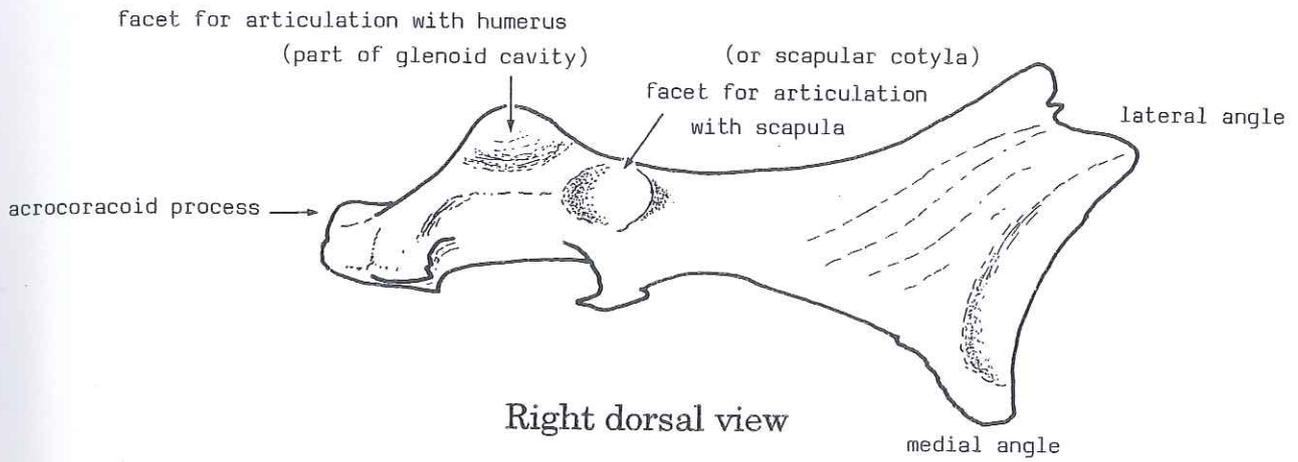


Figure 5 Bones of the foot of domestic fowl

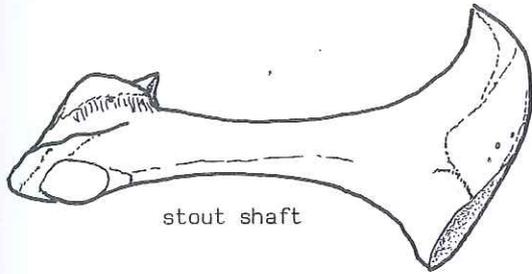
CORACOID

Mute Swan

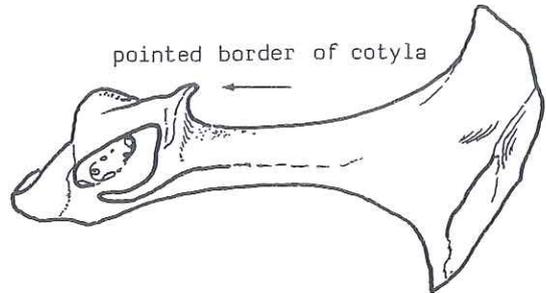


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L

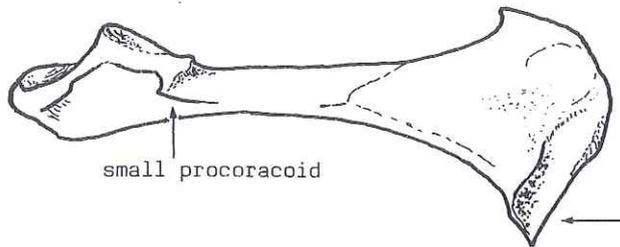
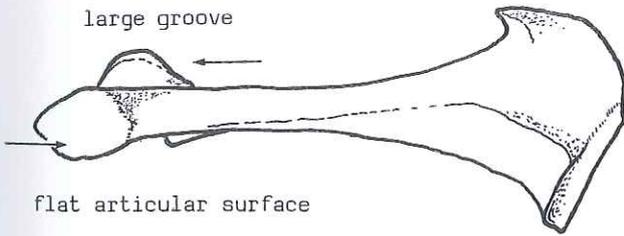


R

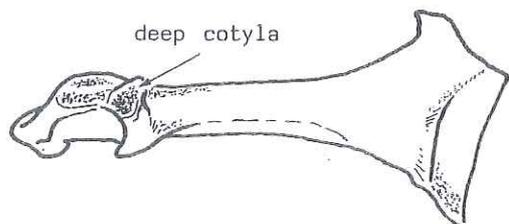
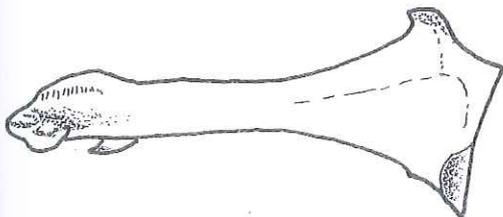


Gannet

large groove



Cormorant

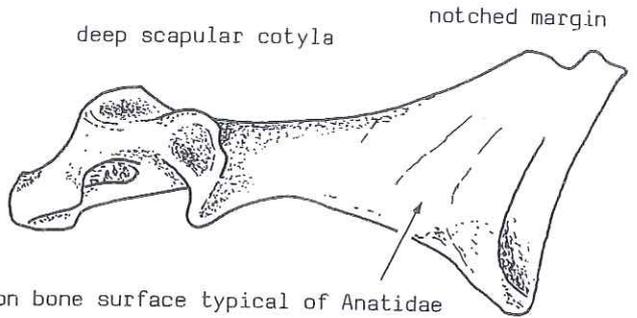
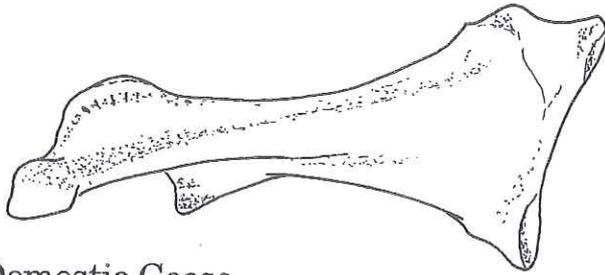


Grey Heron

CORACOID

L

R



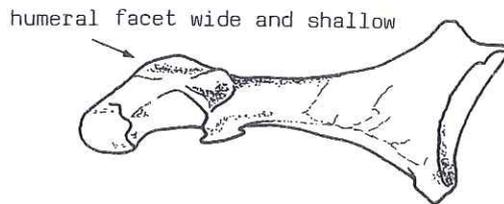
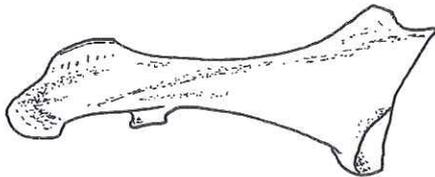
Domestic Goose

stouter bone shaft
than Ducks

ridges on bone surface typical of Anatidae

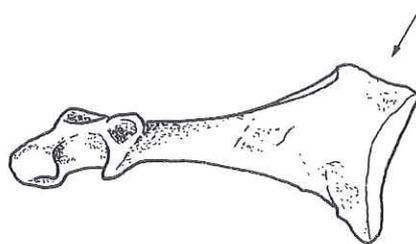
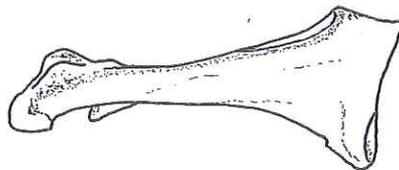
deep scapular cotyla

notched margin



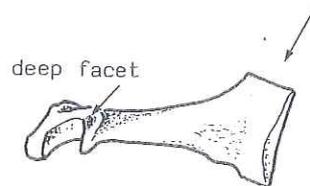
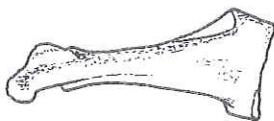
Brent Goose

humeral facet wide and shallow



Mallard

characteristic square sterno-coracoid process of Ducks

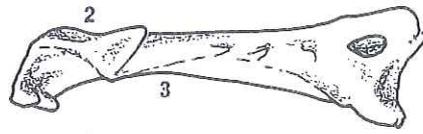
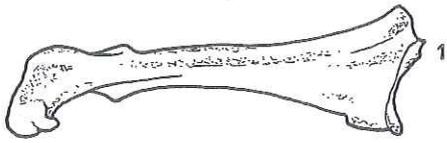


Teal

deep facet

CORACOID

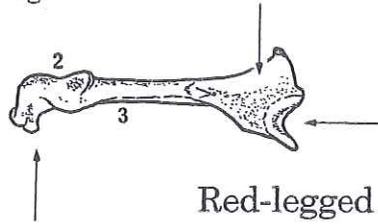
L A long thin bone in Galliformes R



Pheasant

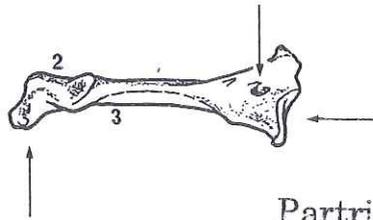
Note several common features:

- 1 angular distal margin
- 2 shallow humeral facets
- 3 ridge from procoracoid to medial angle

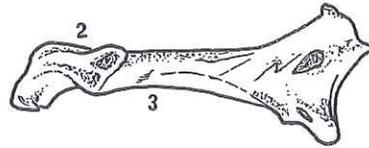


Red-legged Partridge

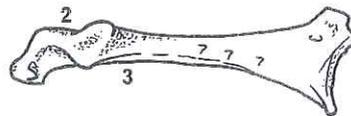
note major differences here



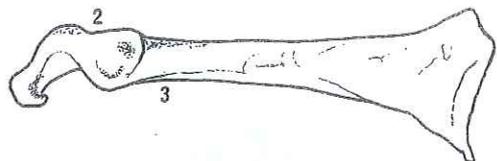
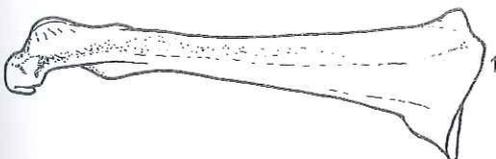
Partridge



Red Grouse



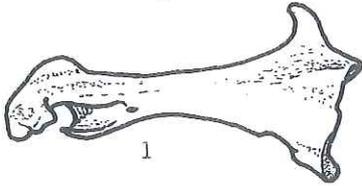
Bantam



Domestic Fowl

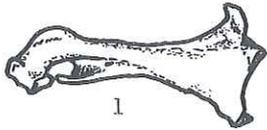
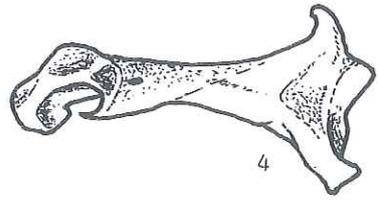
CORACOID

L

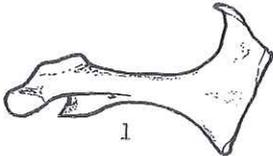
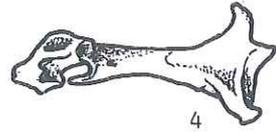


Herring Gull

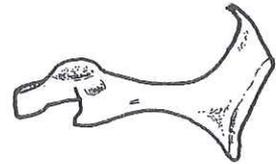
R



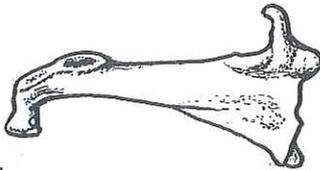
Kittiwake



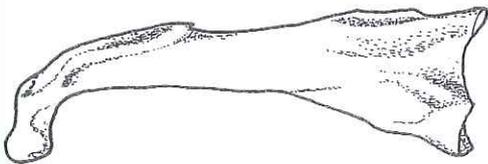
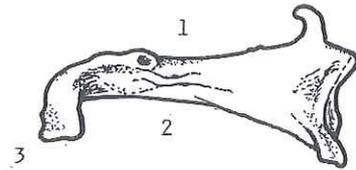
Manx Shearwater



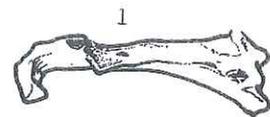
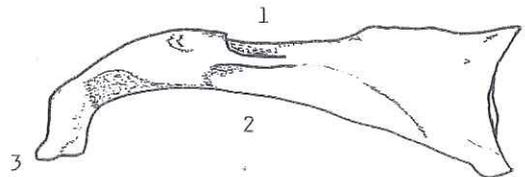
Note: 1 foramen penetrating procoracoid
 2 prominent caudally directed procoracoids of Auks
 3 shape of acrocoracoid process of Auks
 4 notch in Gulls



Guillemot



Great Auk



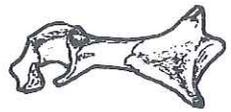
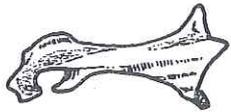
CORACOID

L

R

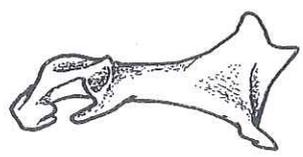
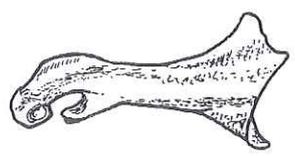


Snipe

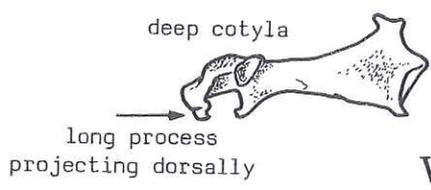
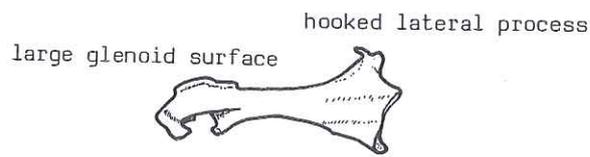


In the Waders a short bone with a wide sternal end similar to Gulls but no foramen

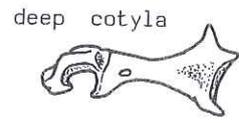
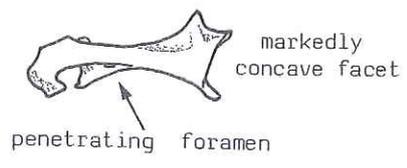
Godwit



Curlew

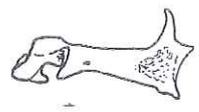


Woodcock



Lapwing

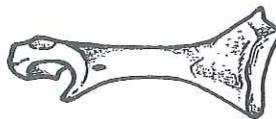
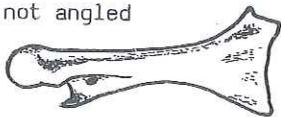
Plovers do have a coracoidal foramen



Golden Plover

CORACOID

humeral end not angled



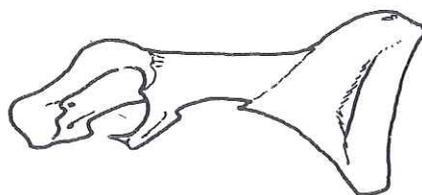
Tawny Owl

L

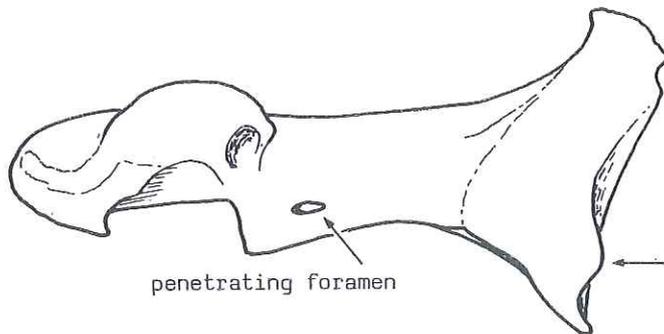
R



no foramen



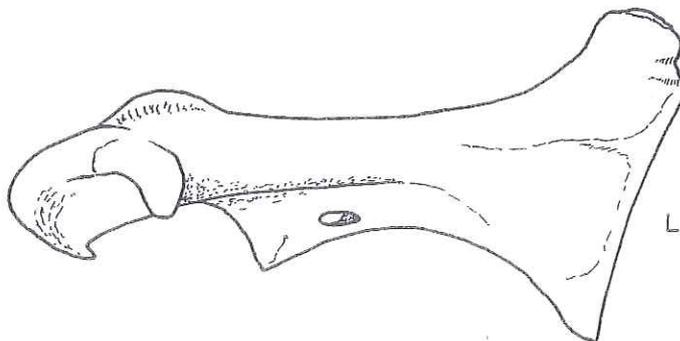
Peregrine Falcon



penetrating foramen

R

note deep concave facet

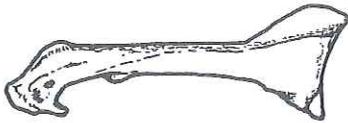


L

White-tailed Eagle

CORACOID

L



long thin bone with
triangular sternal end

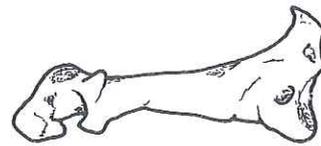
R



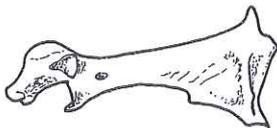
Crow



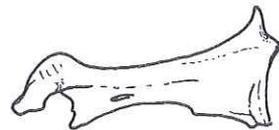
enclosed triosseal canal



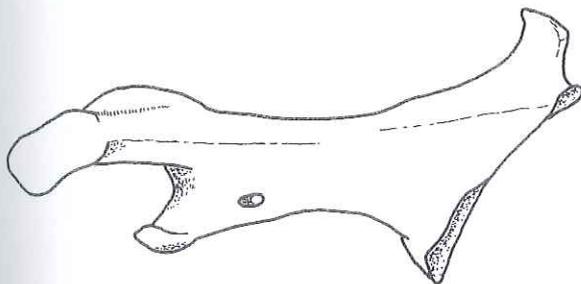
Wood Pigeon



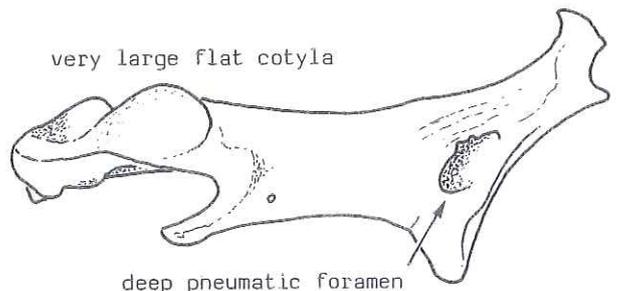
long foramen
penetrating obliquely



Coot



very large flat cotyla

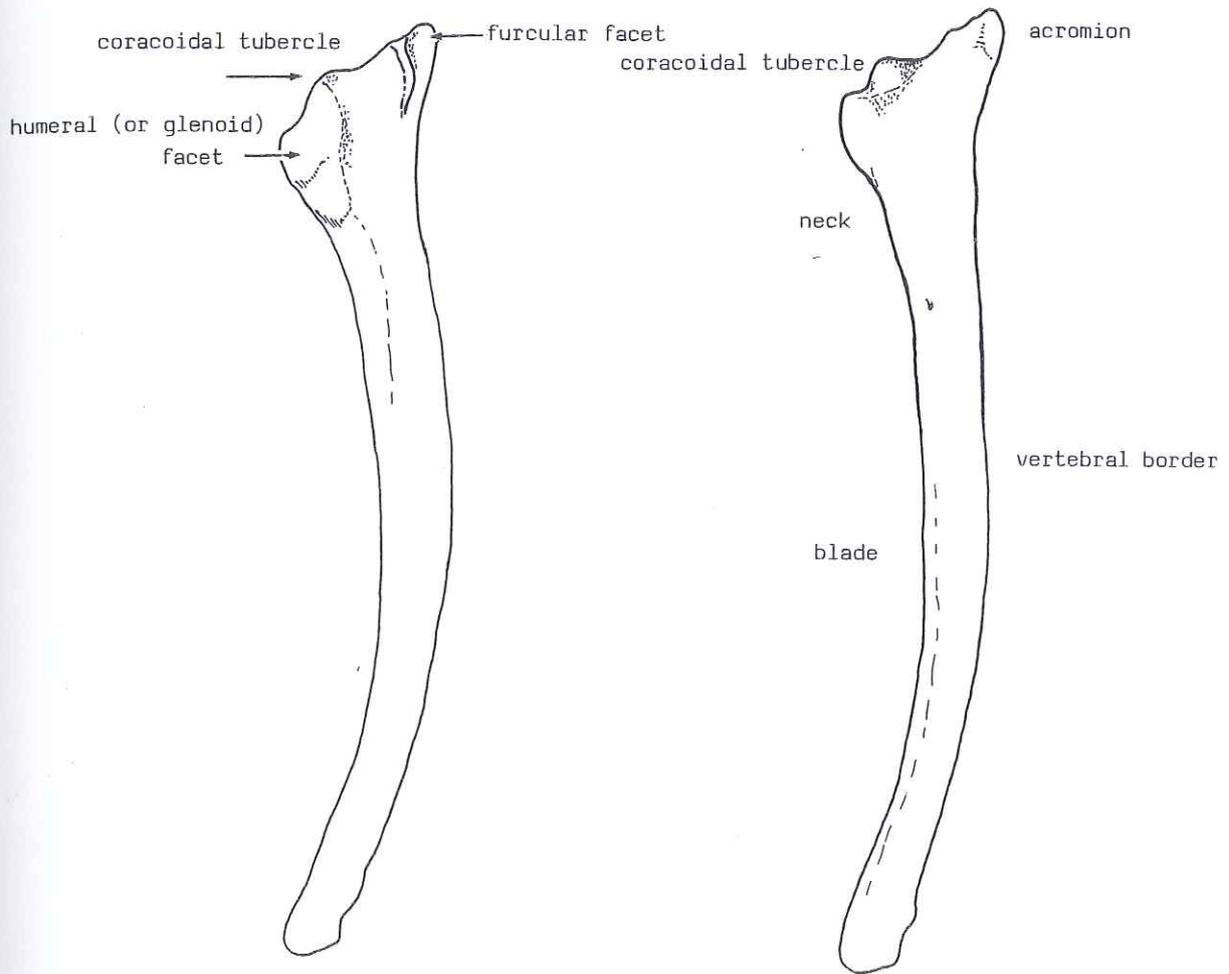


deep pneumatic foramen

Crane

SCAPULA

Mute Swan



Left lateral view

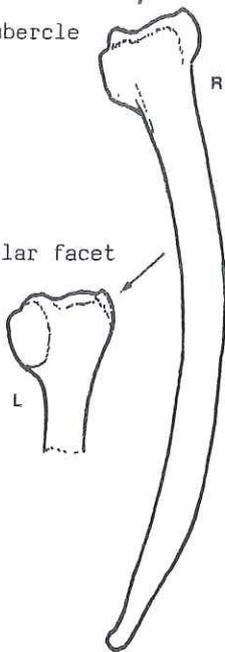
Right costal view

The shapes of glenoid and acromion are good diagnostic features

SCAPULA

conical coracoidal tubercle rounded acromion

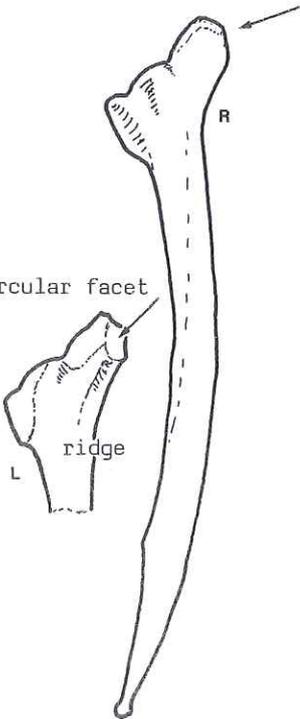
small furcular facet



Grey Heron

furcular facet not visible

furcular facet



Cormorant

pointed acromion

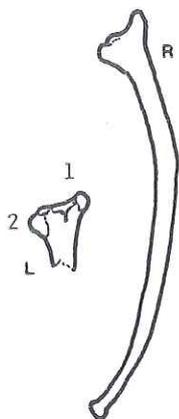
no acromial crest

pneumatic foramen

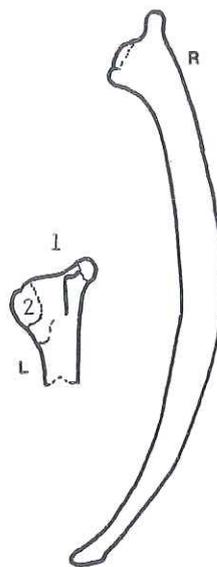


Gannet

SCAPULA

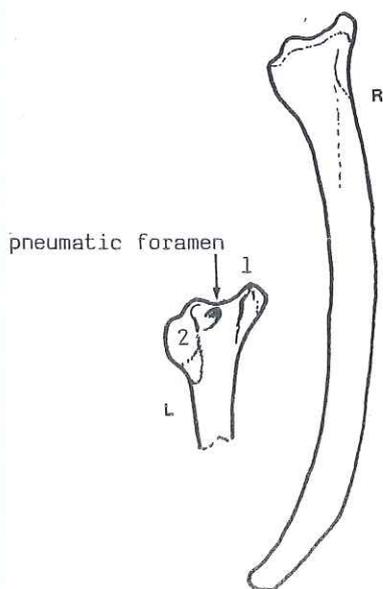


Teal

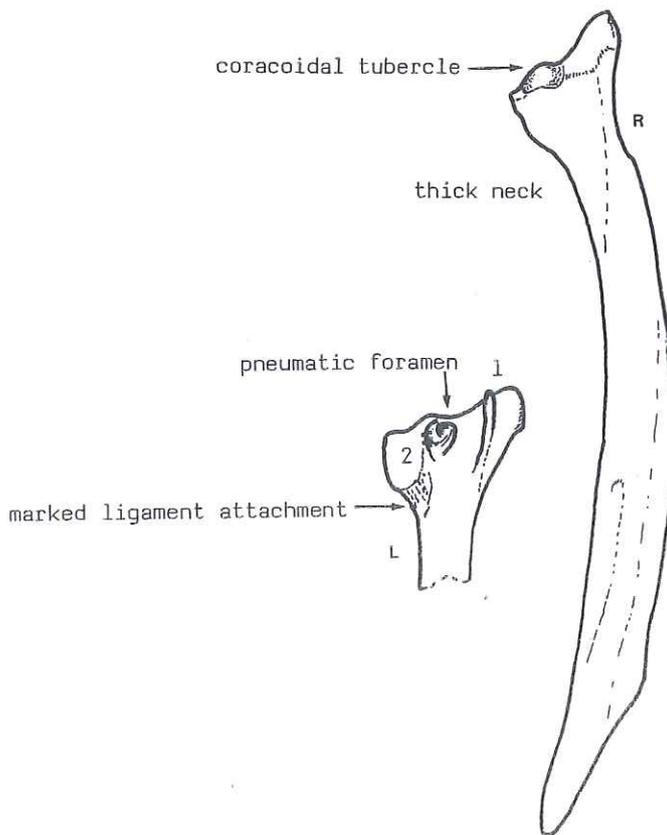


Mallard

Geese and Ducks have:
 1 projection on acromion
 2 flat glenoid facets

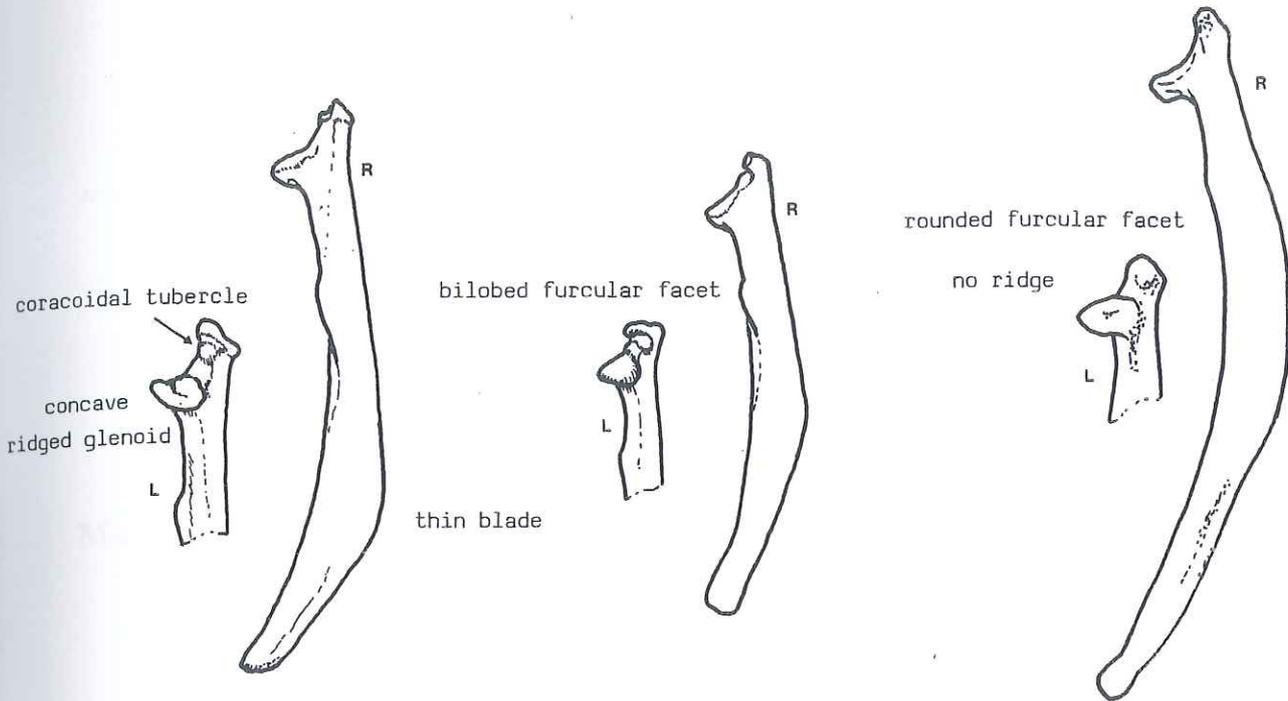


Brent Goose



Domestic Goose

SCAPULA



Domestic Fowl

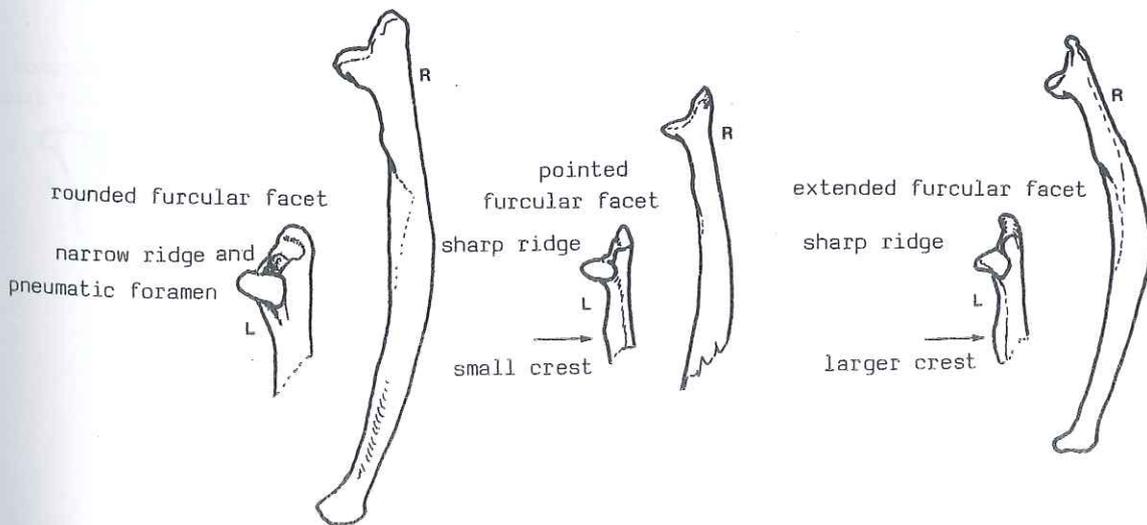
Bantam

Pheasant

Note:

1 platform shaped glenoid facet in Galliformes

2 ridge joining glenoid and furcular facets varies between species

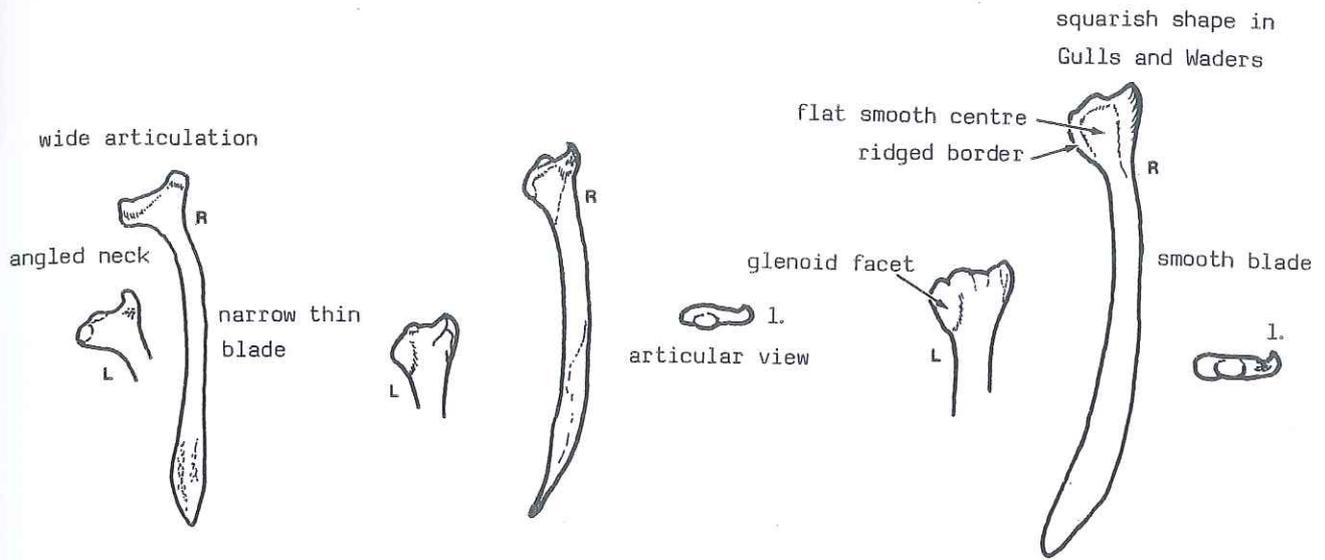


Red Grouse

Partridge

Red-legged Partridge

SCAPULA

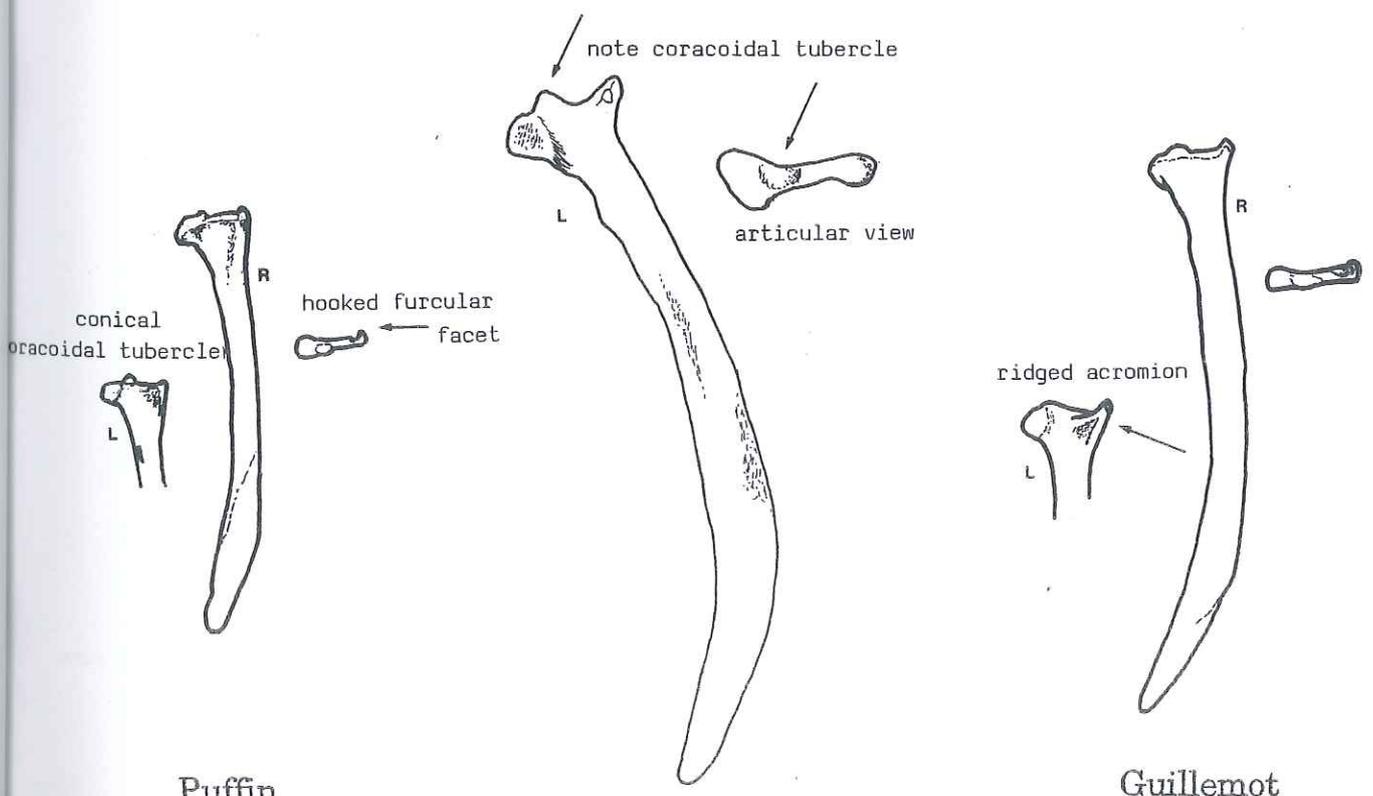


Manx Shearwater

Kittiwake

Herring Gull

1 note furcular facet curved and hooked laterally in Gulls



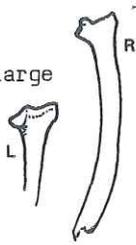
Puffin

Great Auk

Guillemot

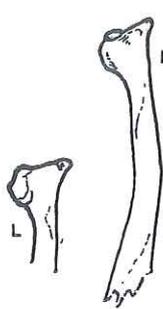
SCAPULA

relatively large
glenoid
facet



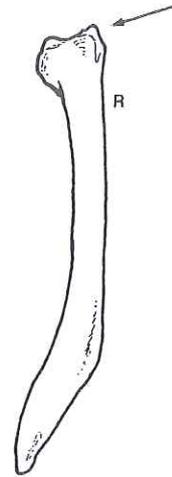
Snipe

pointed process

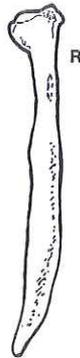


Godwit

elongated
oval glenoid
facet

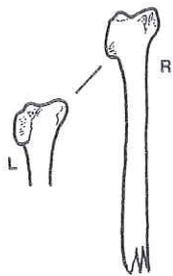


Curlew



Woodcock

squarish glenoid facet

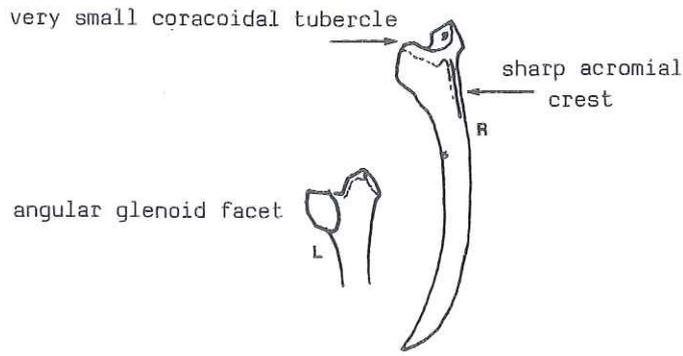


Lapwing

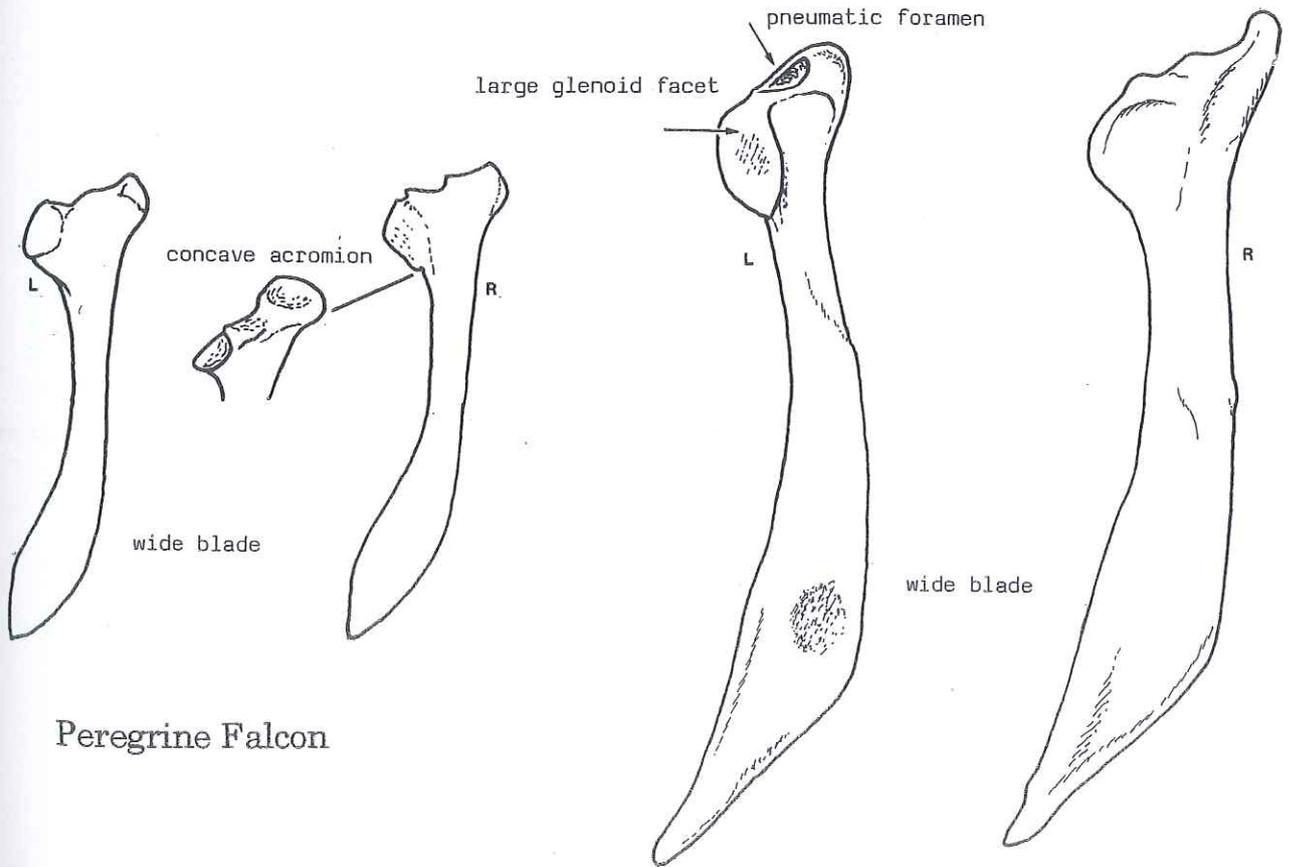


Golden Plover

SCAPULA



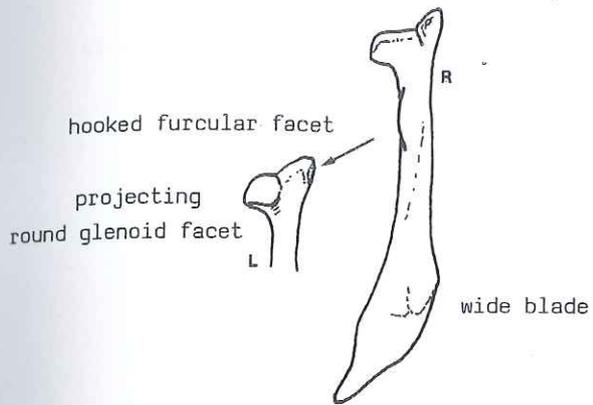
Tawny Owl



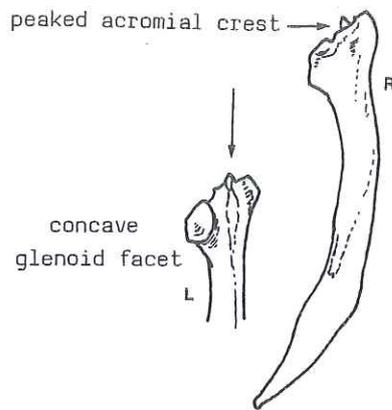
Peregrine Falcon

White-tailed Eagle

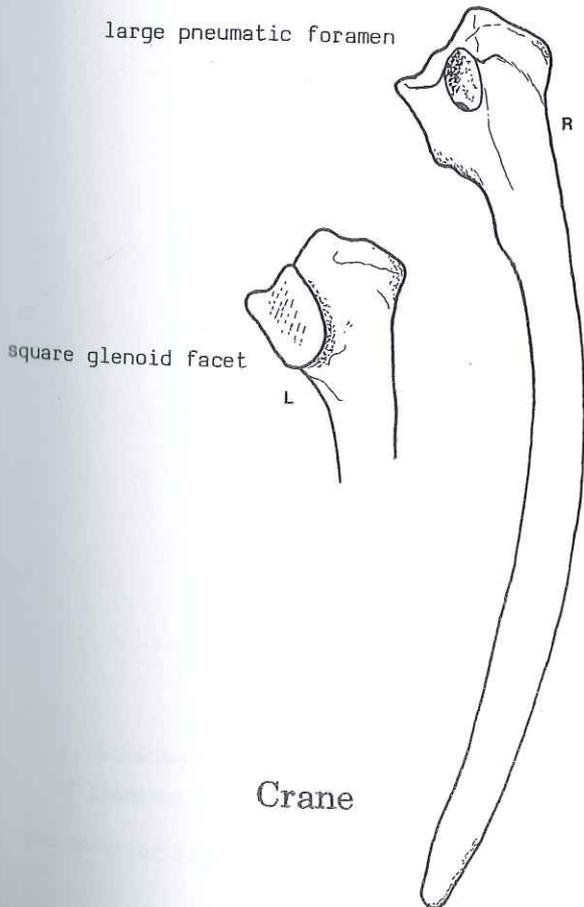
SCAPULA



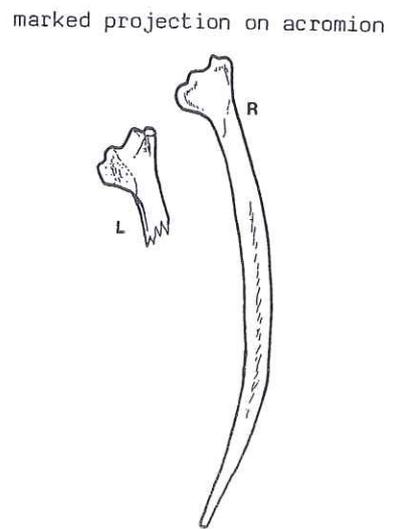
Wood Pigeon



Crow

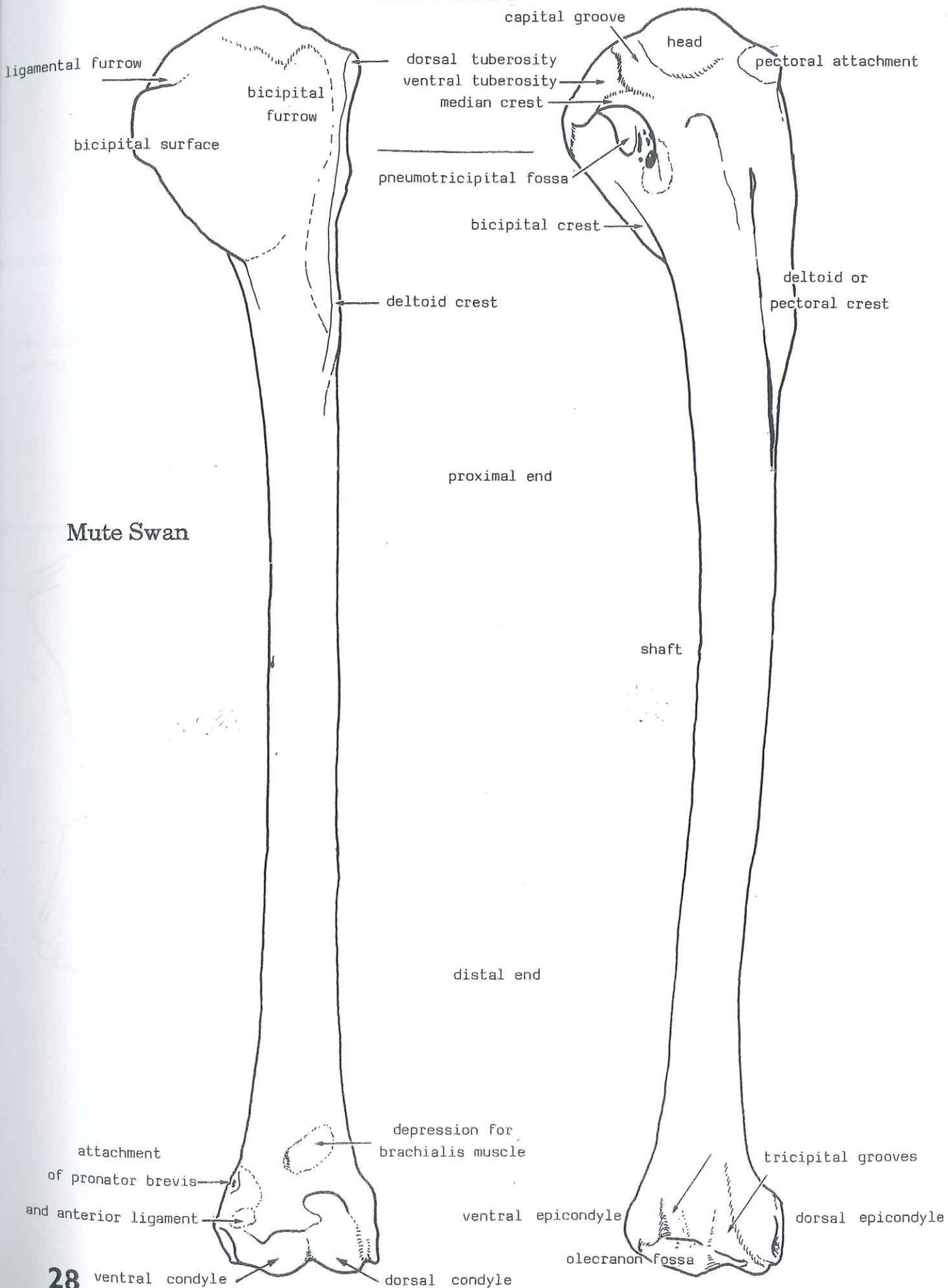


Crane



Coot

HUMERUS

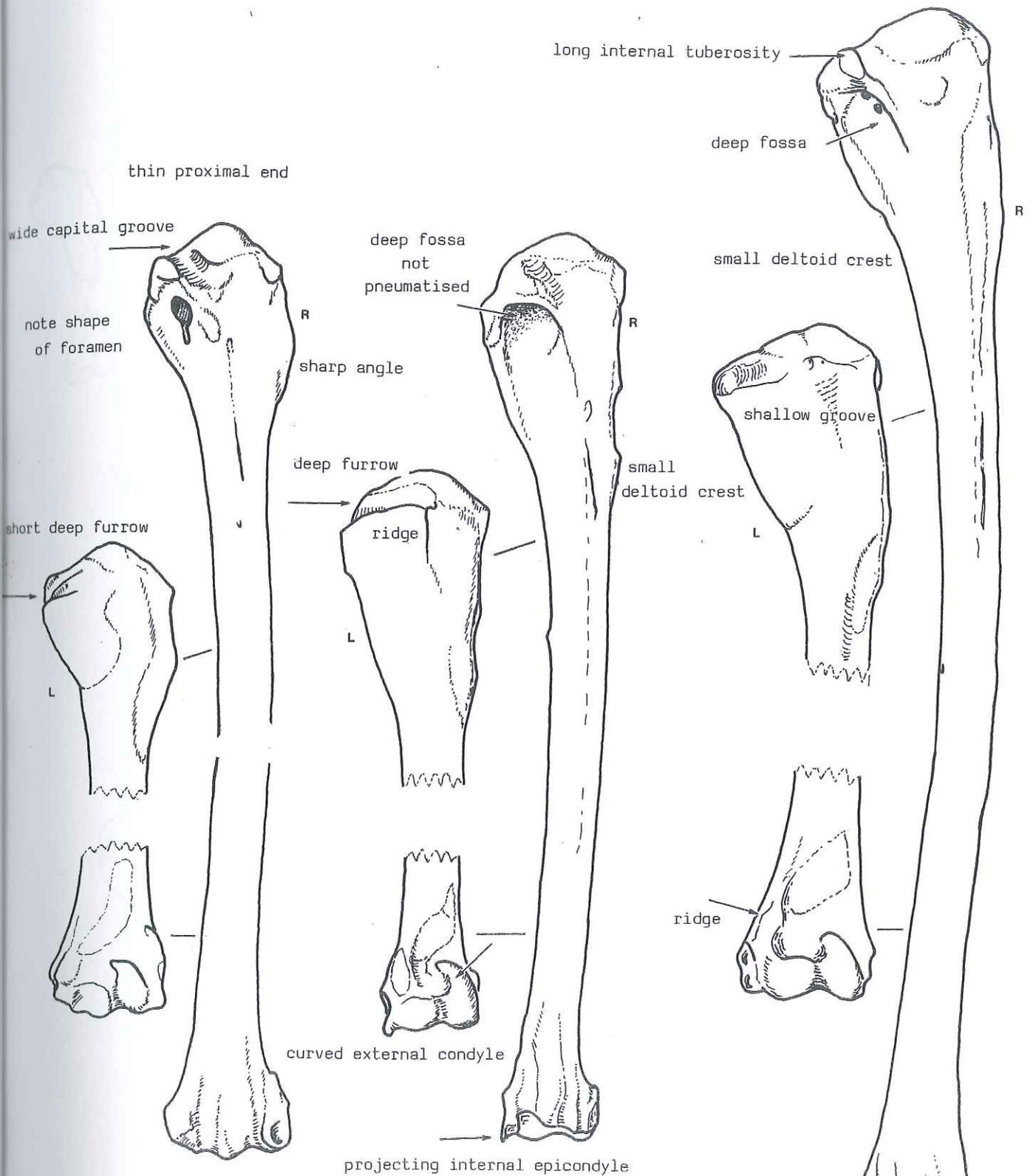


Mute Swan

Left caudal view

Right cranial view

HUMERUS

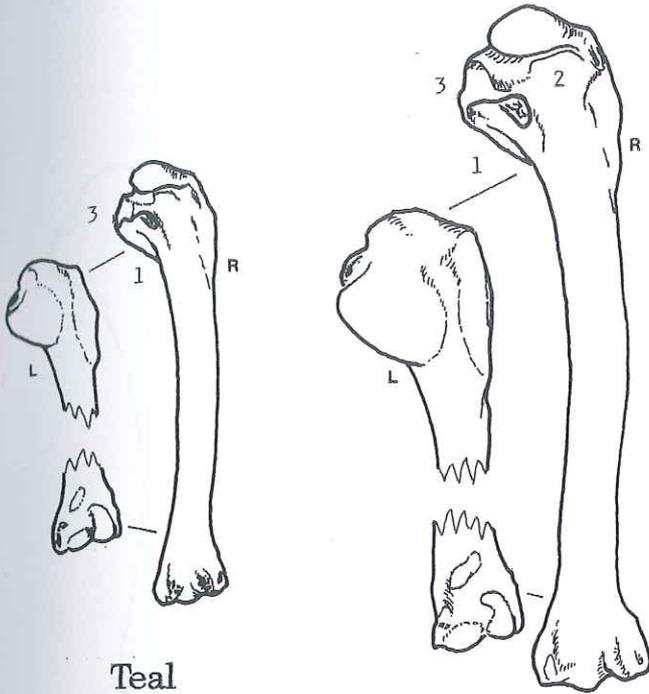


Grey Heron

Cormorant

Gannet

HUMERUS

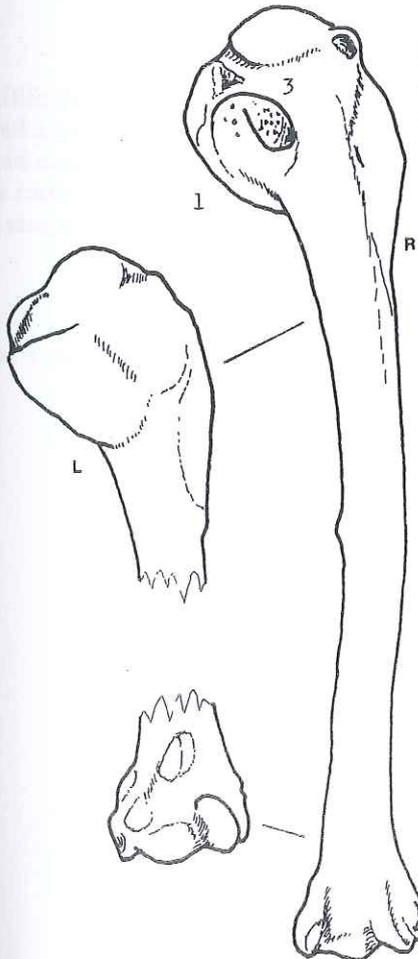


Teal

Mallard

1 bicipital crest: curved in Geese, straight in Ducks
 2 undercut head in Ducks
 3 median crest more curved in Geese

stout proximal end in Geese and Ducks



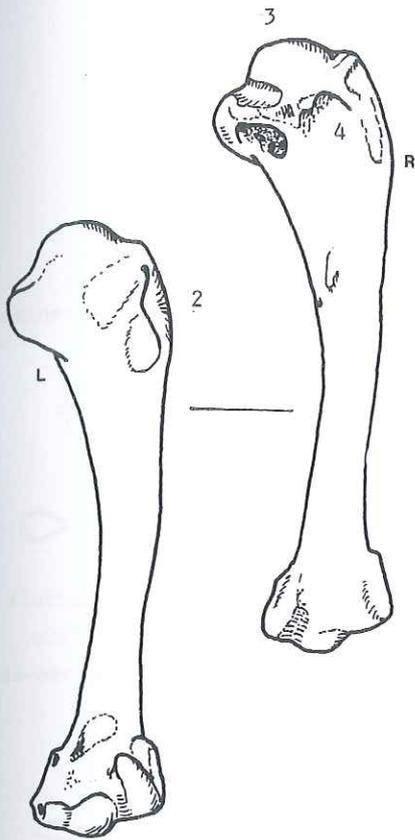
Brent Goose



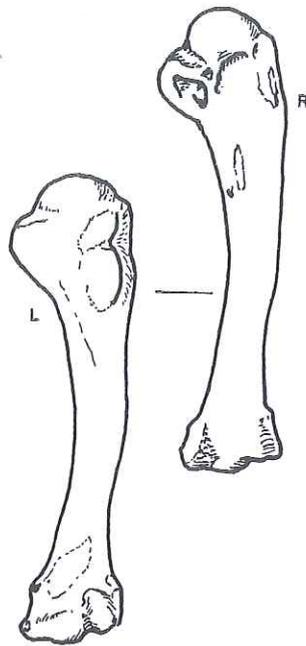
Domestic Goose

prominent
 deltoid crest in
 Geese and Ducks

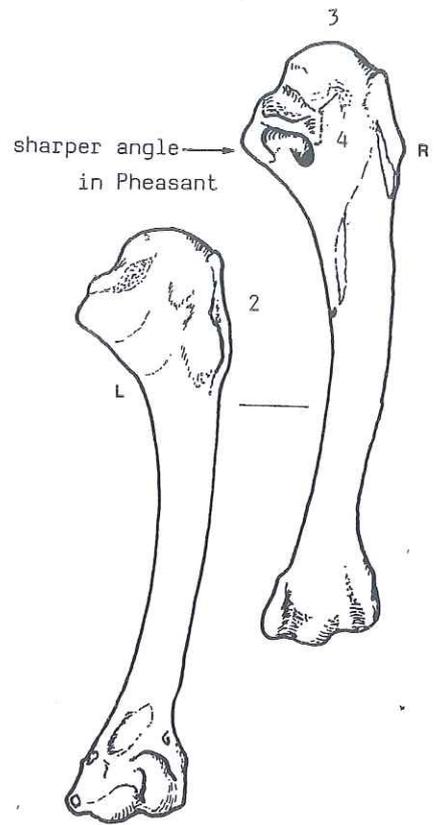
HUMERUS



Domestic Fowl



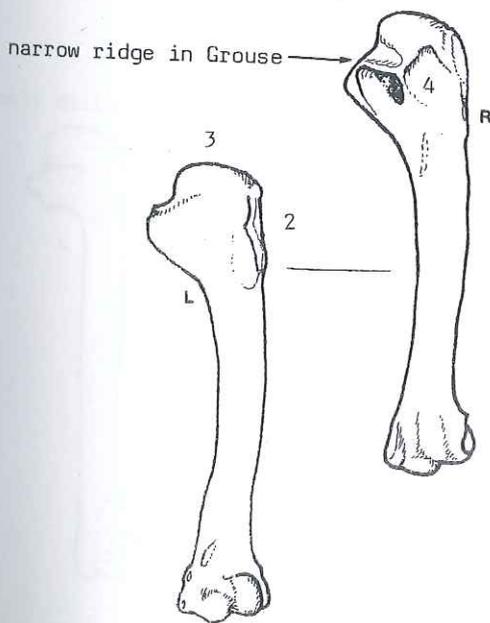
Bantam



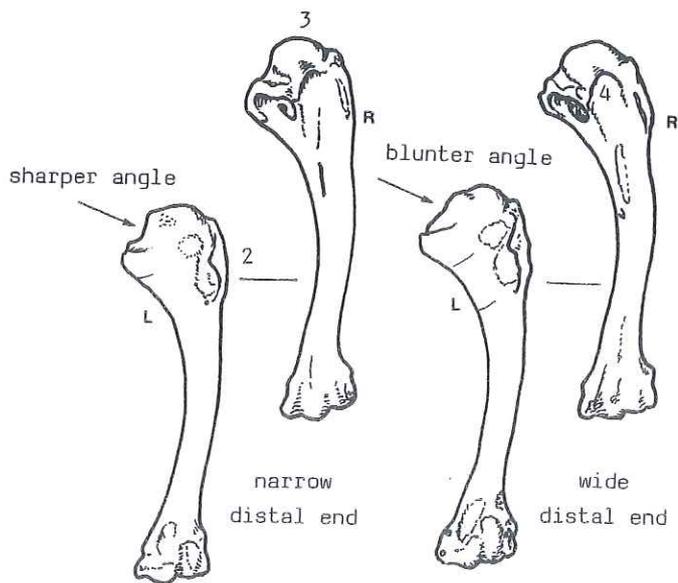
Pheasant

All Galliformes:

- 1 curved stout shaft
- 2 deltoid crest curved over
- 3 large rounded asymmetrical head
- 4 note shape of undercutting of head



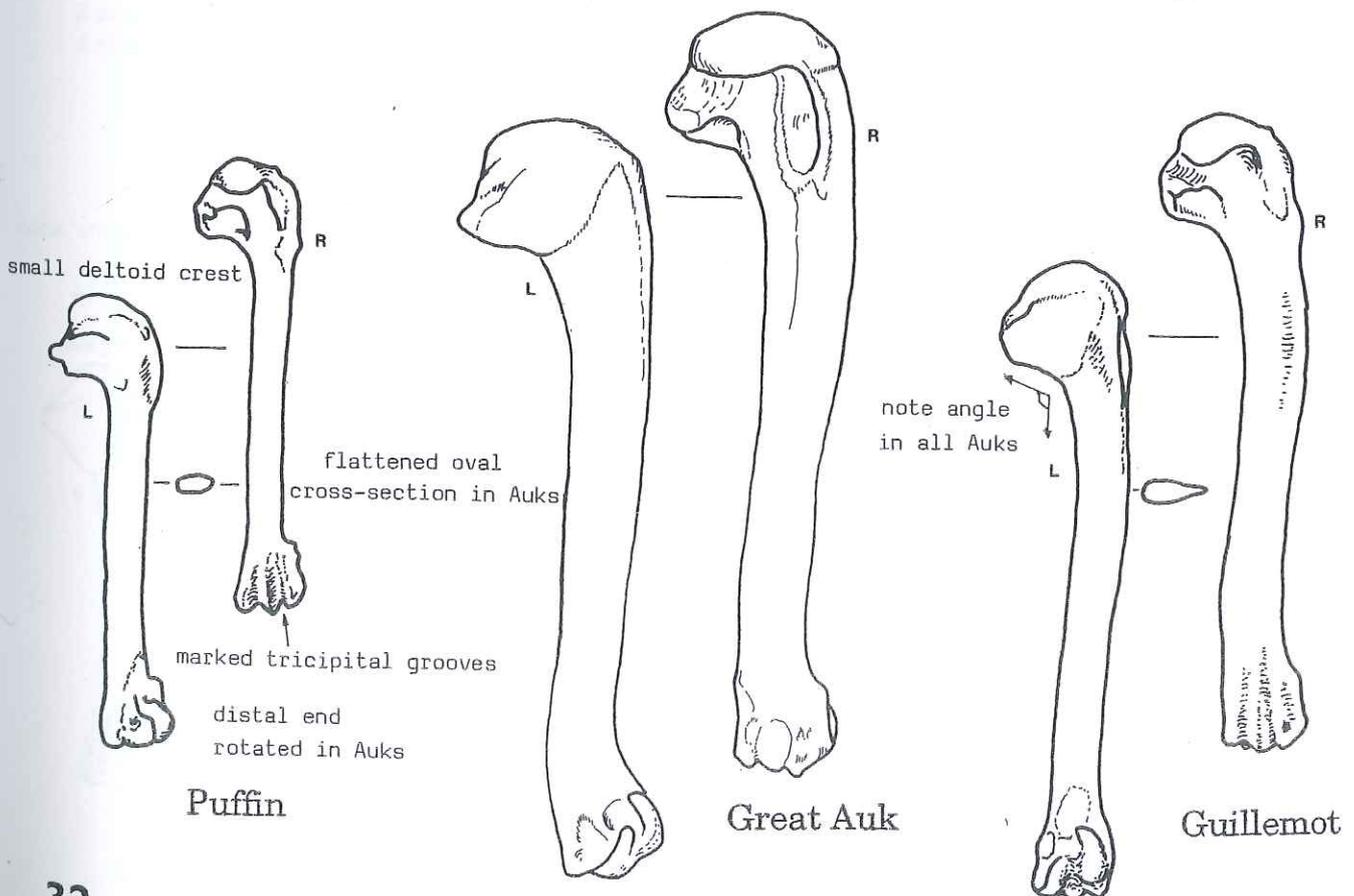
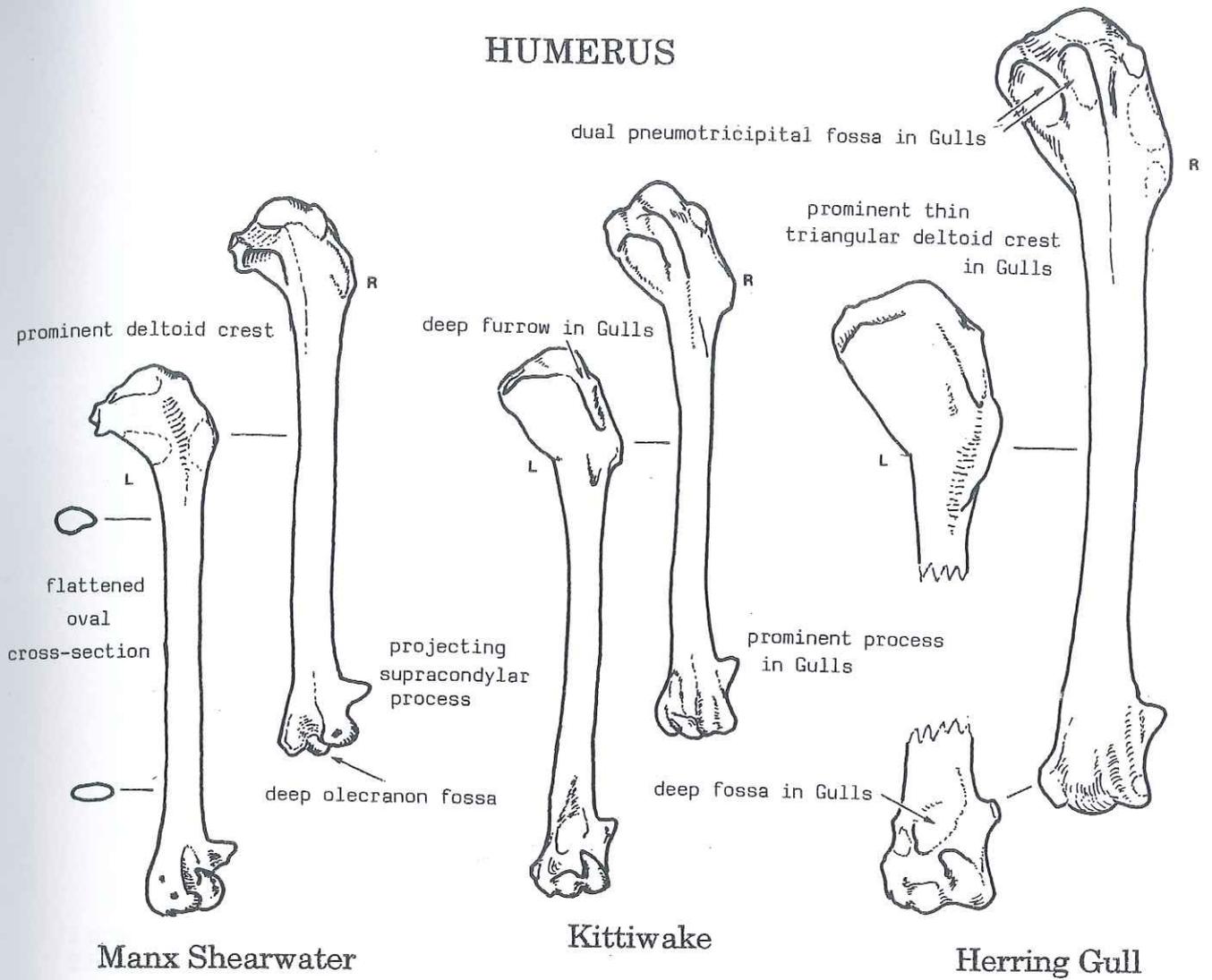
Red Grouse



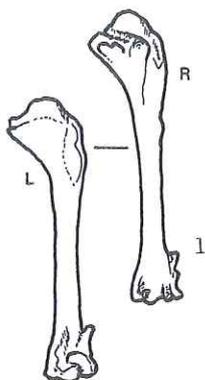
Partridge

Red-legged Partridge

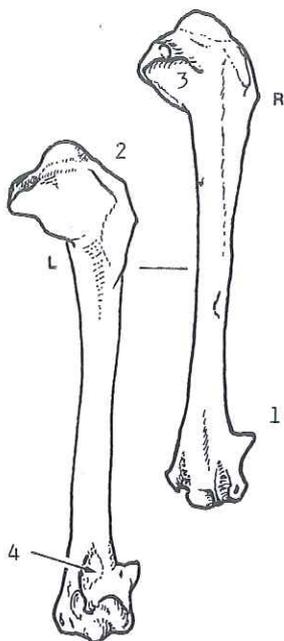
HUMERUS



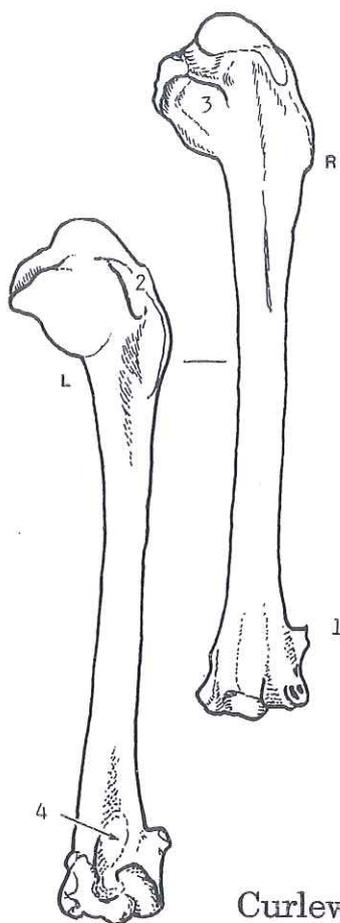
HUMERUS



Snipe



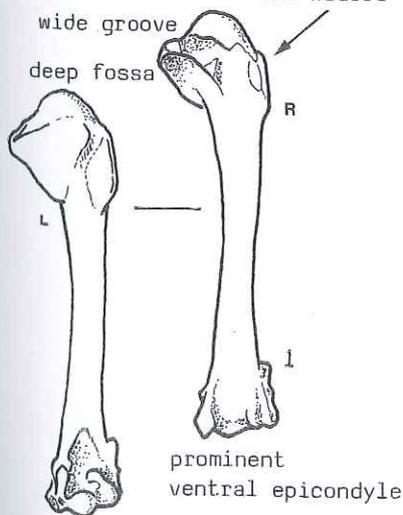
Godwit



Curlew

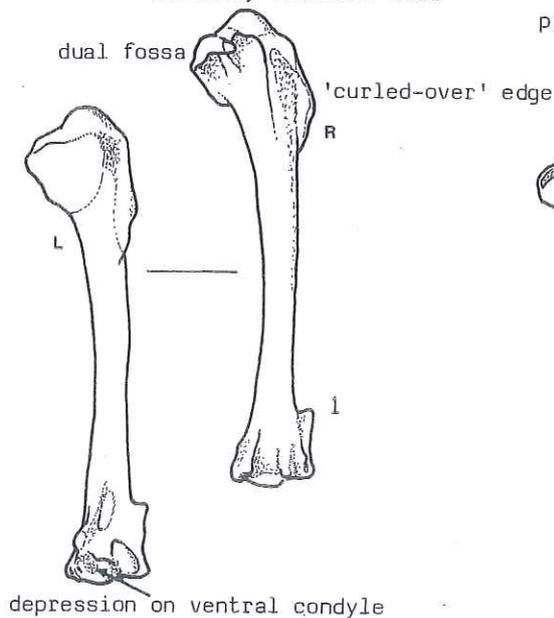
- 1 prominent process in Waders, Gulls and Songbirds
- 2 bicipital furrow shallower than in Gulls
- 3 single deep pneumatic fossa
- 4 shallow brachialis depression

note shape of pectoral attachment
cf. waders



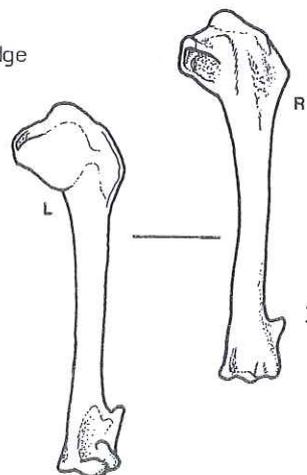
Woodcock

markedly undercut head



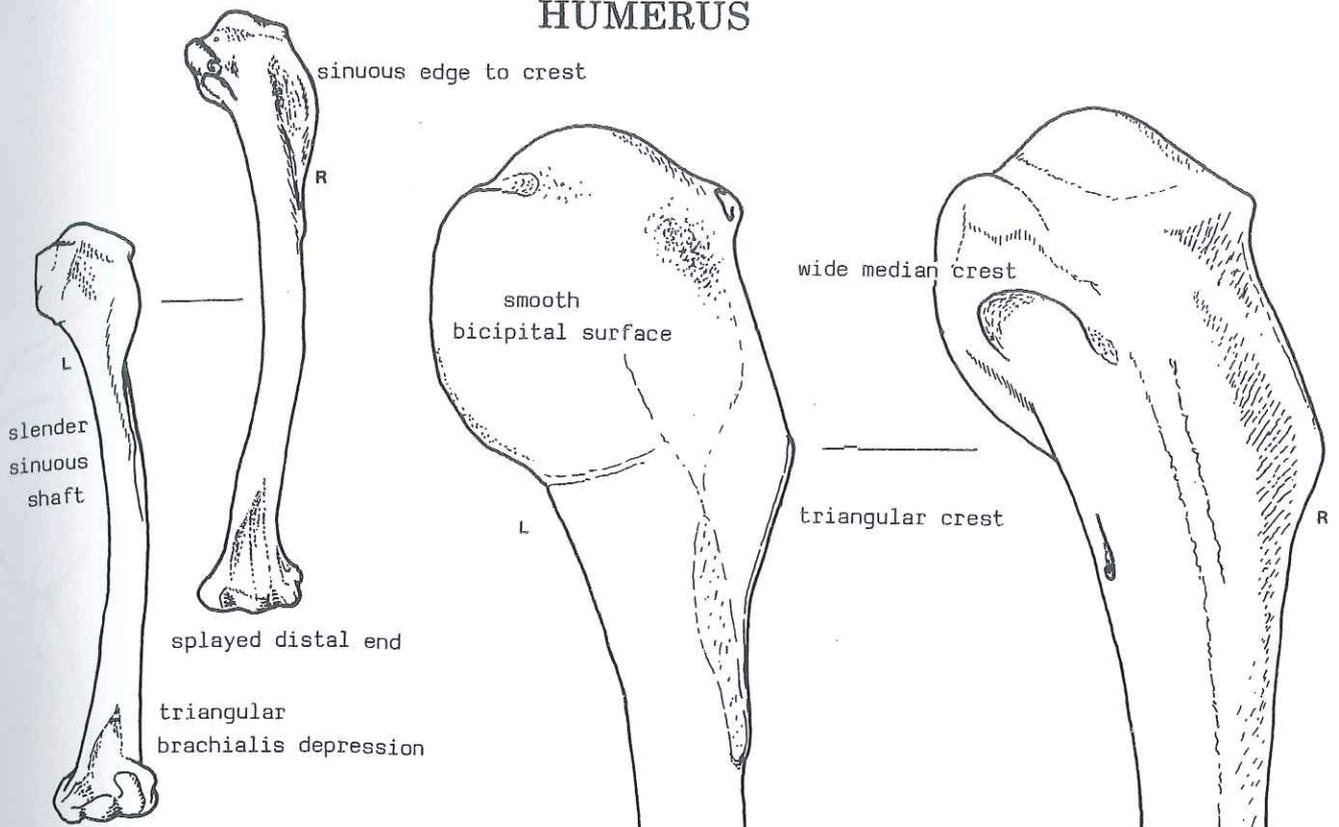
Lapwing

prominent bicipital furrow

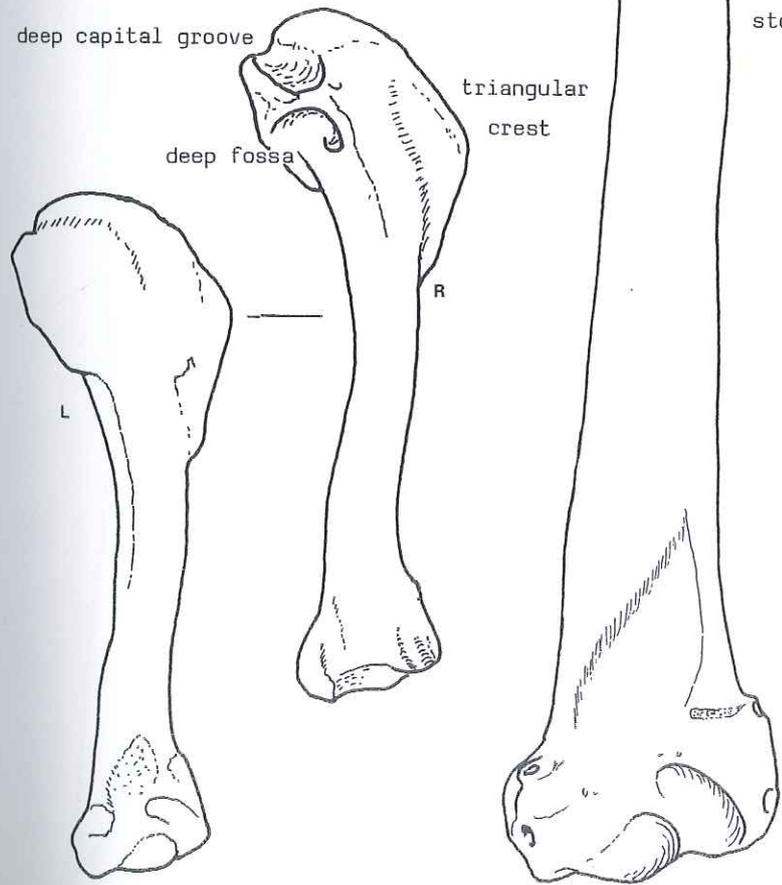


Golden Plover

HUMERUS



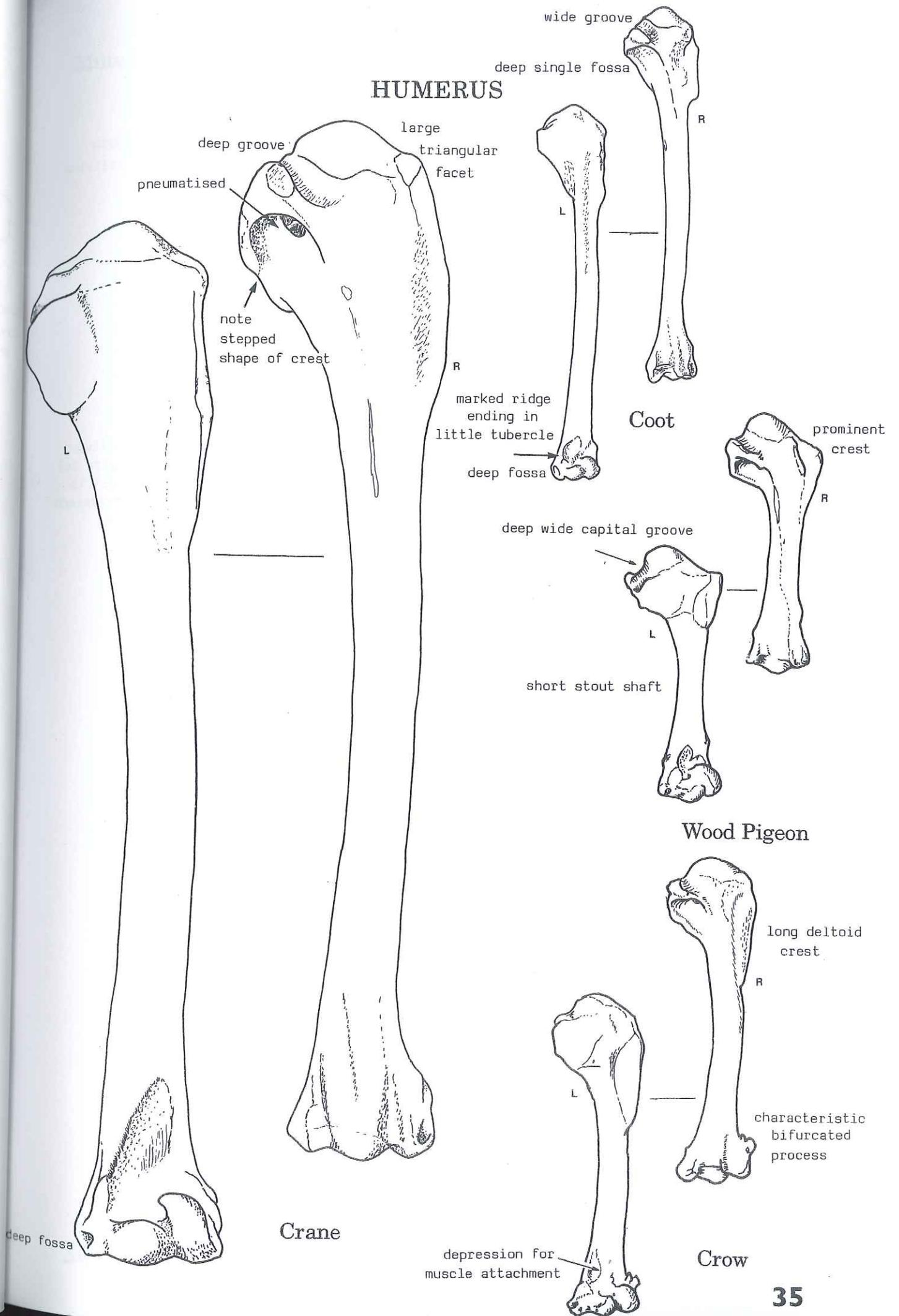
Tawny Owl



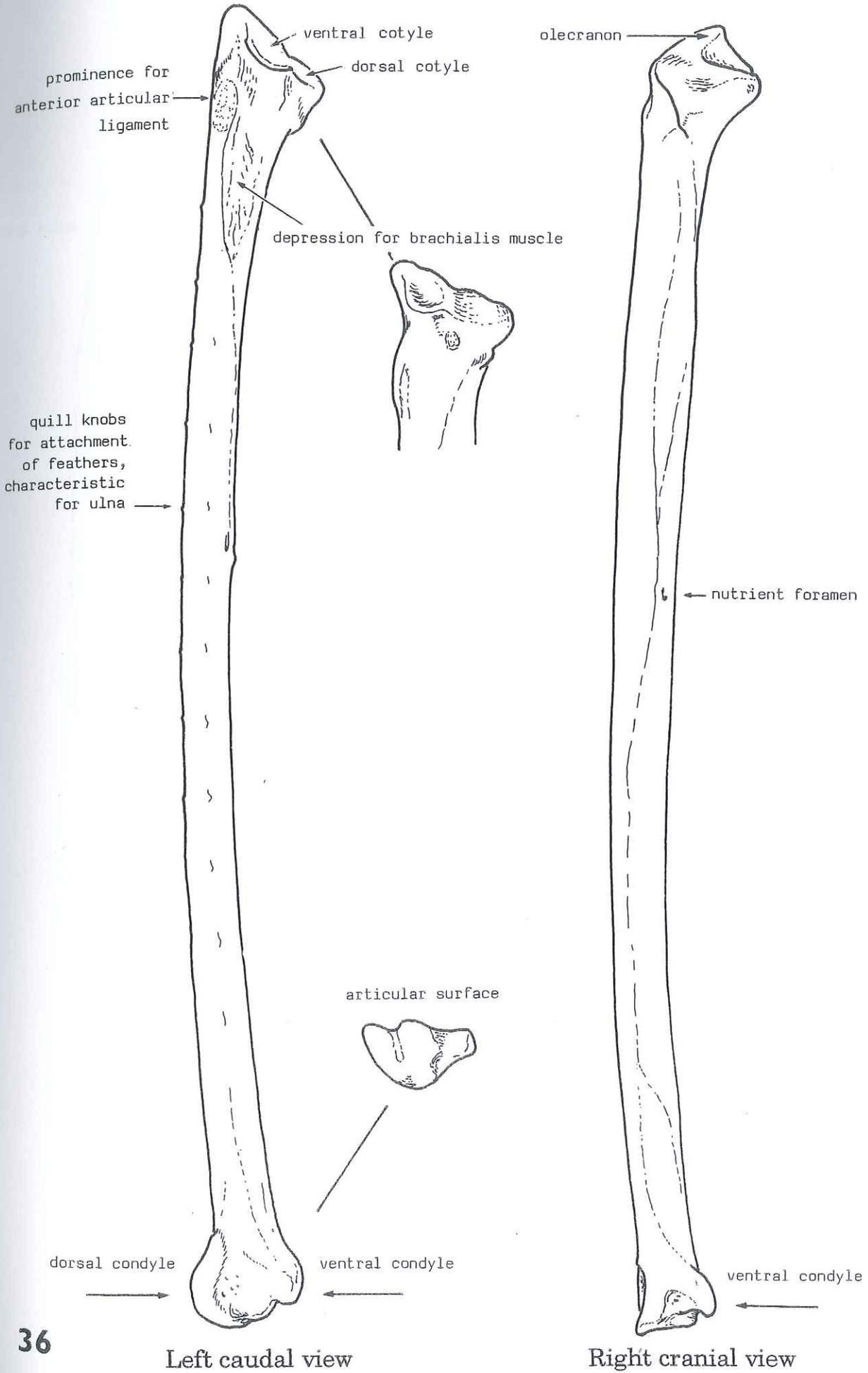
Peregrine Falcon

White-tailed Eagle

HUMERUS



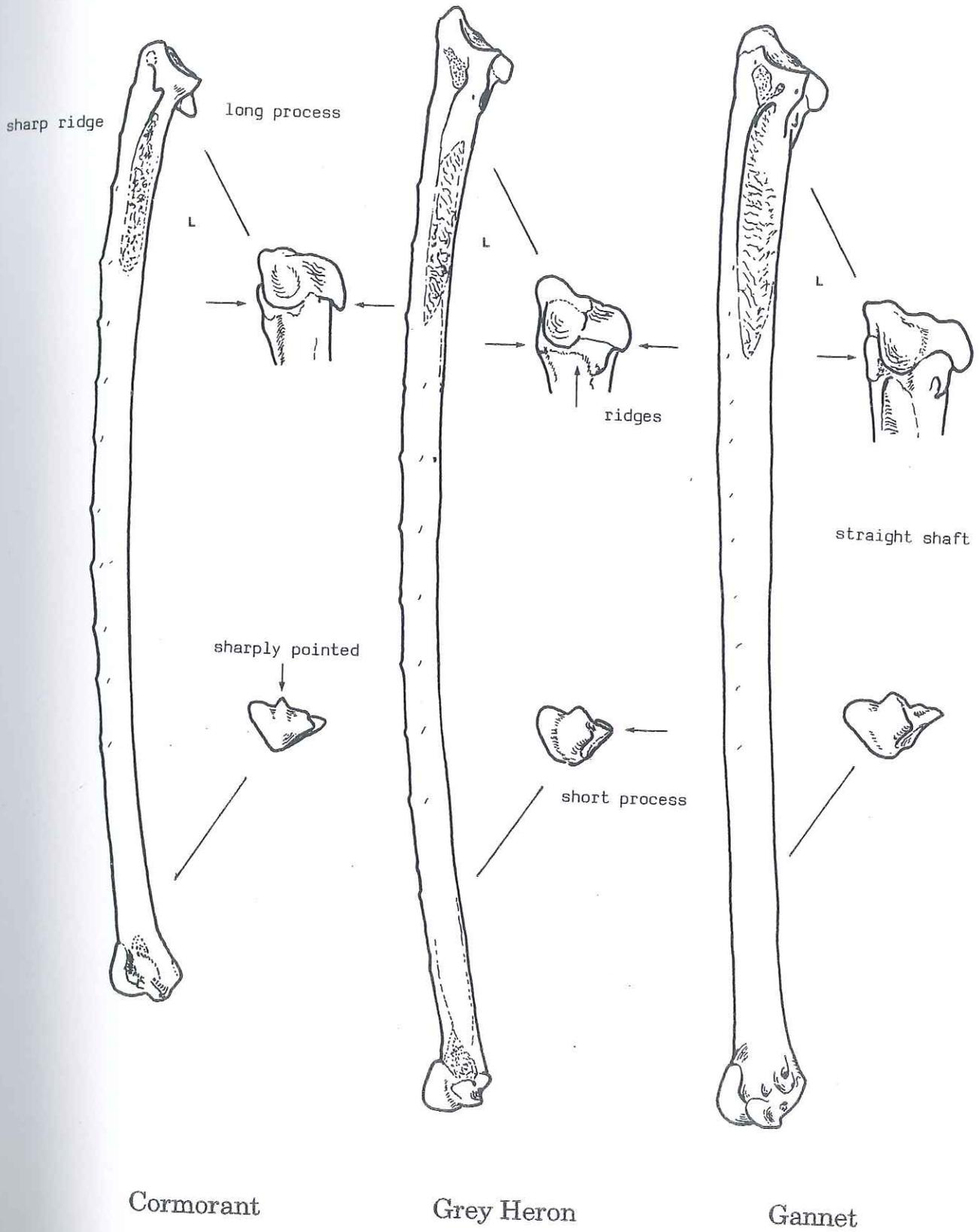
ULNA



Left caudal view

Right cranial view

ULNA

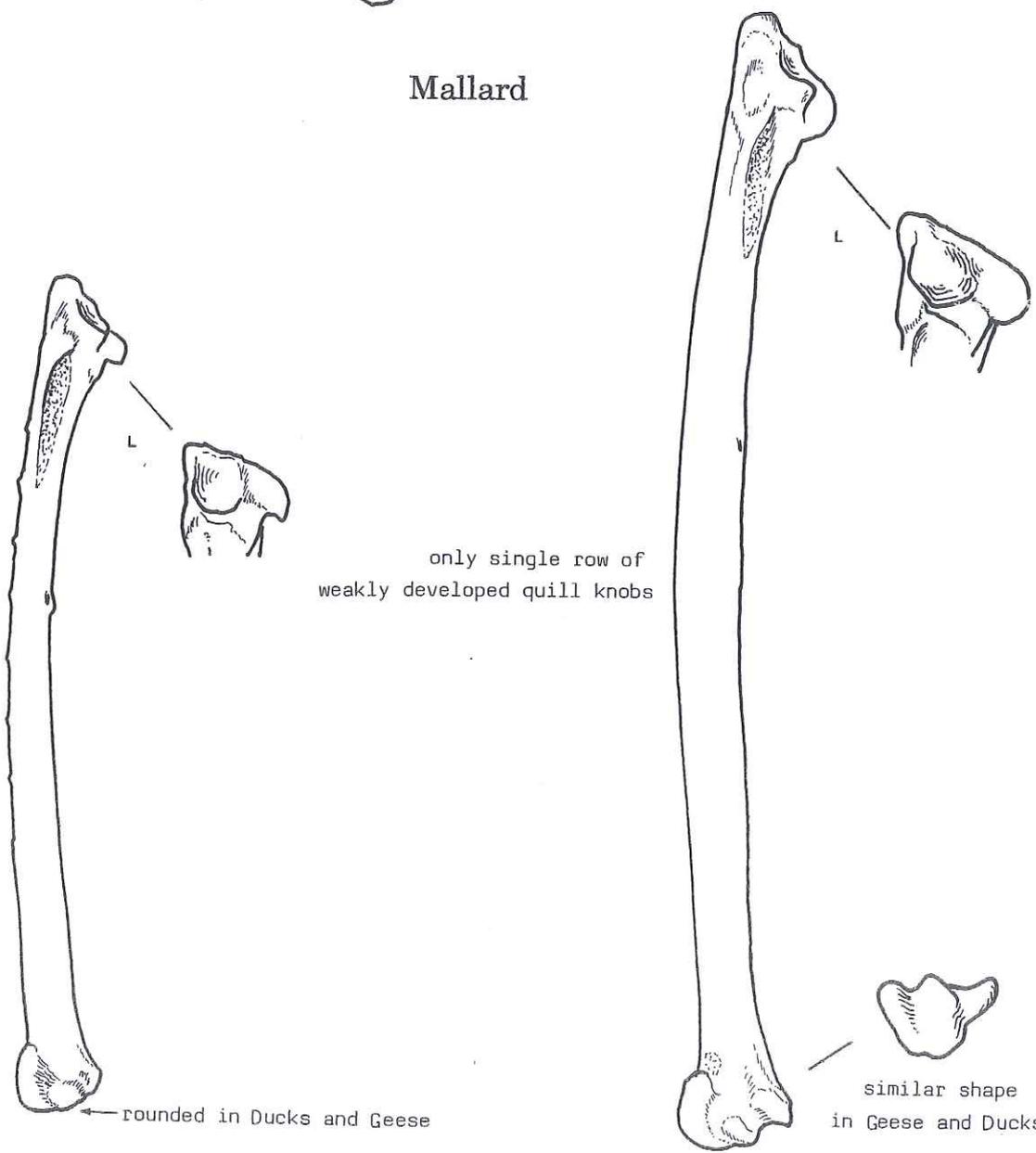
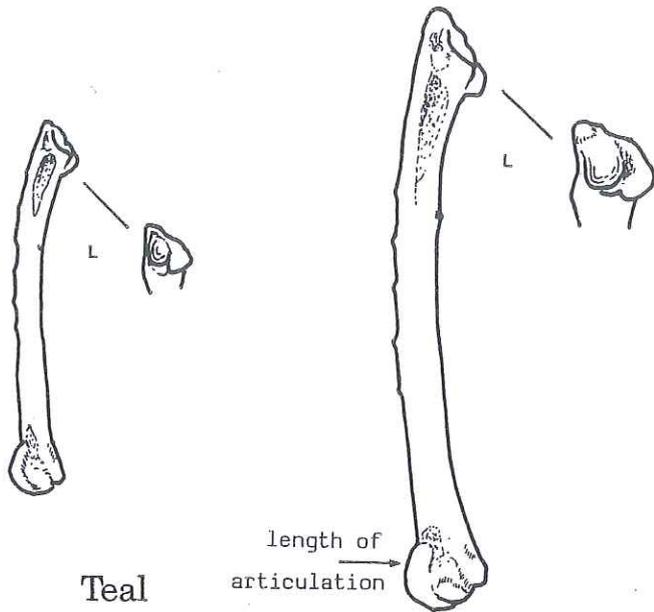


Cormorant

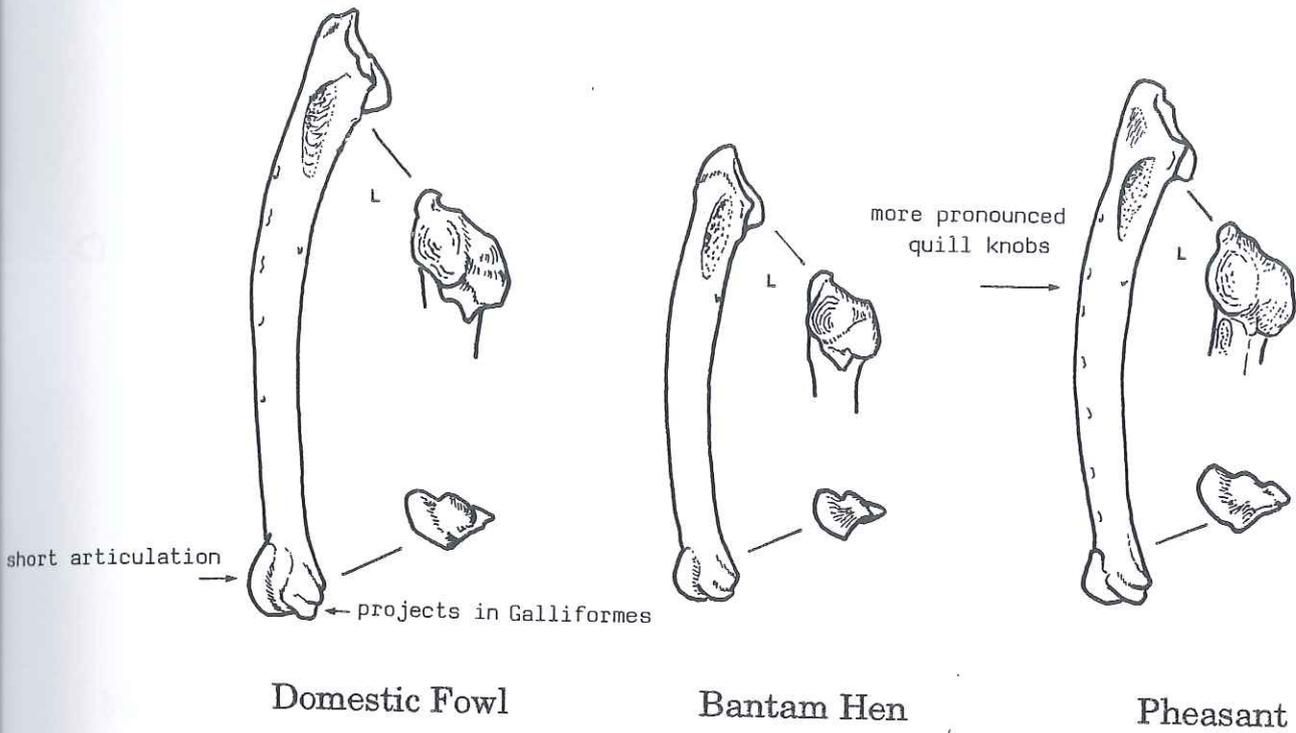
Grey Heron

Gannet

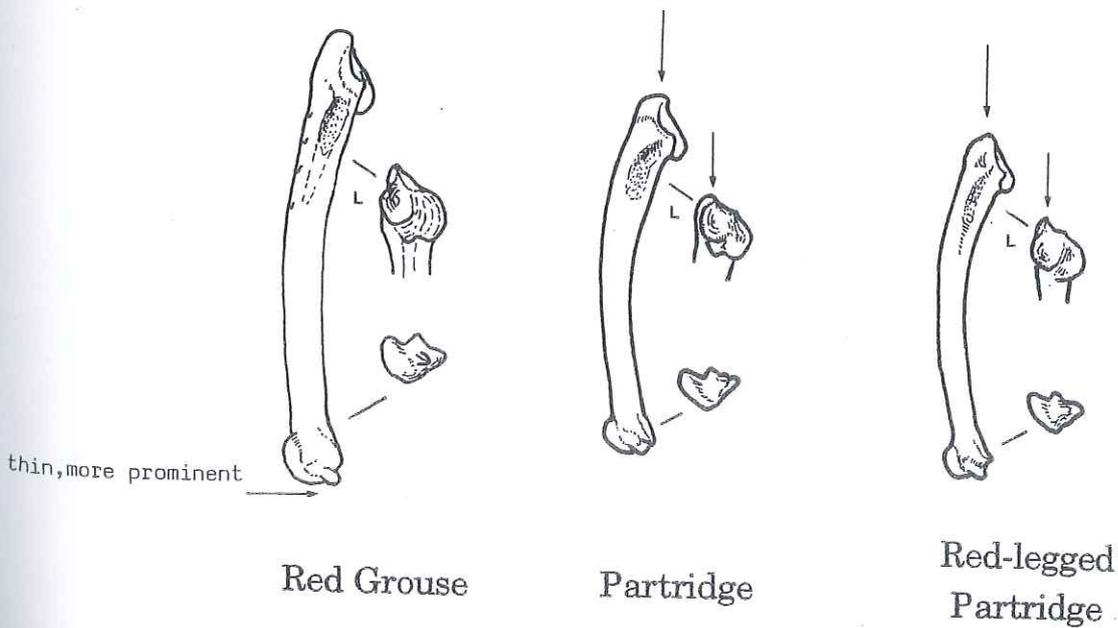
ULNA



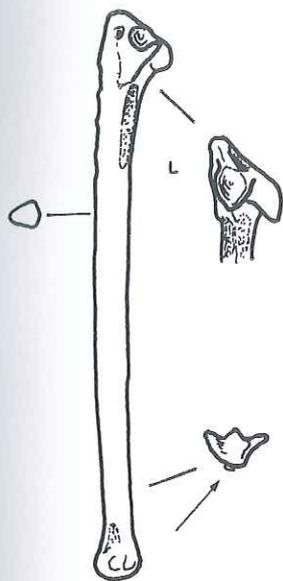
ULNA



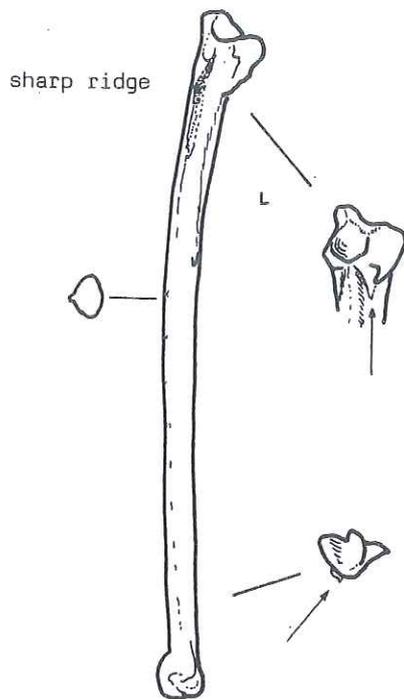
- 1 triangular cross-section, flattened at proximal end
- 2 most galliformes have weakly developed quill knobs
- 3 curvature of shaft greater than most other families



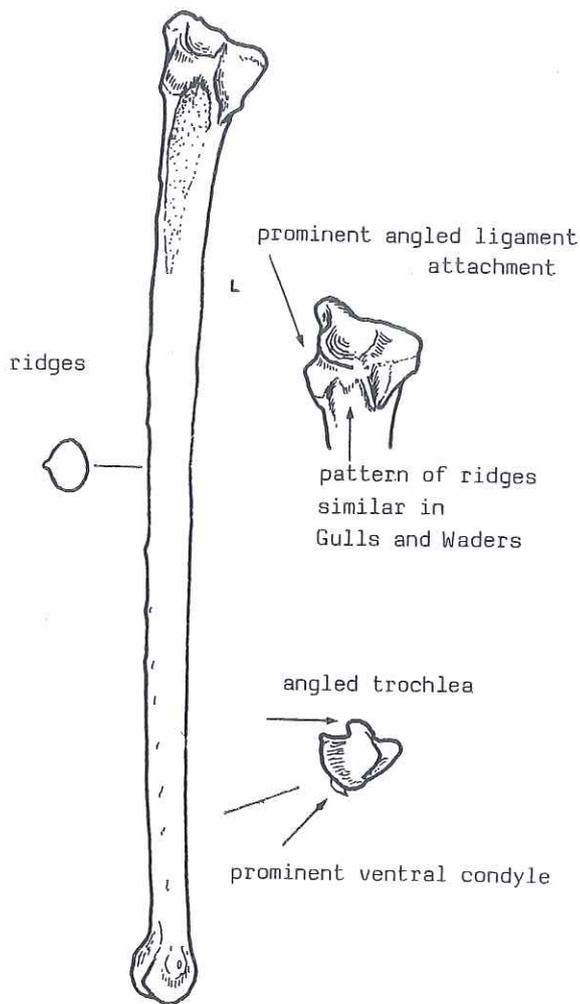
ULNA



Manx Shearwater

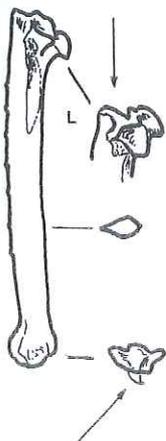


Kittiwake

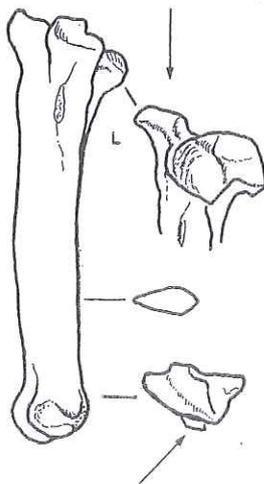


Herring Gull

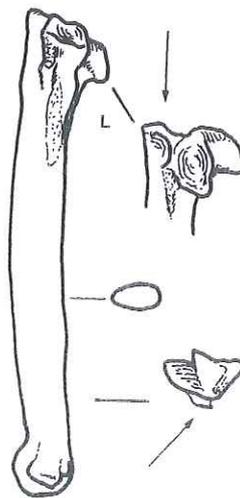
Note flattened cross section of bone shaft and hooked olecranon in Auks



Puffin

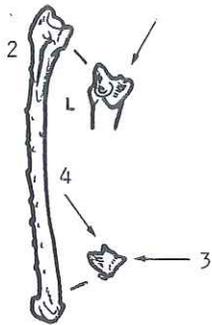


Great Auk

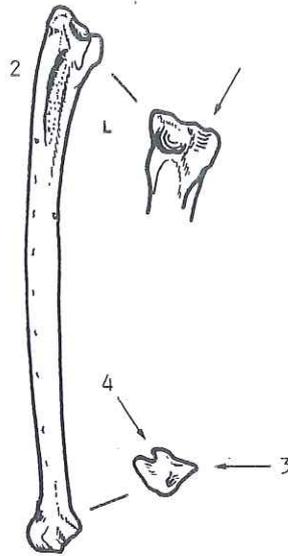


Guillemot

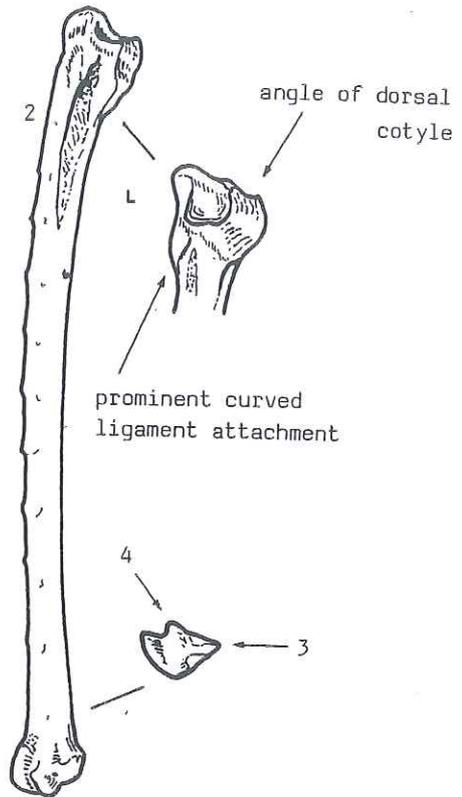
ULNA



Snipe



Godwit

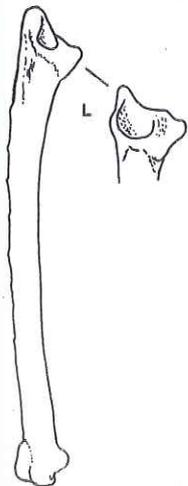


Curlew

In Waders note:

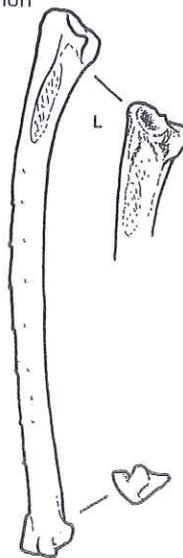
- 1 deep facet of ventral cotyle
- 2 sharp ridge of brachialis depression
- 3 elongated ventral condyle
- 4 angle of trochlea cf. Gulls

deep round ventral cotyle



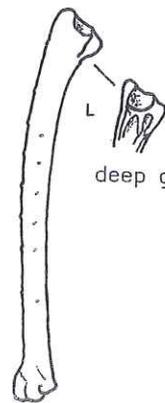
Woodcock

rounded olecranon



Lapwing

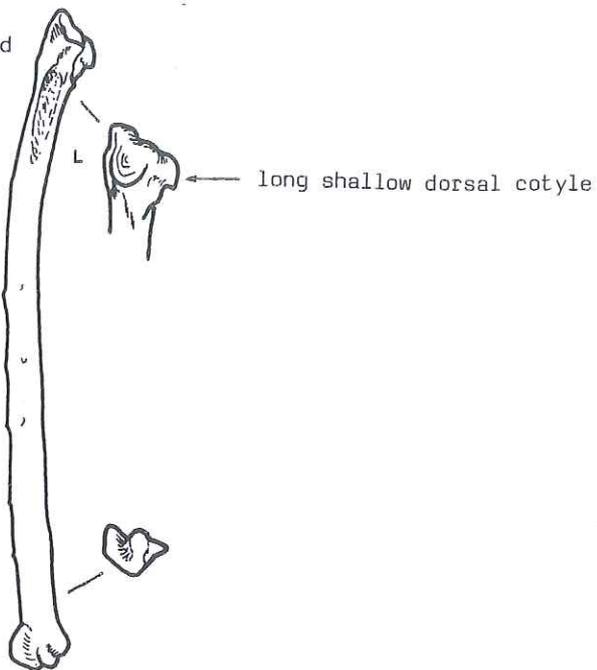
deep grooves



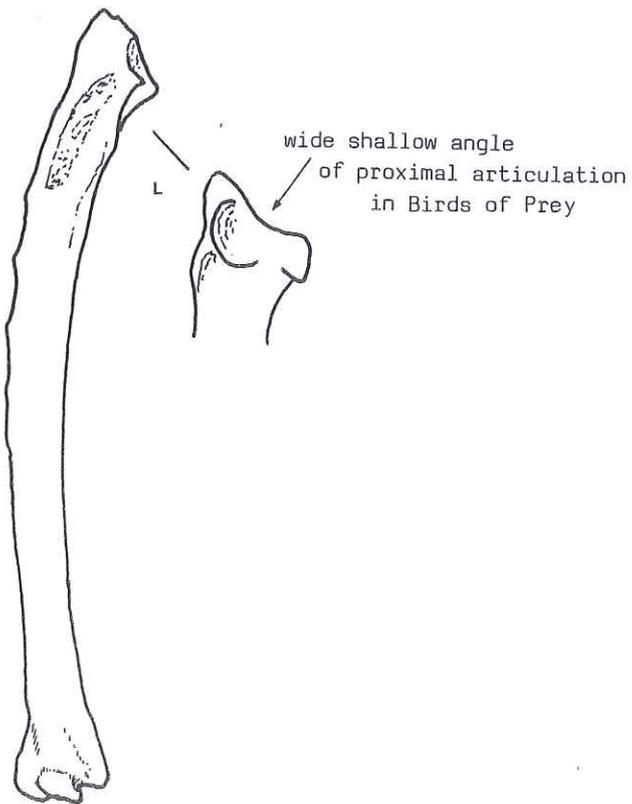
Golden Plover

ULNA

shaft more curved
at proximal end



Tawny Owl



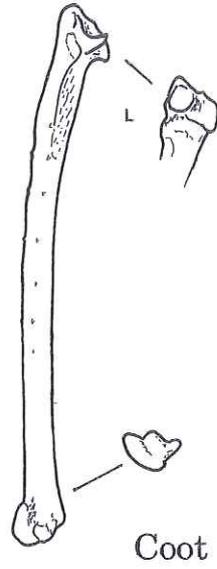
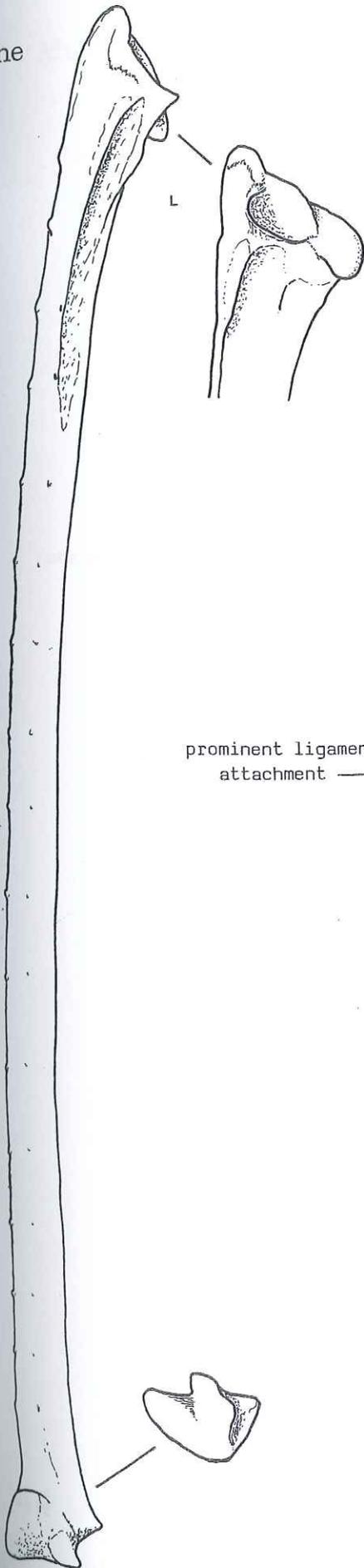
Peregrine Falcon



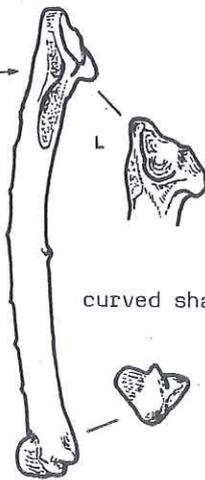
White-tailed
Eagle

ULNA

Crane



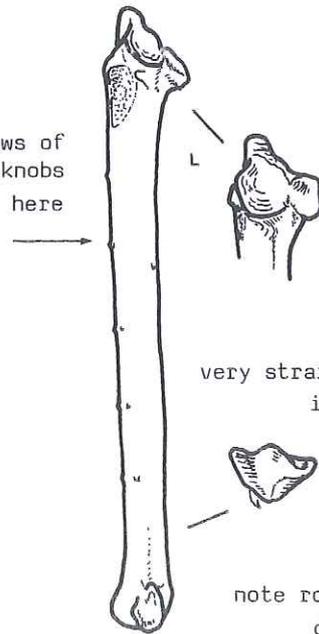
prominent ligament attachment



curved shaft in Pigeons

Wood Pigeon

both rows of quill knobs merge here

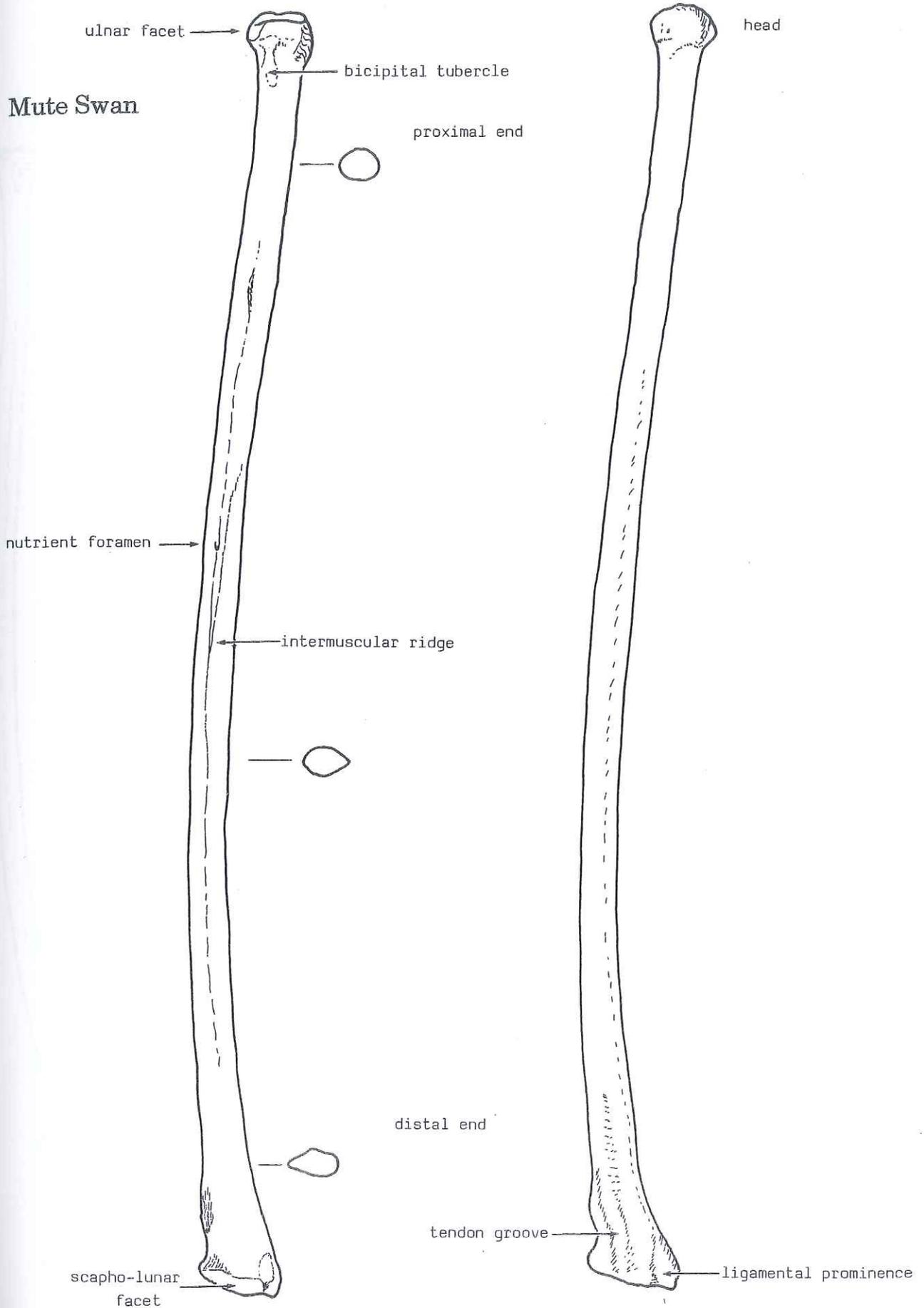


very straight shaft in Crows

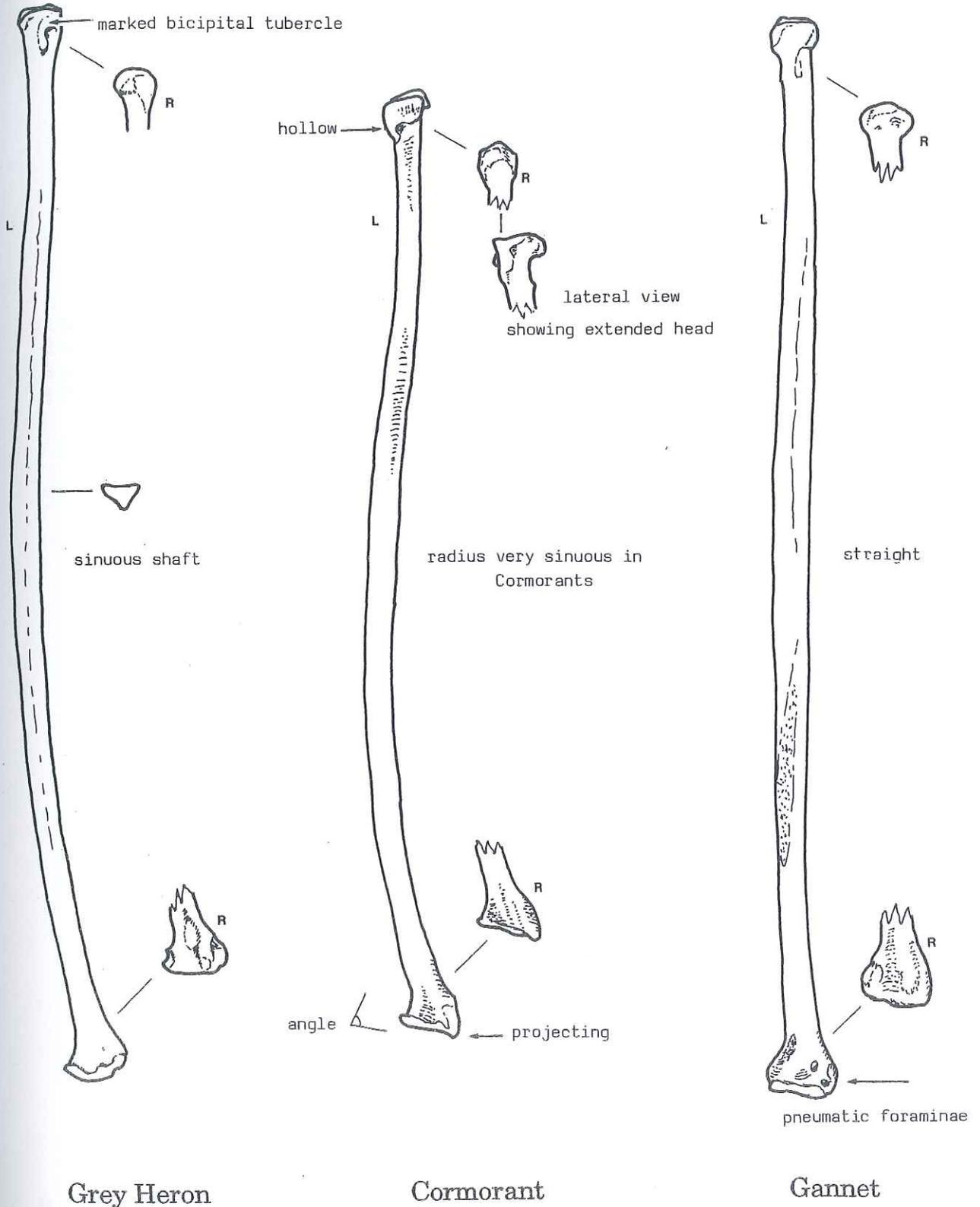
Crow

RADIUS

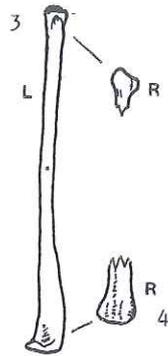
Mute Swan



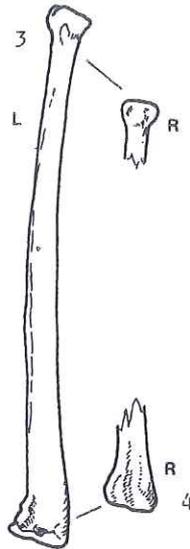
RADIUS



RADIUS



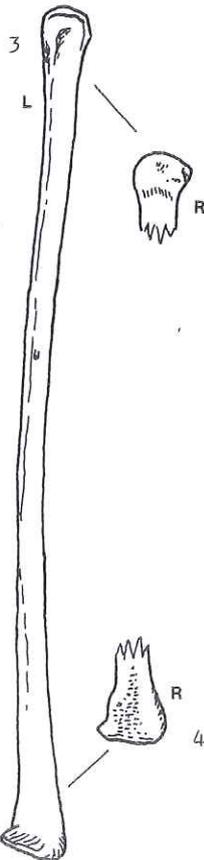
Teal



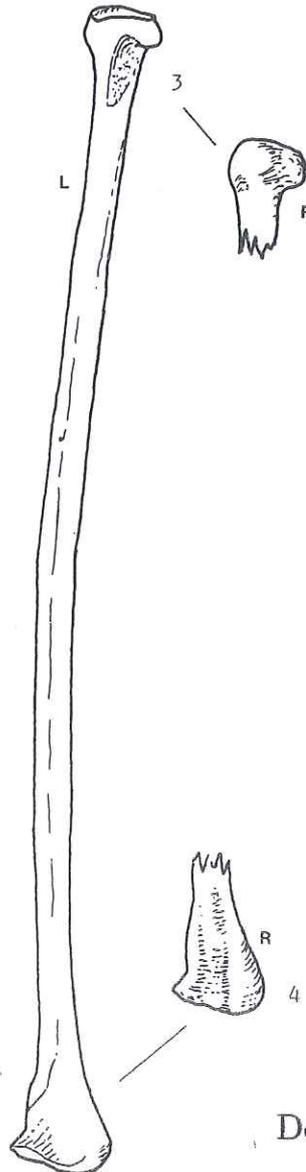
Mallard

In Geese and Ducks:

- 1 shaft slightly bowed
- 2 relatively large, round proximal articular surface
- 3 marked hollow by ulnar facet
- 4 thick ligamental prominence

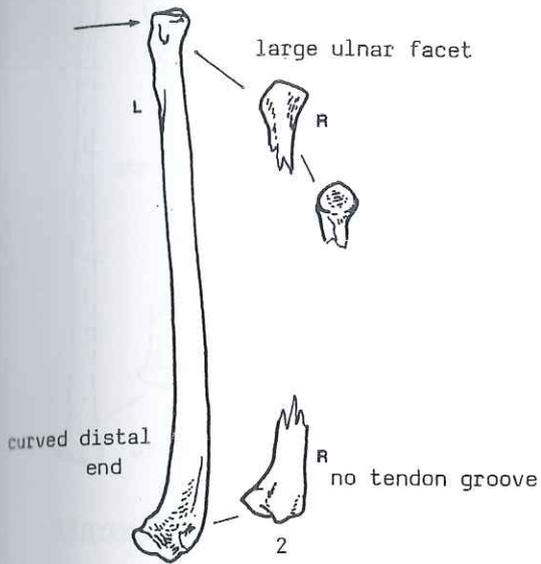


Brent Goose

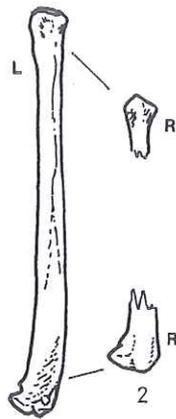


Domestic Goose

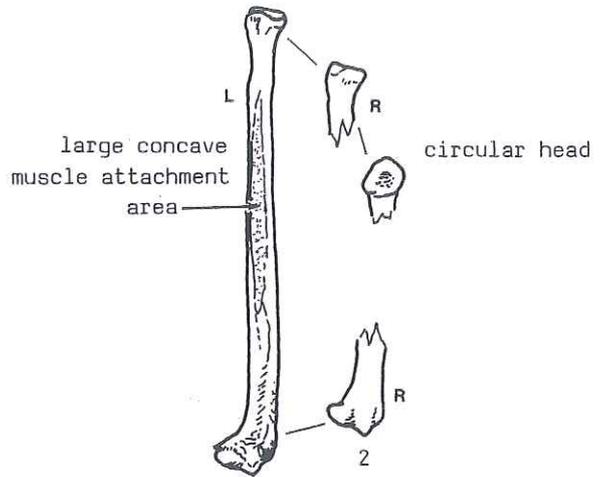
RADIUS



Domestic Fowl



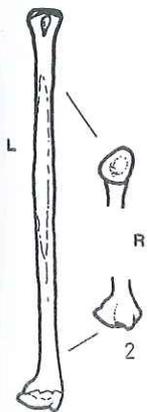
Bantam



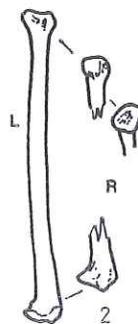
Pheasant

In Galliformes:

- 1 cross-section round proximally and flattened distally
- 2 projecting process

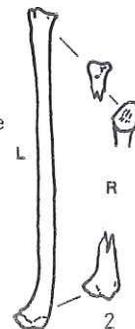


Red Grouse



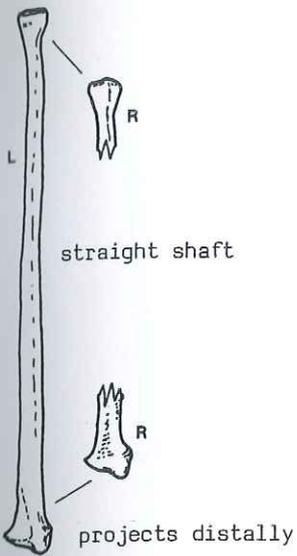
Partridge

trapezoidal articular surface

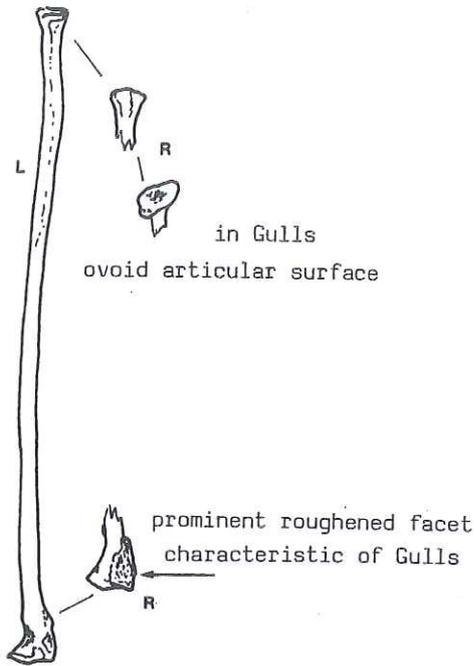


Red-legged Partridge

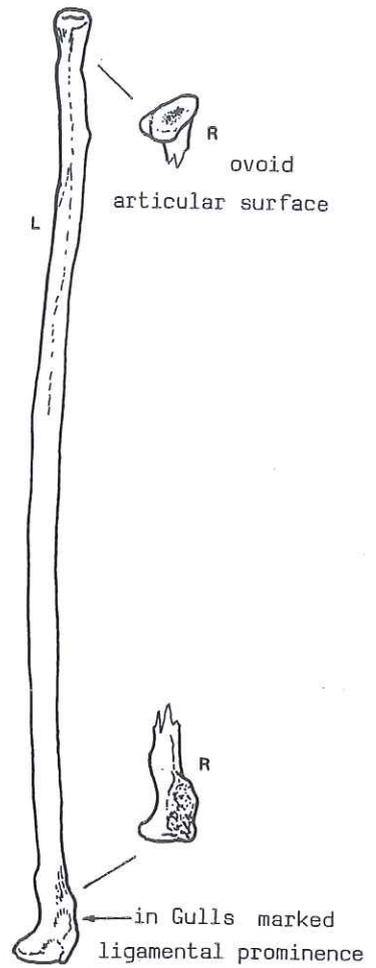
RADIUS



Manx Shearwater

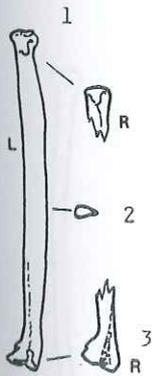


Kittiwake

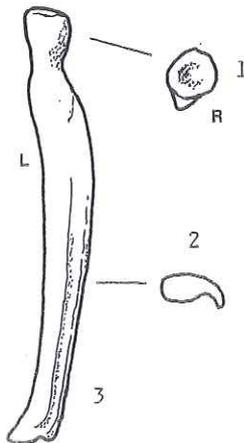


Herring Gull

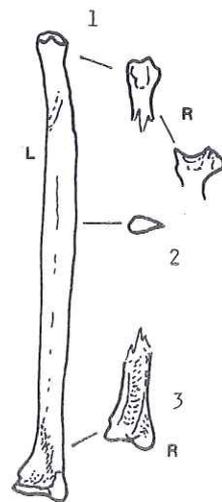
- Auks have:
- 1 round concave proximal articular surfaces
 - 2 flattened cross-sections
 - 3 marked tendon grooves with ridged borders



Puffin

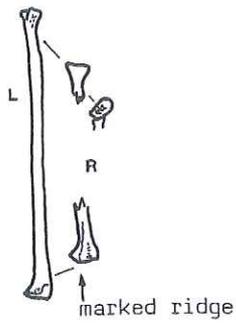


Great Auk

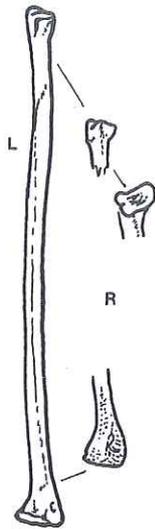


Guillemot

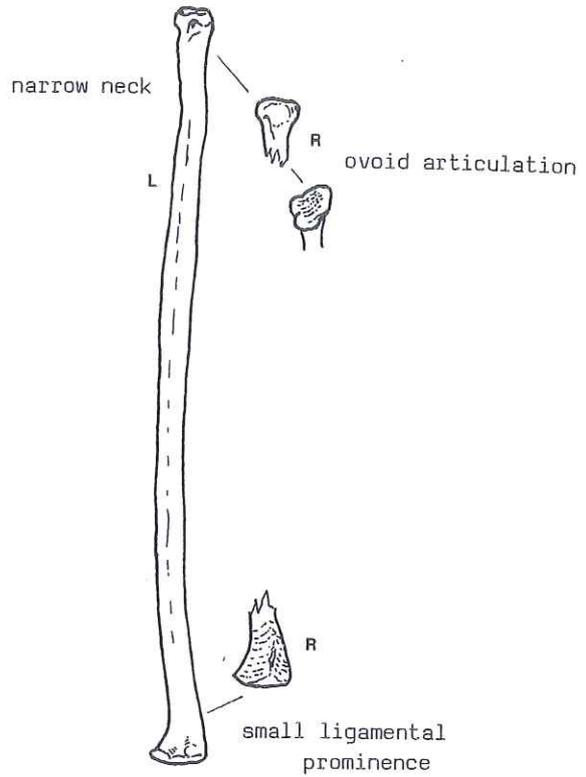
RADIUS



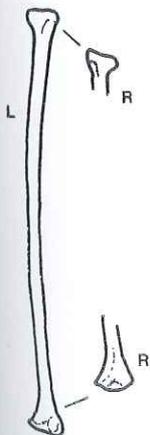
Snipe



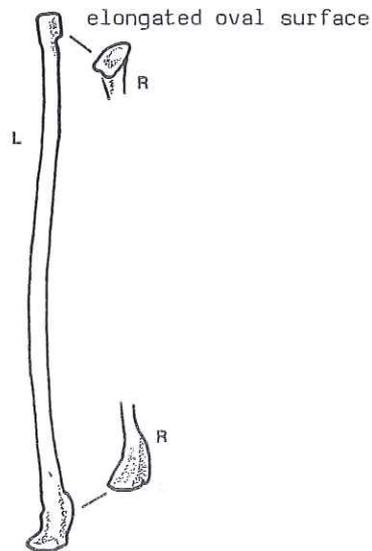
Godwit



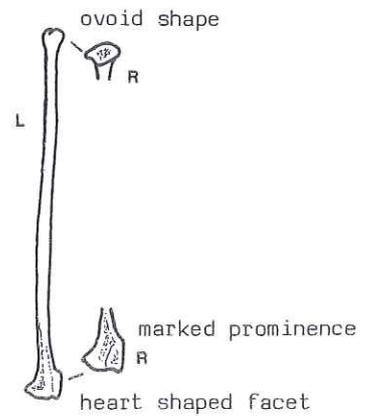
Curlew



Woodcock



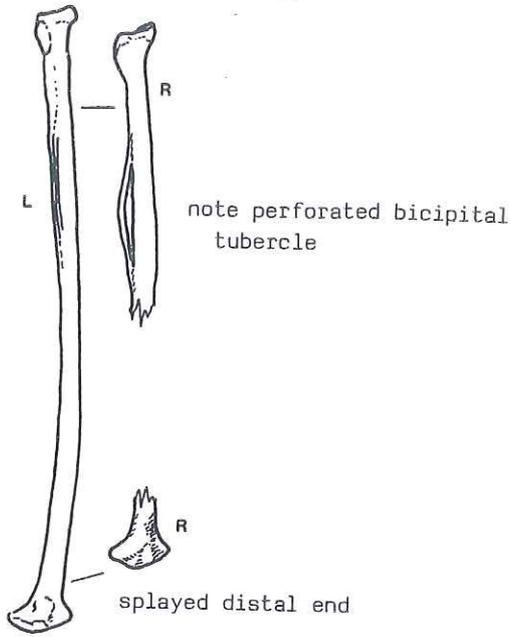
Lapwing



Golden Plover

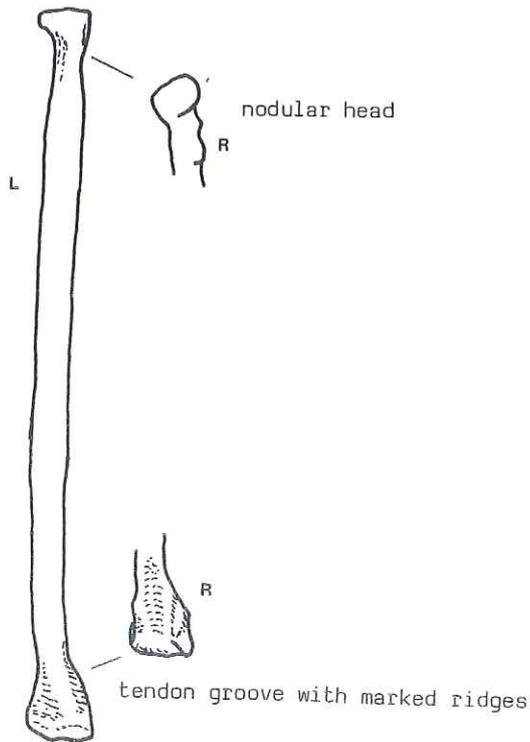
RADIUS

flattened oval articulation



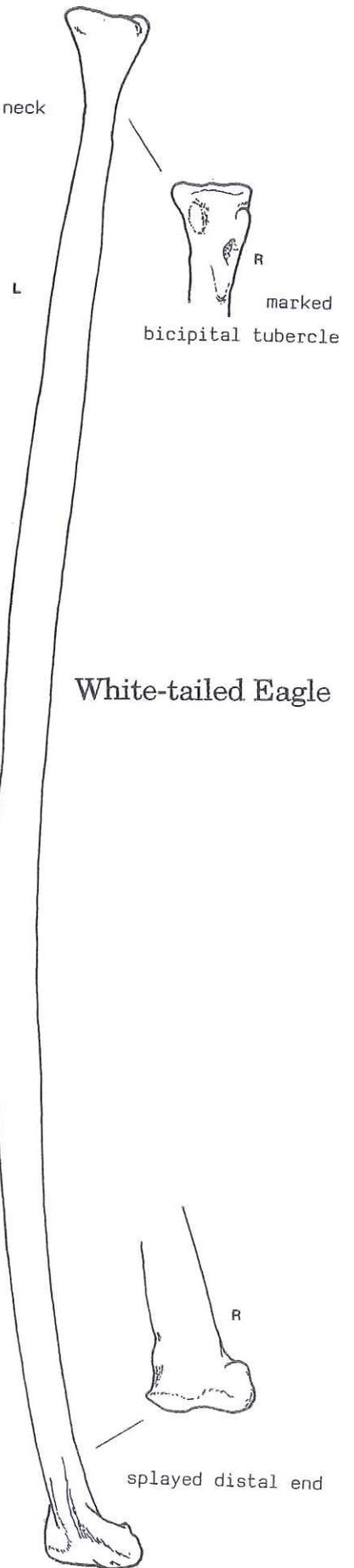
Tawny Owl

oval concave articular surface



Peregrine Falcon

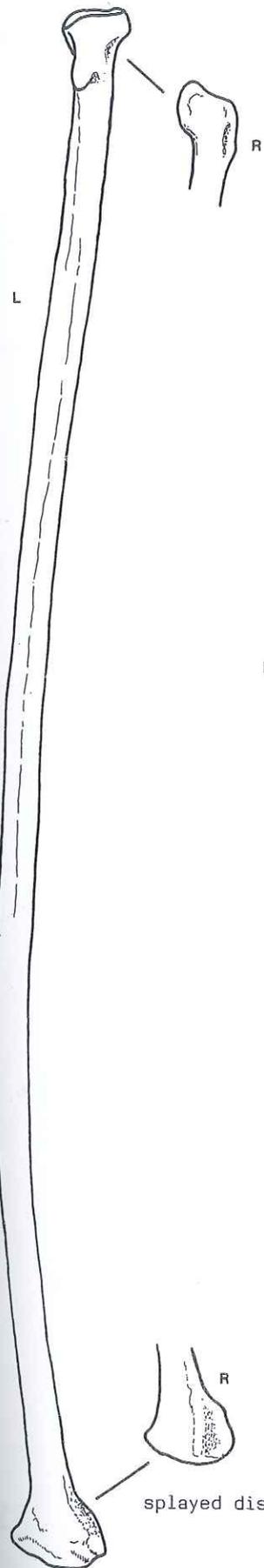
narrow neck



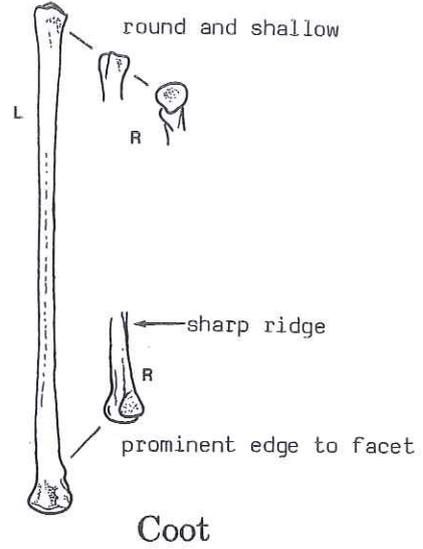
White-tailed Eagle

RADIUS

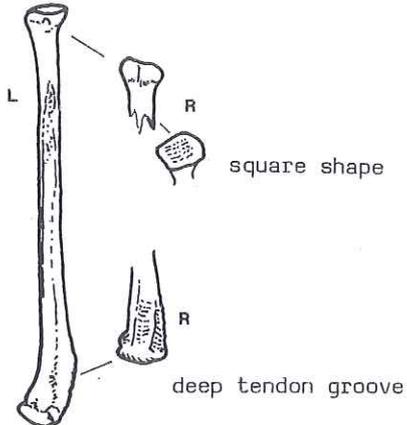
Crane



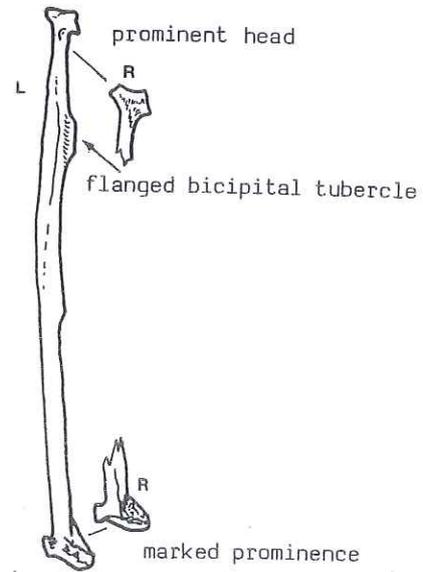
splayed distal end



Coot



Wood Pigeon

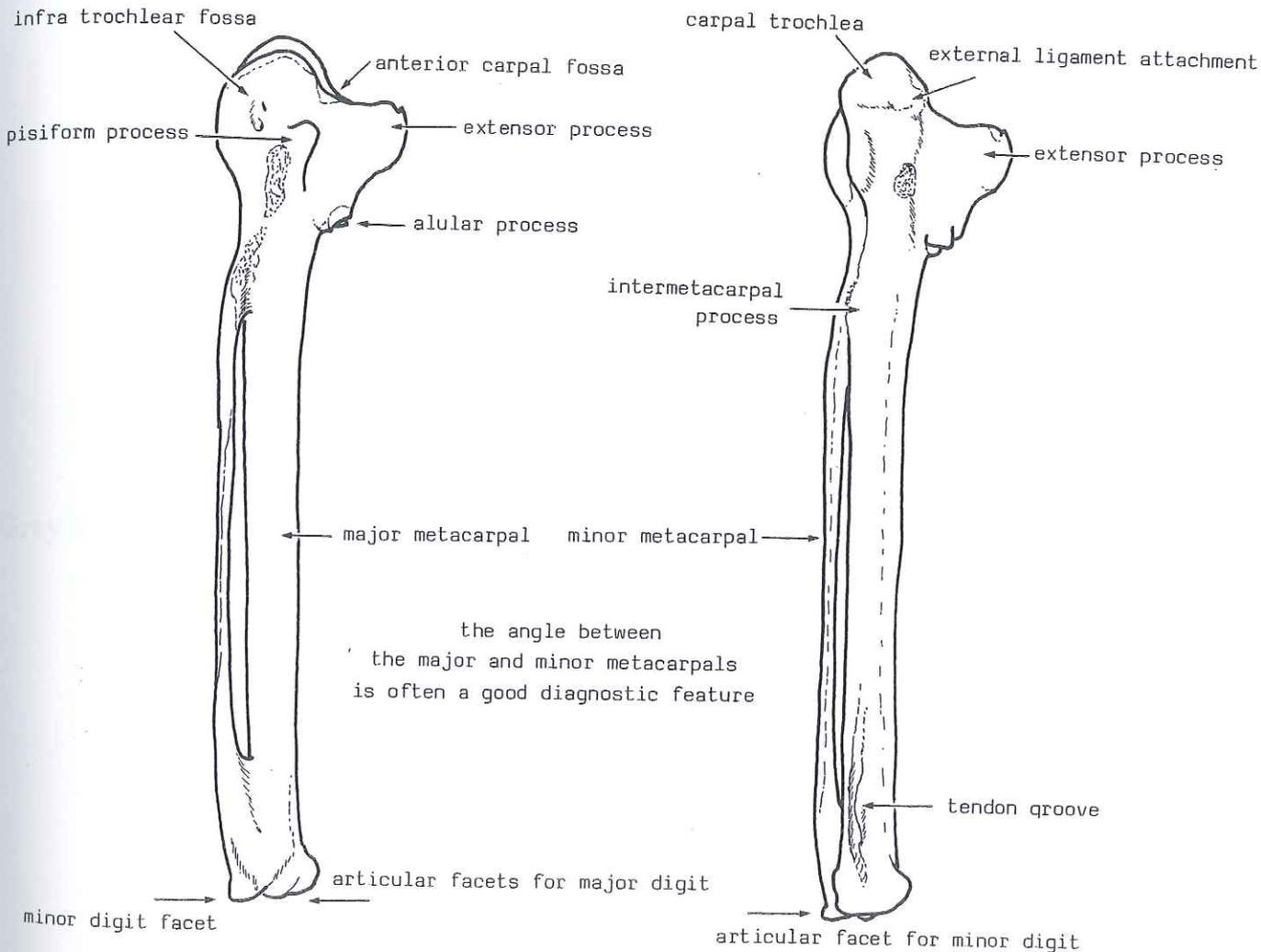


Crow

CARPO-METACARPUS

Mute Swan

Proximal end

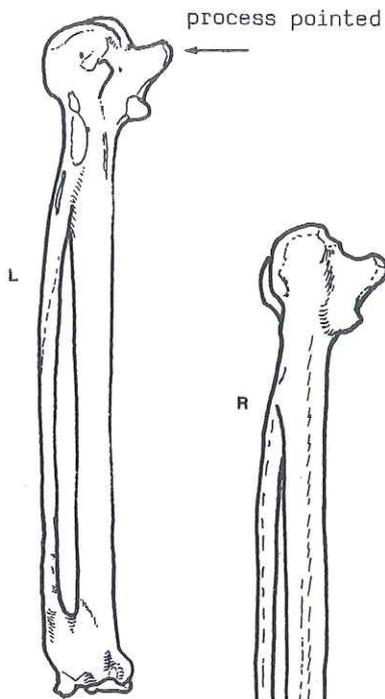


Distal end

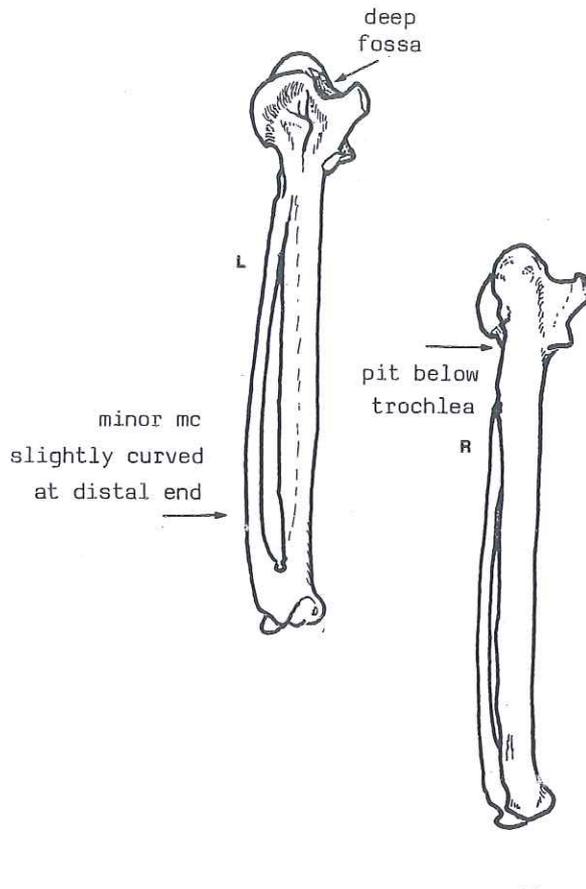
Left ventral view

Right dorsal view

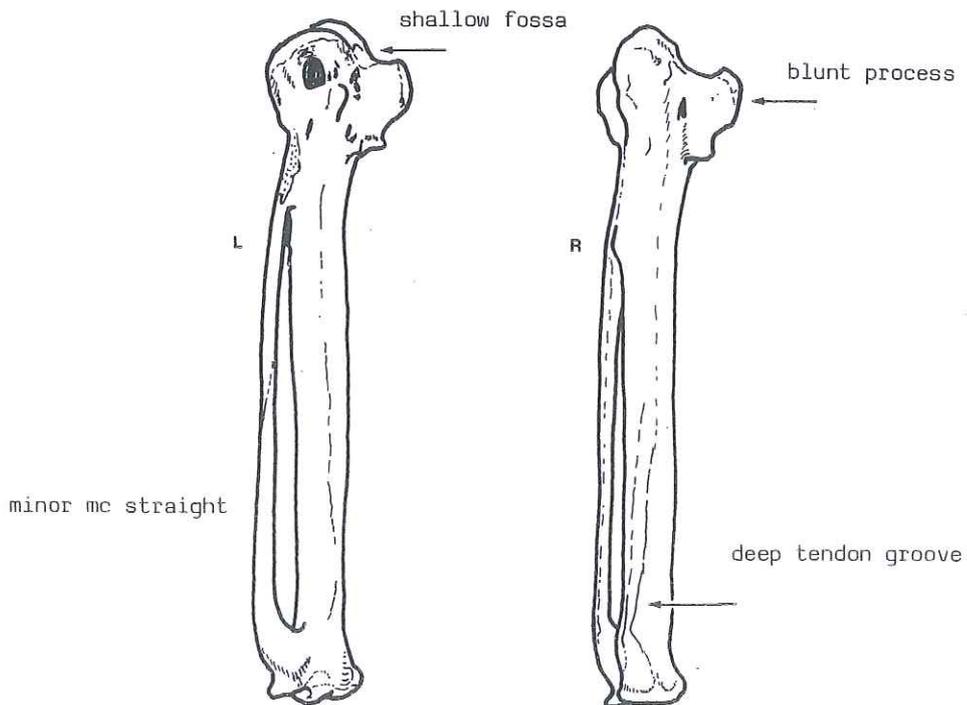
CARPO-METACARPUS



Grey Heron



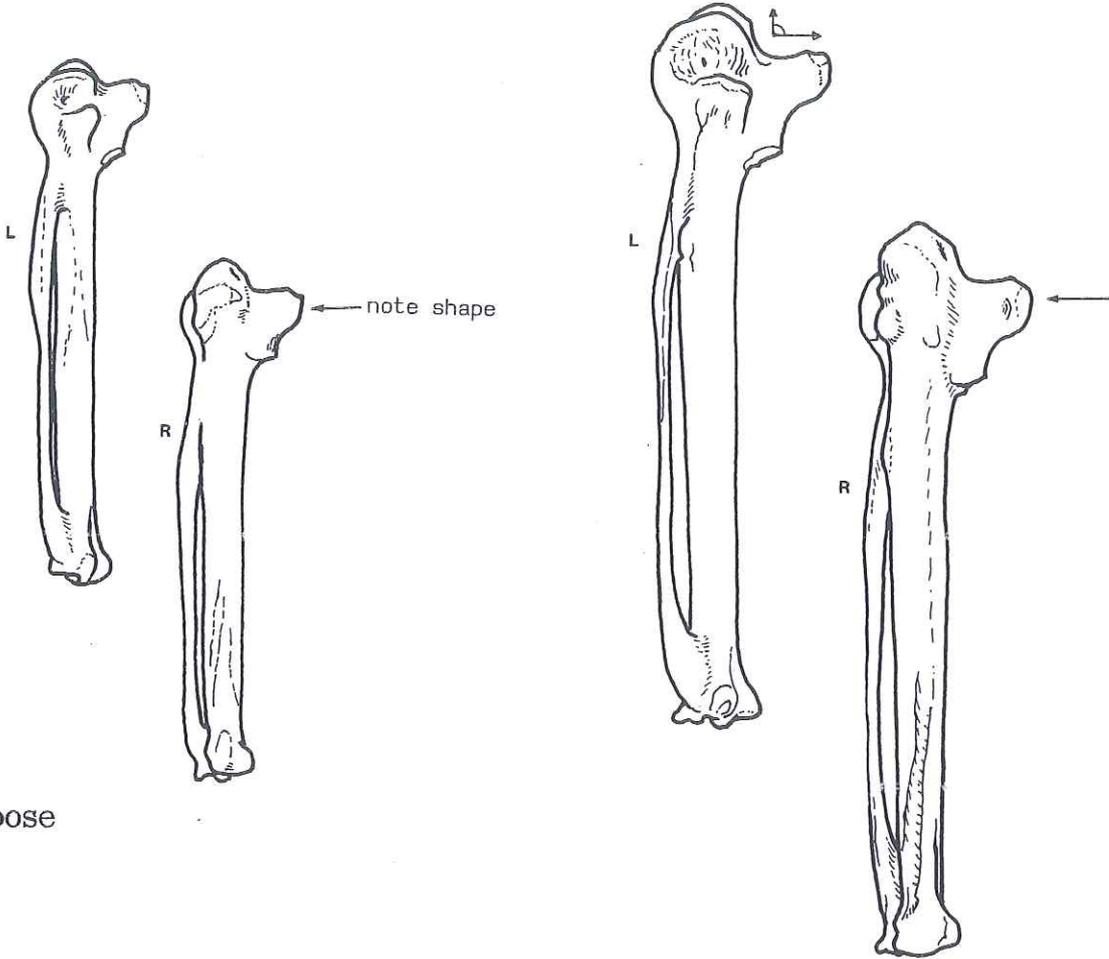
Cormorant



Gannet

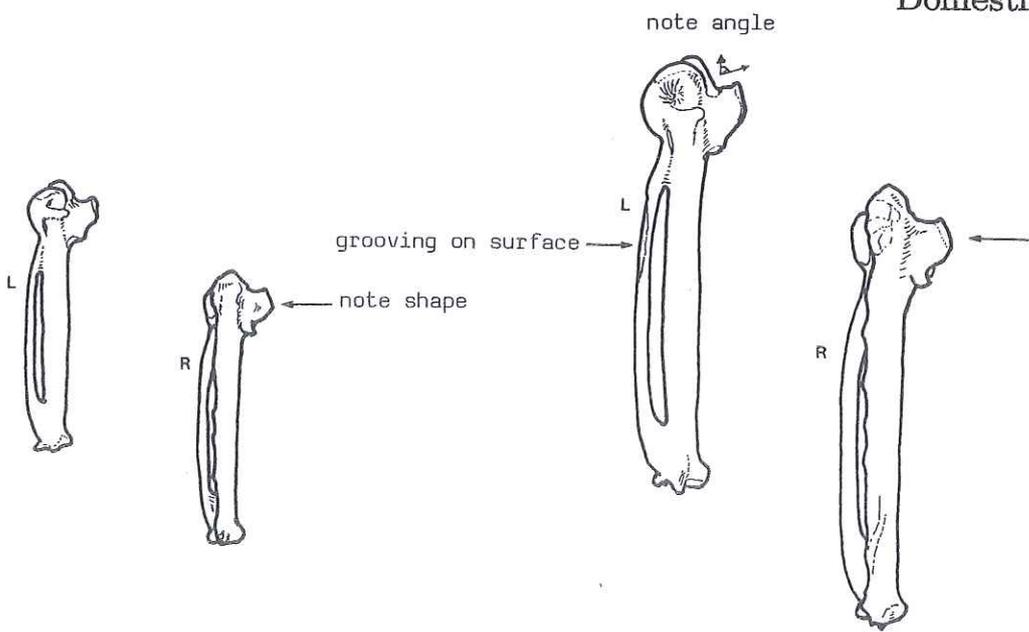
CARPO-METACARPUS

note angle different in Geese and Ducks



Brent Goose

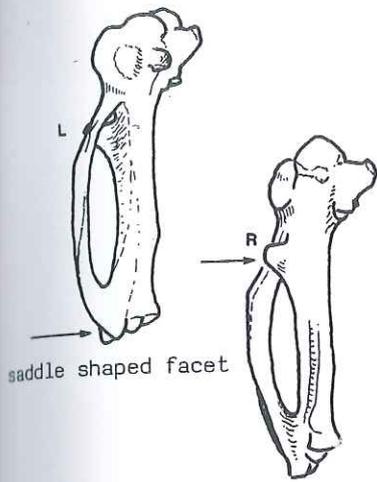
Domestic Goose



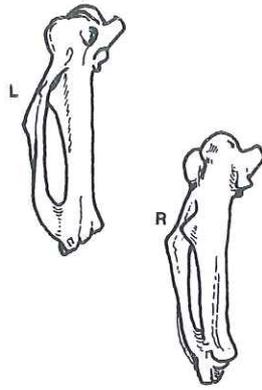
Teal

Mallard

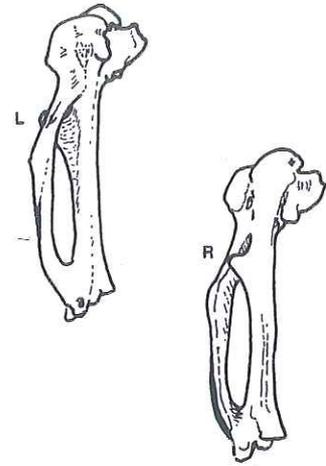
CARPO-METACARPUS



Domestic Fowl



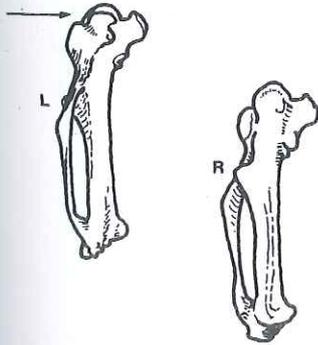
Bantam



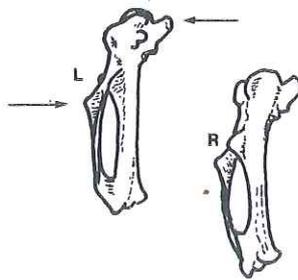
Pheasant

In Galliformes
minor mc is curved and twisted
prominent intermetacarpal process

note notch in border of trochlea

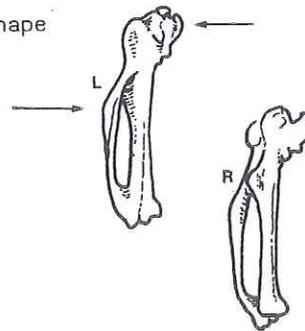


Red Grouse



Partridge

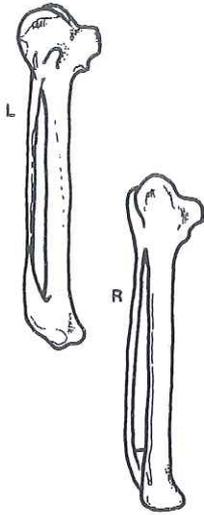
note shape



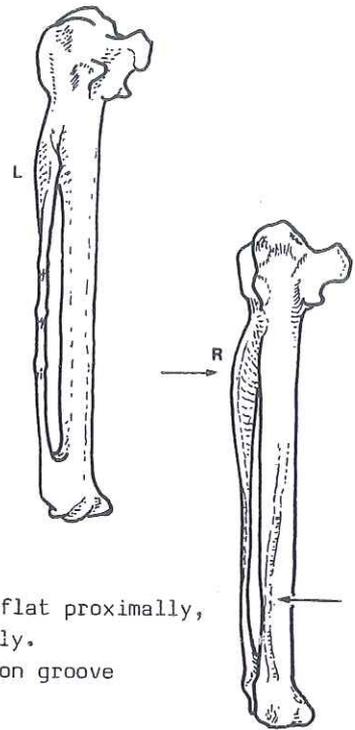
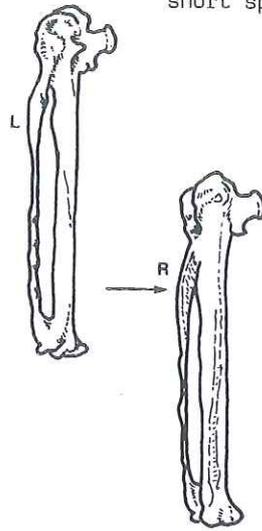
Red-legged Partridge

CARPO-METACARPUS

whole proximal end thin



in Gulls:
short spiky pisiform



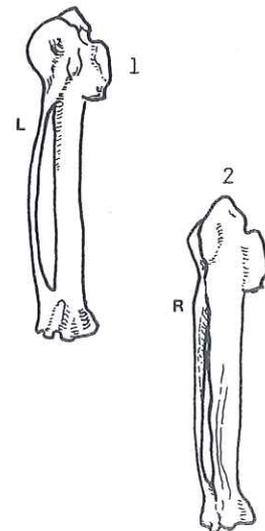
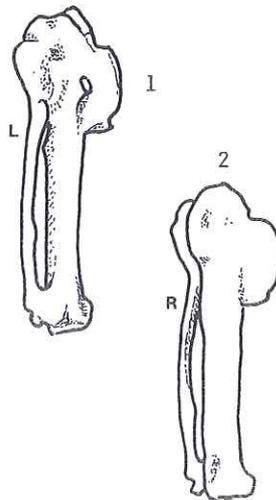
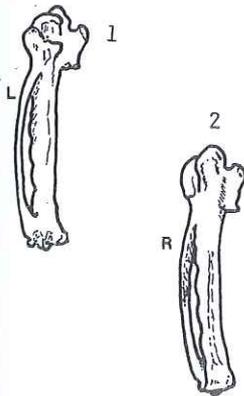
in Gulls:
1. minor mc flat proximally,
thin distally.
2. long tendon groove

Manx Shearwater

Kittiwake

Herring Gull

note: 1 shape of extensor process
2 shape of dorsal carpal trochlea

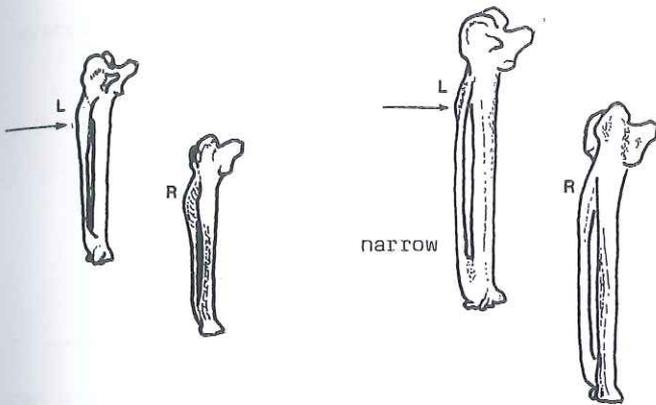


Puffin

Great Auk

Guillemot

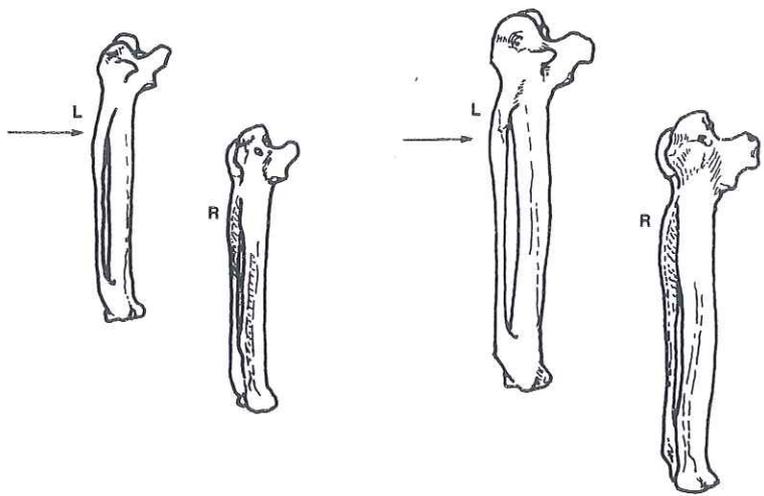
CARPO-METACARPUS



In Waders tends to be long and narrow
minor mc flattened proximally like Gulls

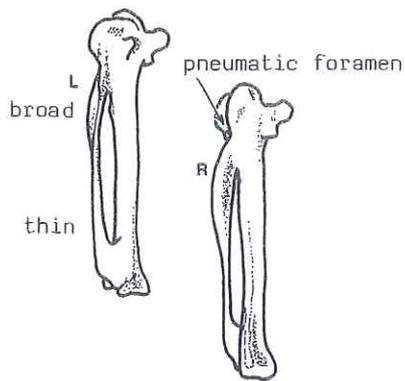
Snipe

Woodcock



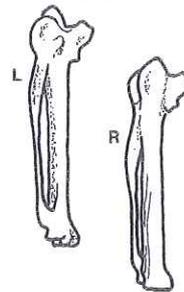
Godwit

Curlew



Lapwing

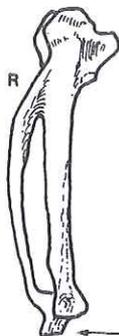
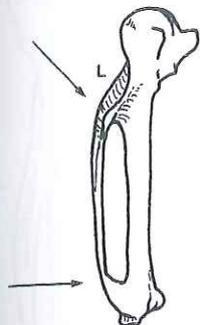
small pisiform



Golden Plover

CARPO-METACARPUS

gracile curved minor mc

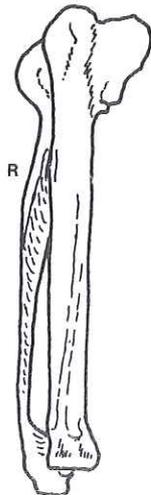
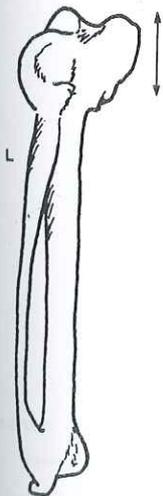


open angle
between major
and minor mc

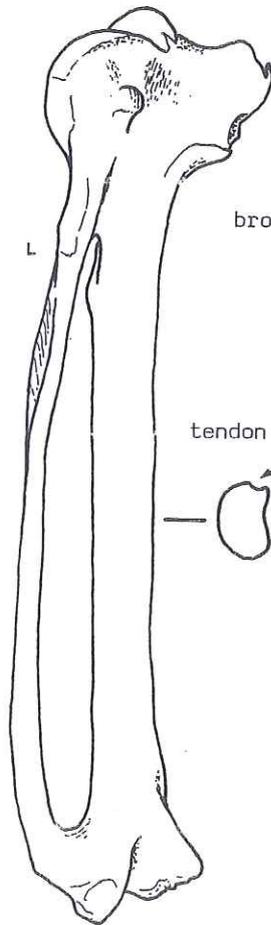
note shape

Tawny Owl

whole of extensor process
proximal to pisiform process



Peregrine Falcon



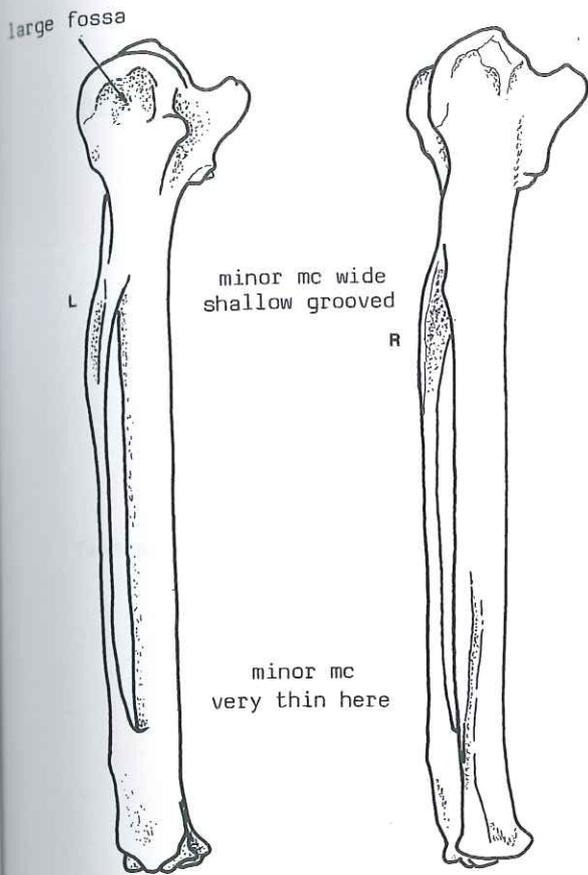
broad and flat

tendon groove

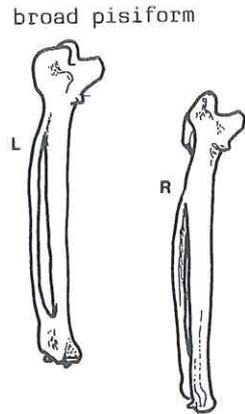
deeply cut
tendon groove

White-tailed Eagle

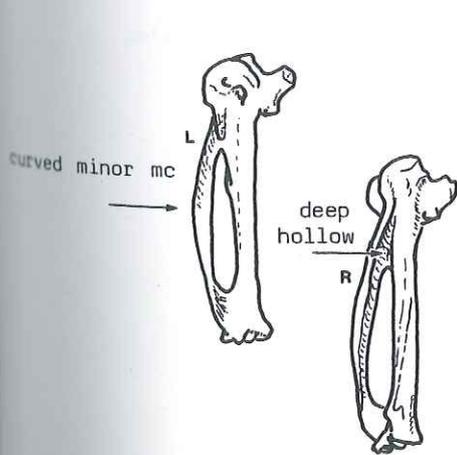
CARPO-METACARPUS



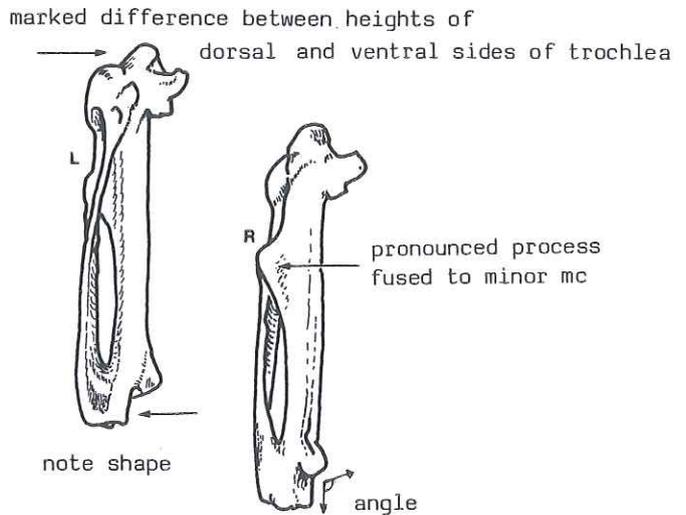
Crane



Coot



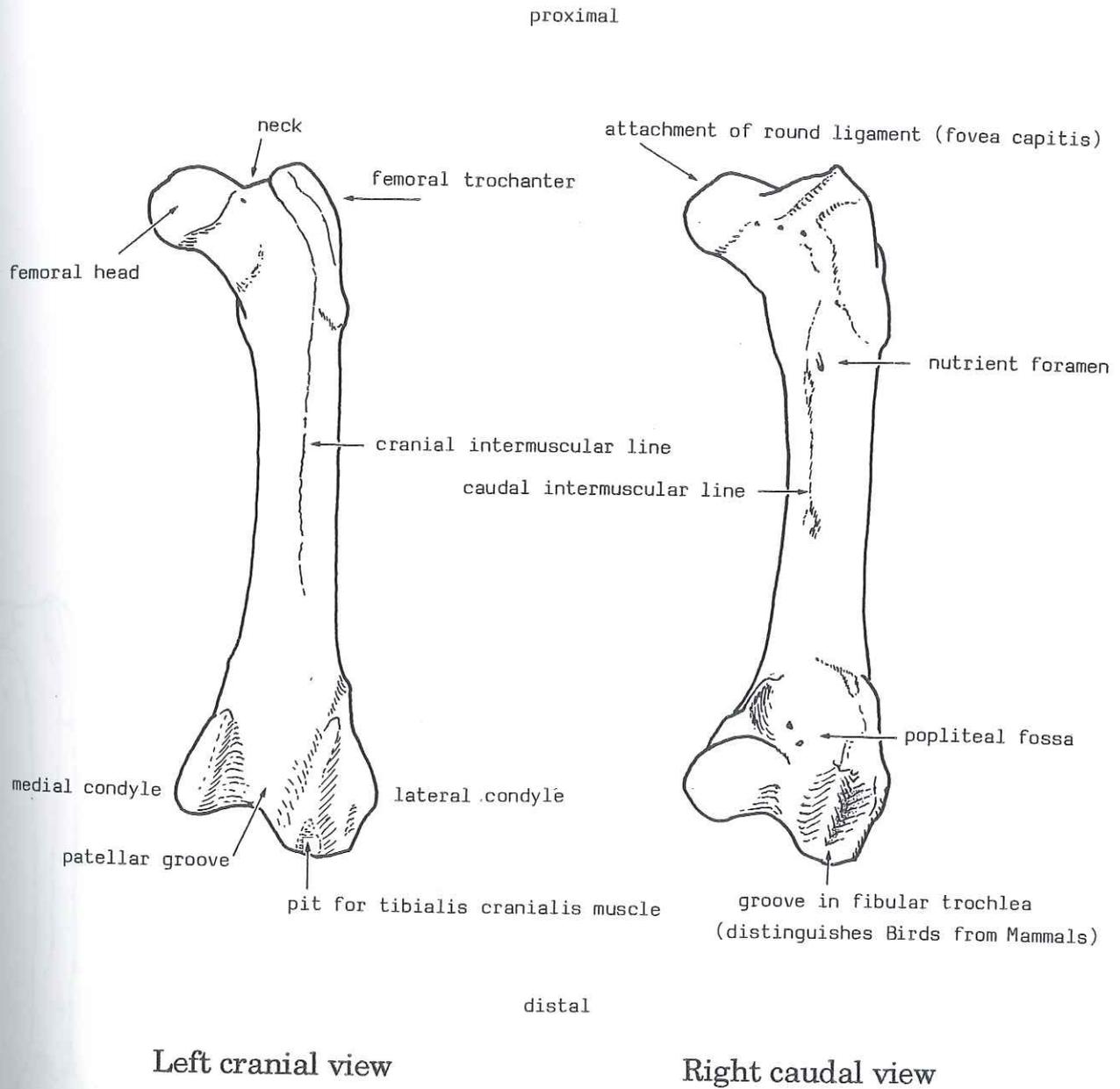
Wood Pigeon



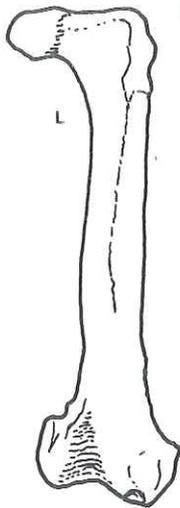
Crow

FEMUR

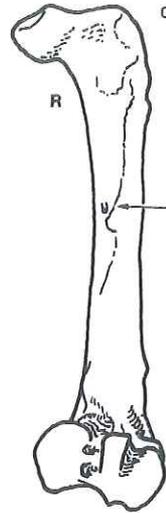
Mute Swan



FEMUR

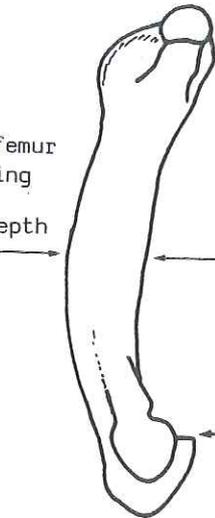


large flat fovea capitis
characteristic flat neck



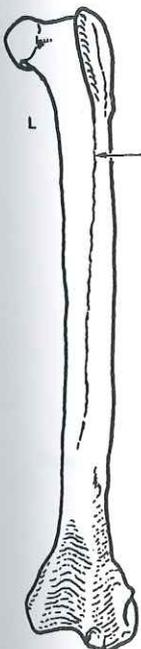
nutrient foramen

medial view of right femur
to show anterior bowing
note cranio-caudal depth

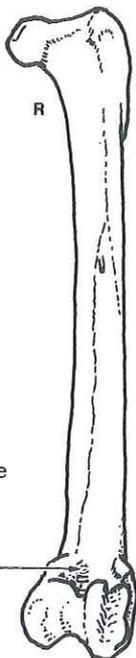


Cormorant

pointed apex of lateral condyle



marked intermuscular ridge



deep narrow patellar groove

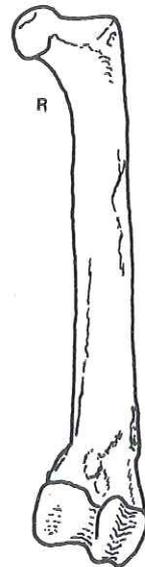
deep popliteal fossa

Grey Heron



well pneumatized

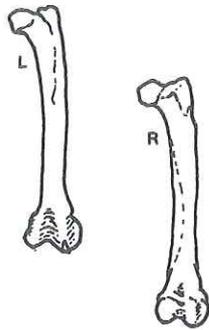
small fovea



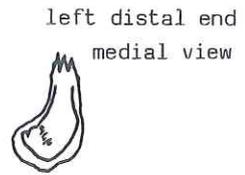
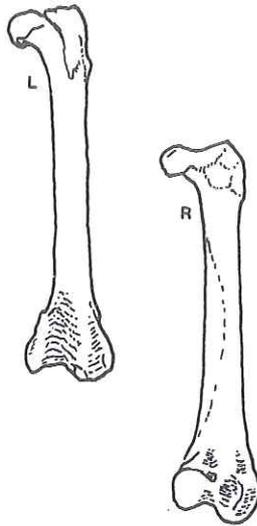
trochlea has rounded edges
and shallow groove

Gannet

FEMUR

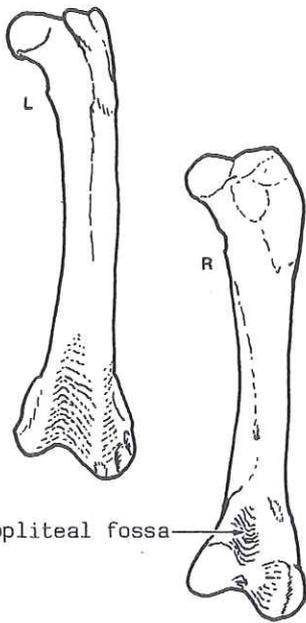


Teal



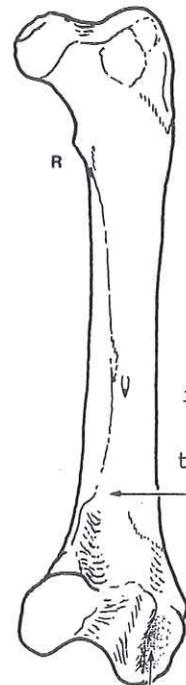
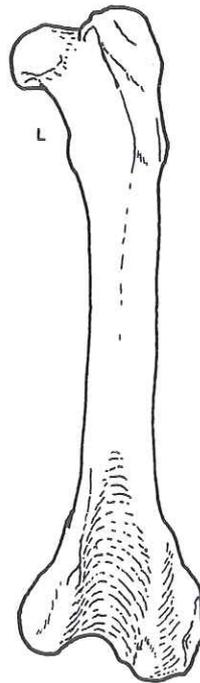
left distal end
medial view

Mallard



deep popliteal fossa

Brent Goose



intermuscular ridge
ending in
thin flange distally

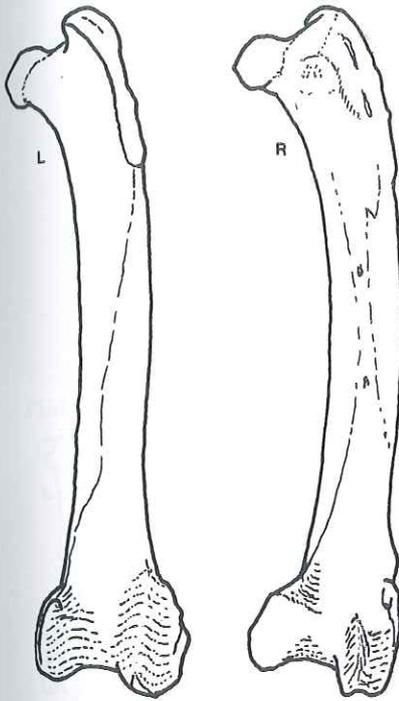
present in Geese
not in Ducks

deep fibular groove

Domestic Goose

medial view of left distal end to show
characteristic shape of medial condyle

FEMUR



Domestic Fowl

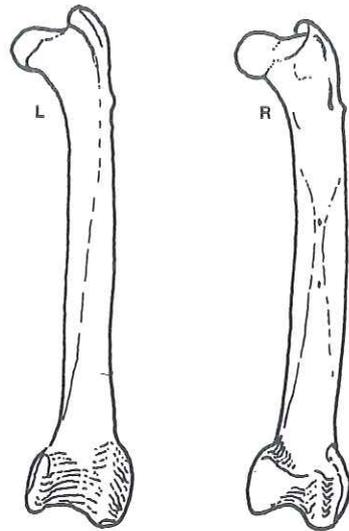
Lt.lateral view



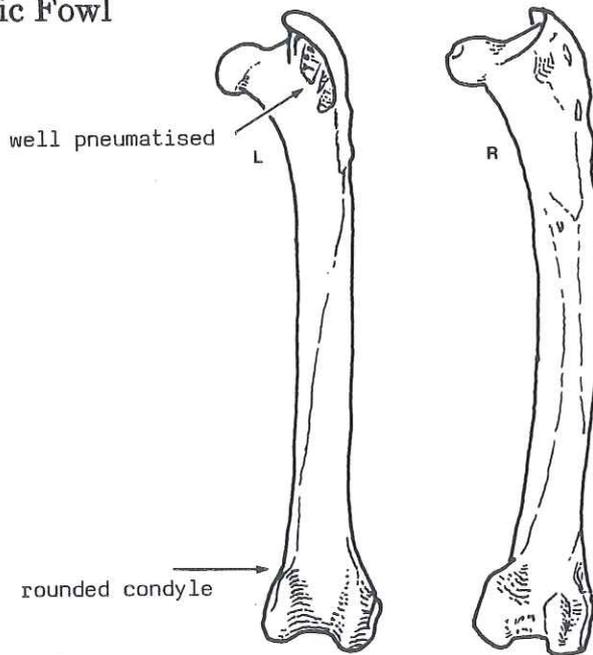
note shape of trochanter and medial condyle in Domestic Fowl



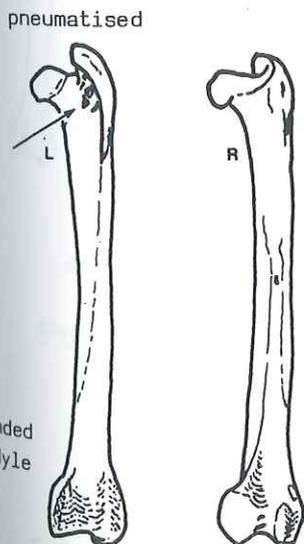
Rt.medial view



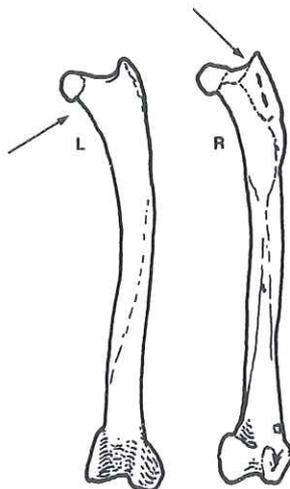
Bantam



Pheasant

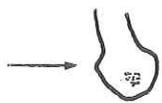
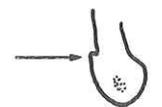


Red Grouse

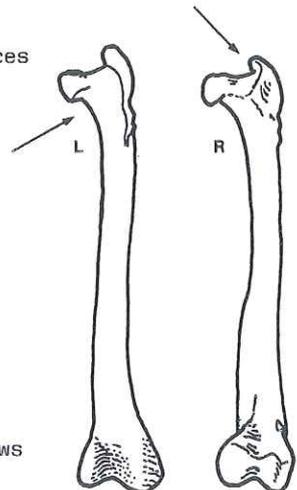


Partridge

note differences

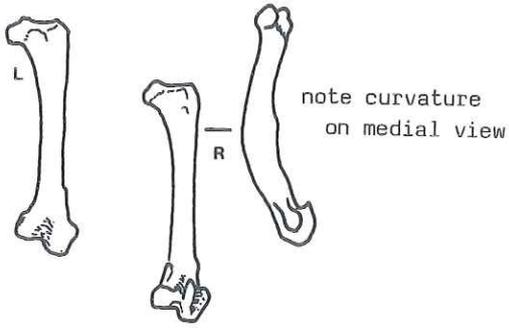


medial views



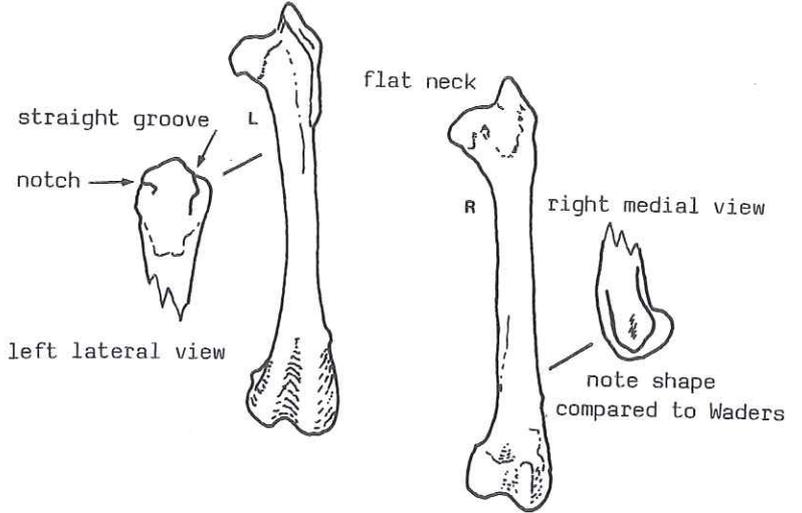
Red-legged Partridge

FEMUR

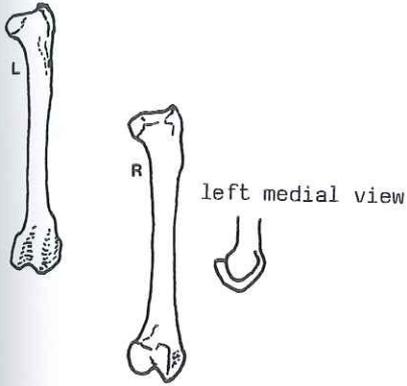


narrow condyle with deep fibular groove

Manx Shearwater



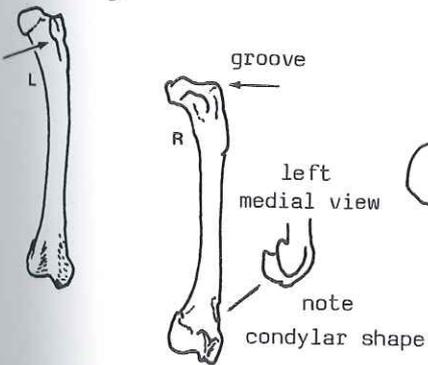
flat head and neck



Kittiwake

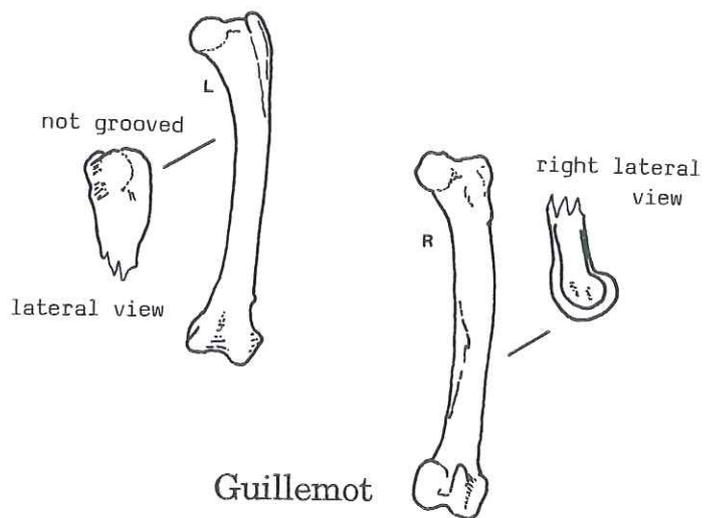
Herring Gull

undercut edge

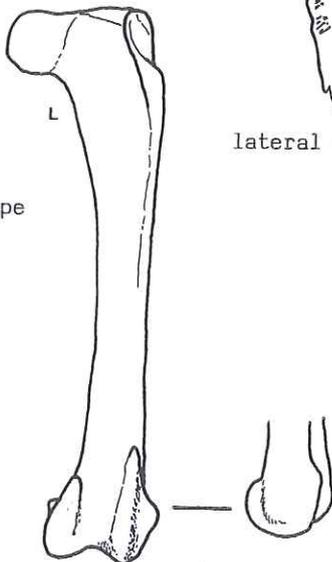


deep fibular groove

Puffin

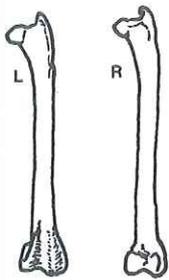


Guillemot

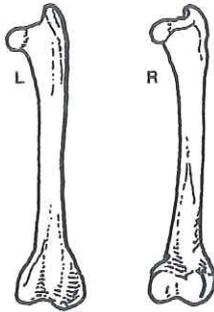


Great Auk

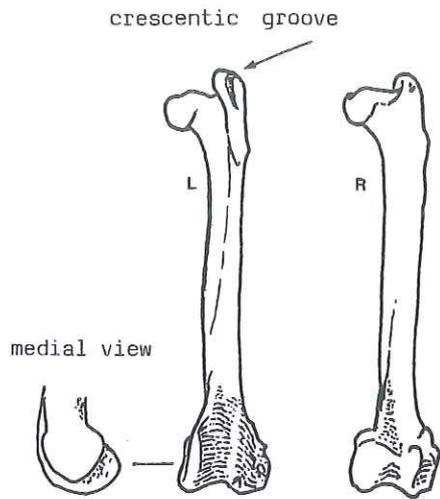
FEMUR



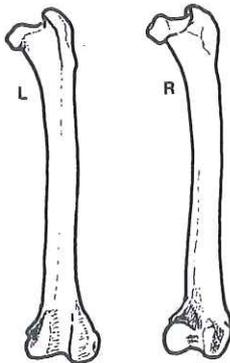
Snipe



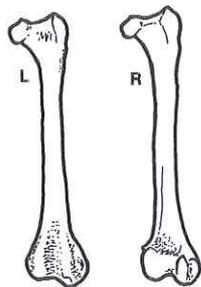
Godwit



Curlew



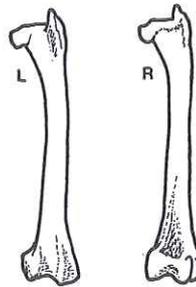
Woodcock



wide distal end

Lapwing

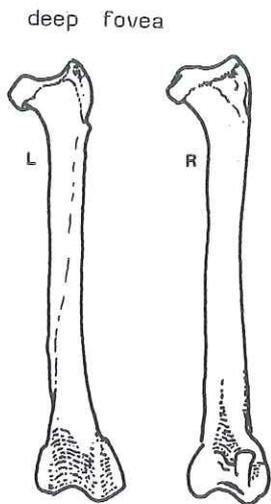
thin flange-like trochanter



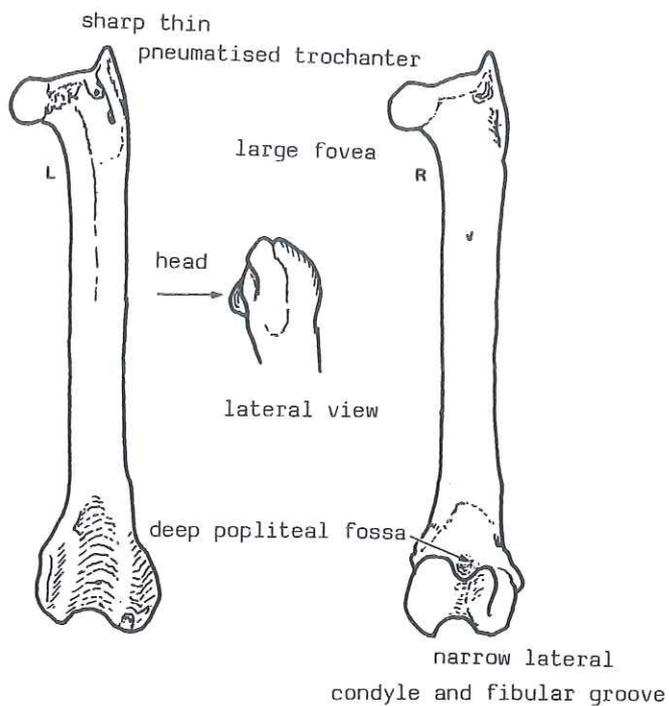
slender shaft

Golden Plover

FEMUR

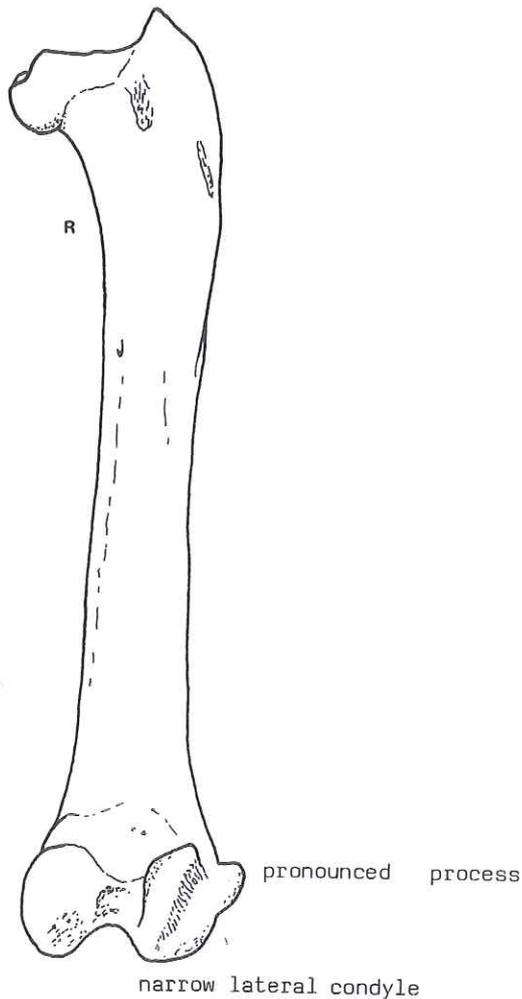
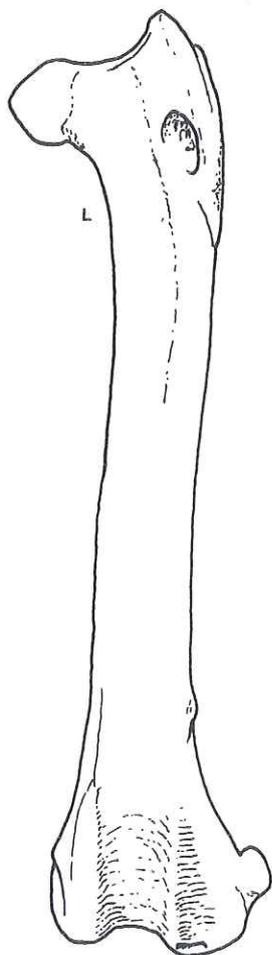


Tawny Owl



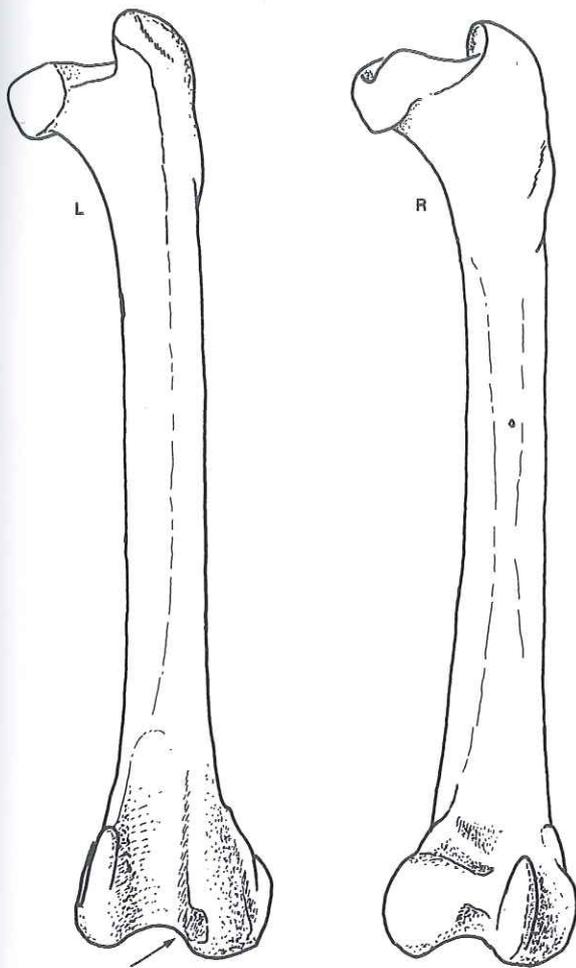
Peregrine Falcon

deeply undercut and pneumatised



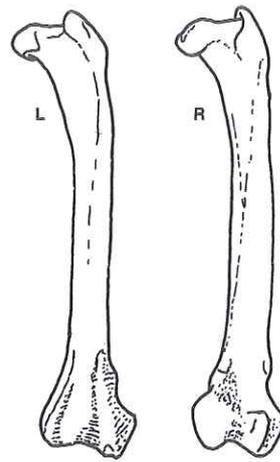
White-tailed Eagle

FEMUR

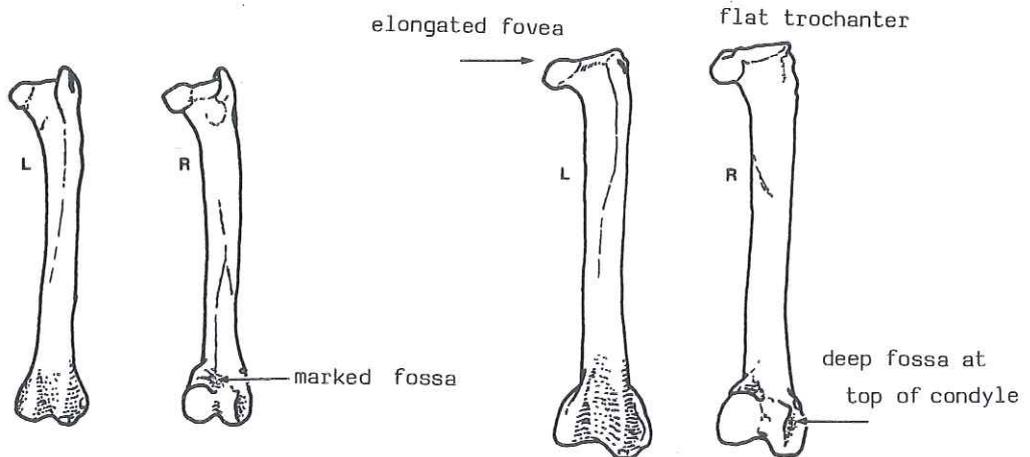


shallow fossa

Crane



Coot

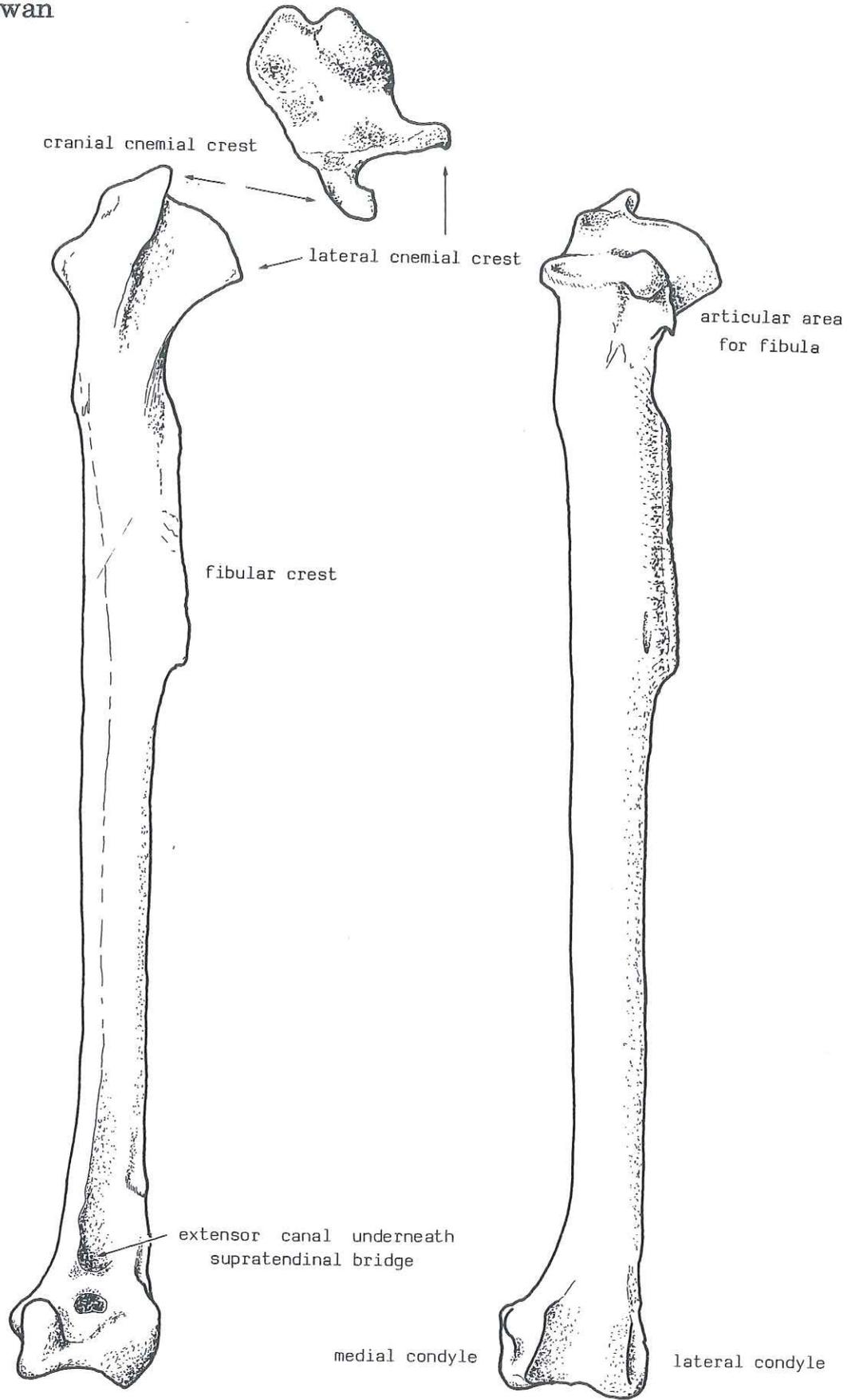


Wood Pigeon

Crow

TIBIO-TARSUS

Mute Swan

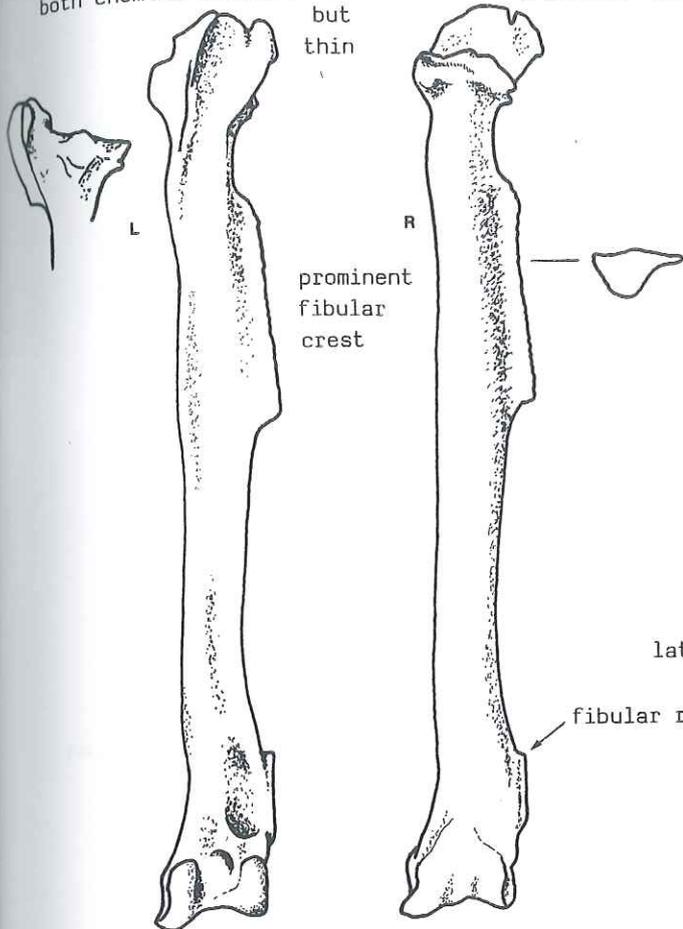


Left cranial view

Right caudal view

TIBIO-TARSUS

both cnemial crests prominent but thin



prominent fibular crest

sharp ridge

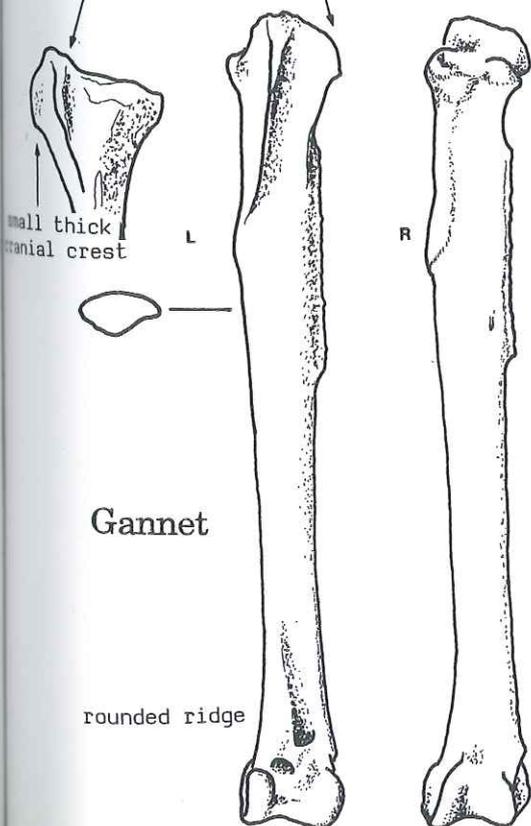
lateral crest larger

fibular remnant

articulation angled in Cormorants

Cormorant

lateral crest virtually a ridge only



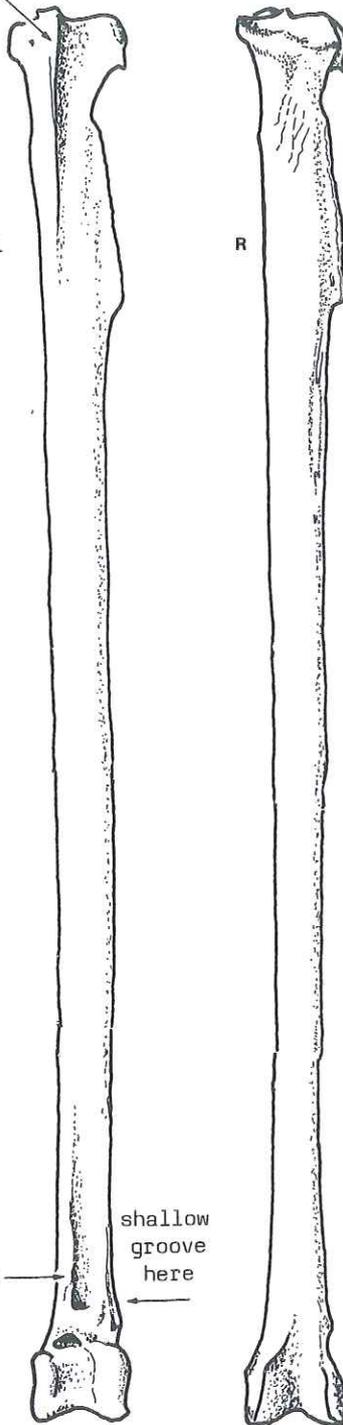
small thick cranial crest

Gannet

rounded ridge

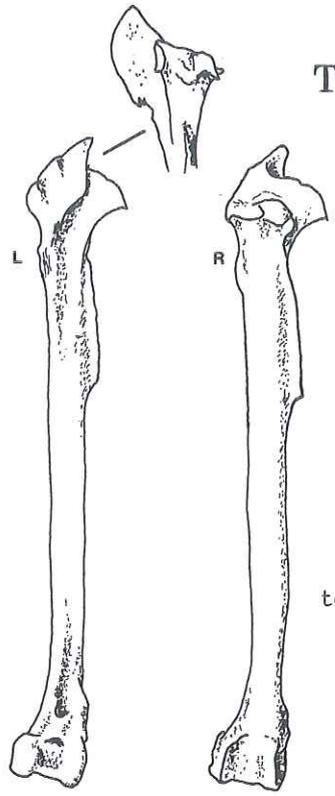
sharp ridge to canal edge

shallow groove here

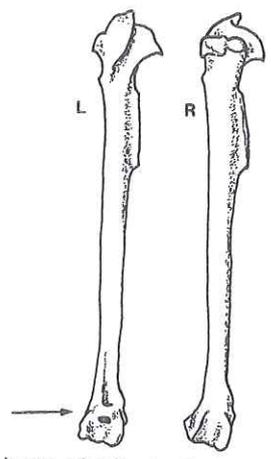


Grey Heron

TIBIO-TARSUS



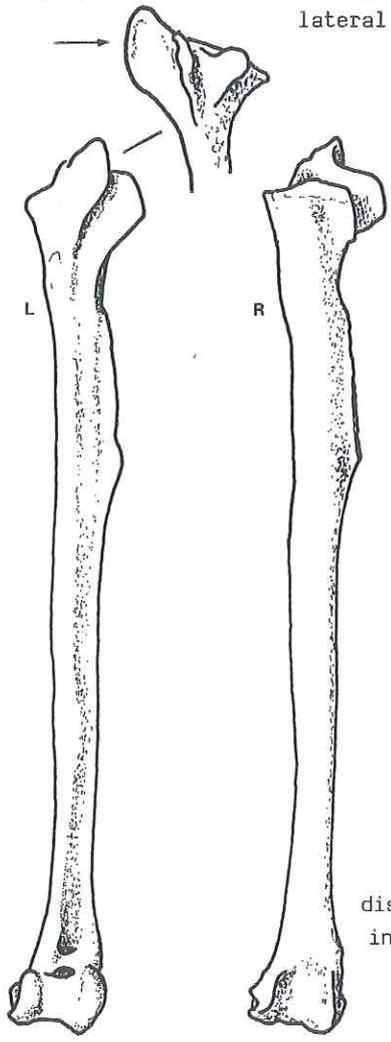
tendinal bridge transverse to bone shaft in Geese and Ducks



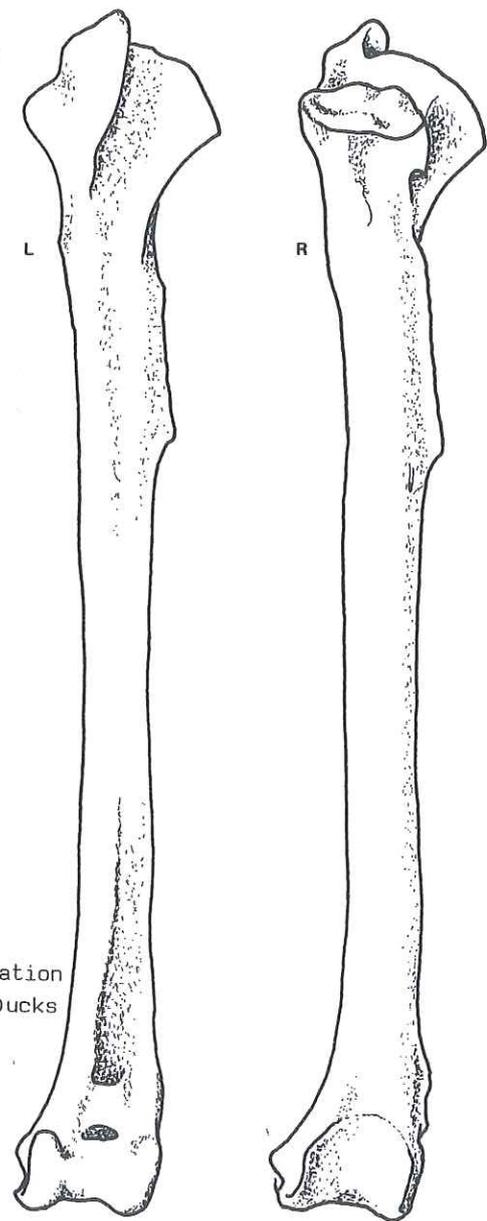
Teal

Mallard

note large thin projecting cnemial crests, best seen in lateral view



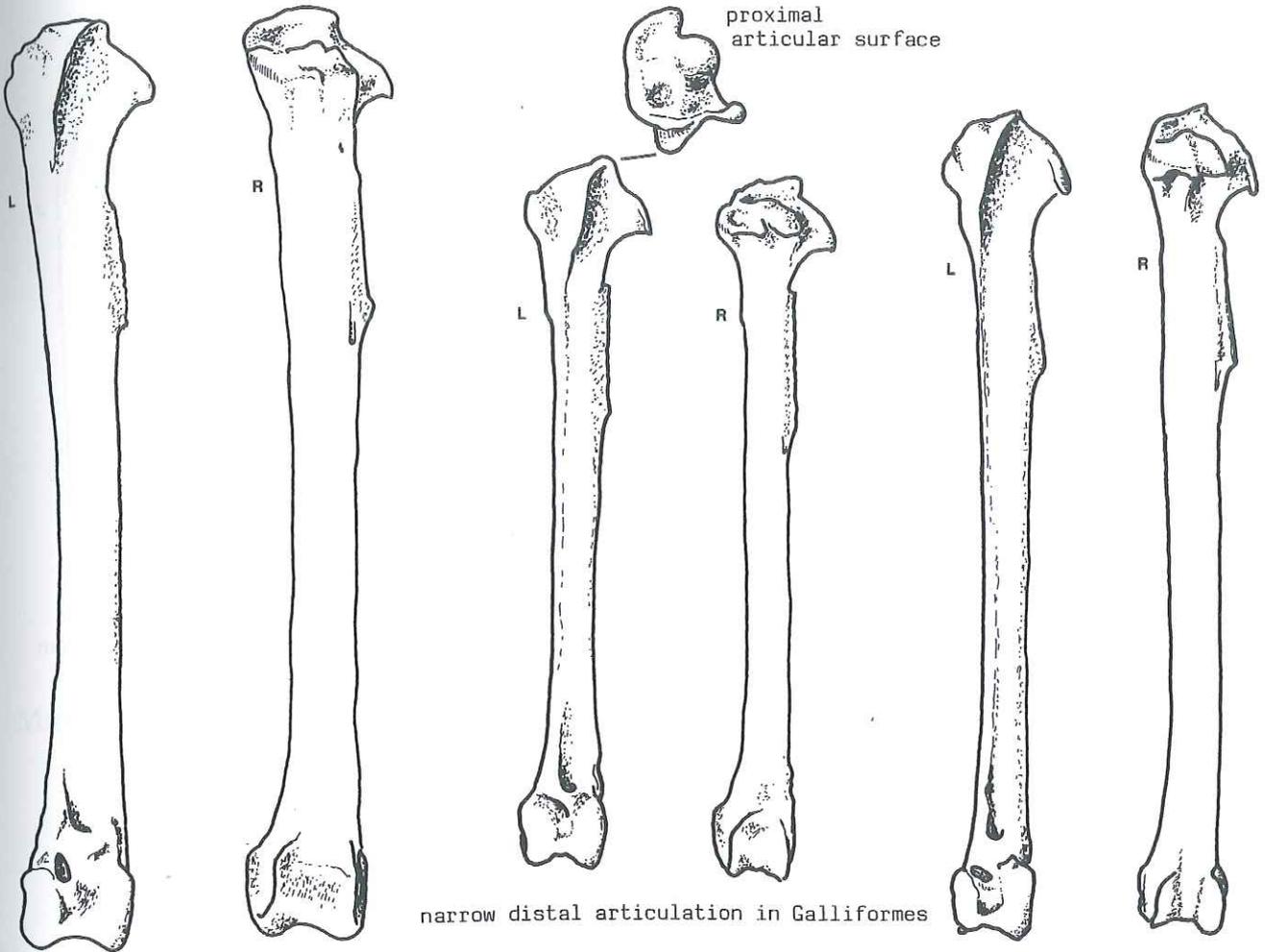
Brent Goose



splayed distal articulation in Geese and Ducks

Domestic Goose

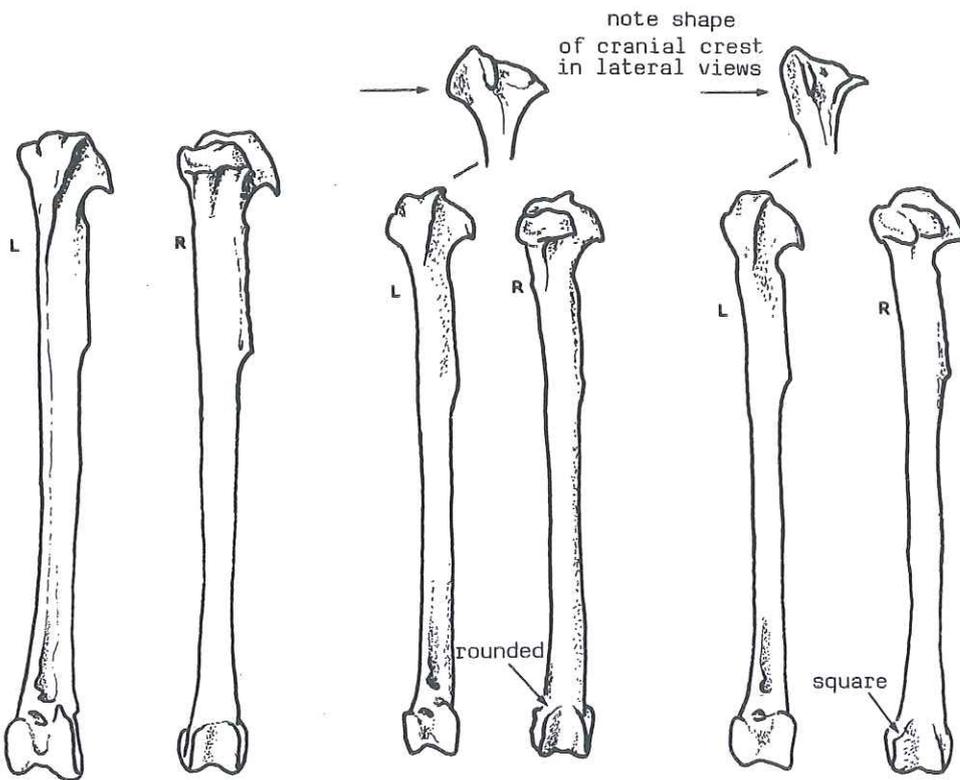
TIBIO-TARSUS



Domestic Fowl

Bantam

Pheasant



Red Grouse

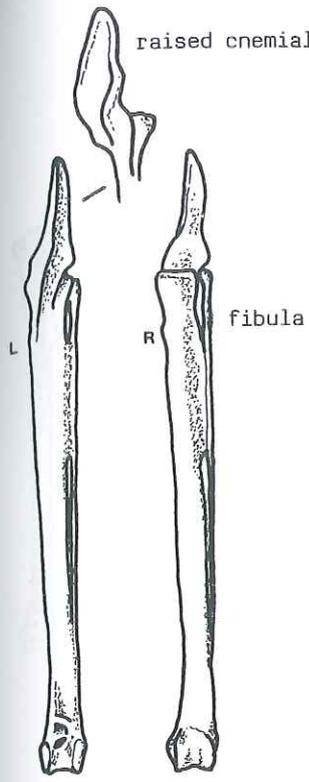
Partridge

Red-legged Partridge

raised cnemial crest

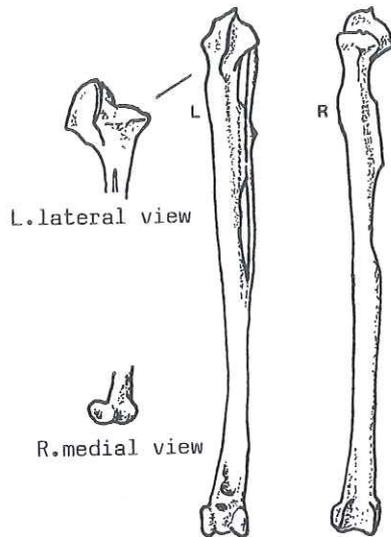
TIBIO-TARSUS

short fibular crest in Gulls and Waders

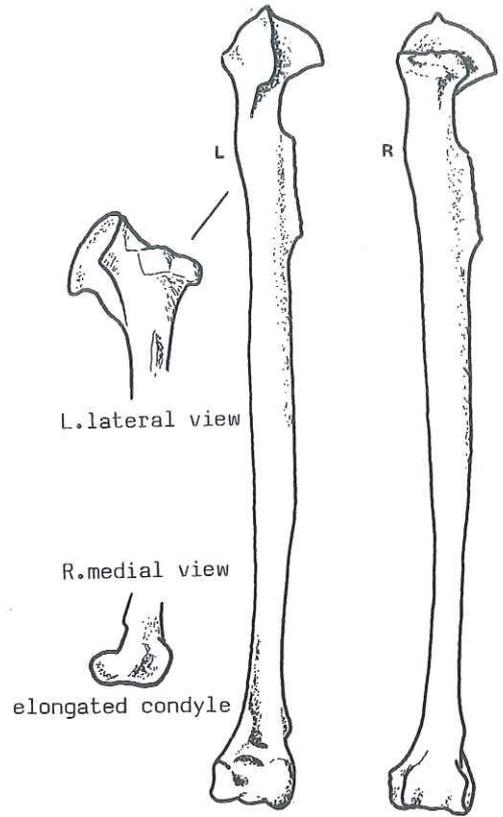


narrow articulation

Manx Shearwater

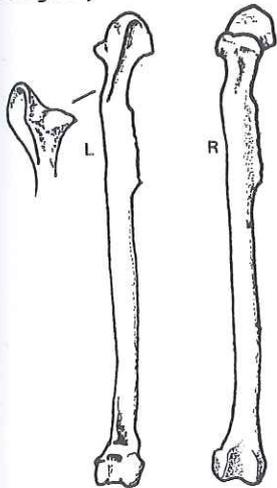


Kittiwake

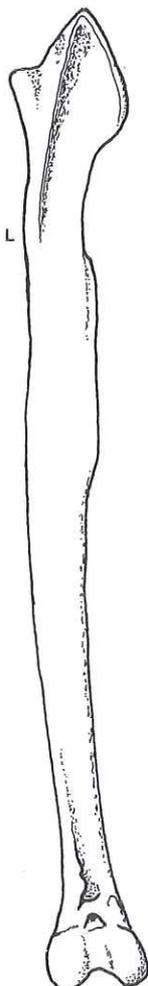


Herring Gull

slightly raised cnemial crest

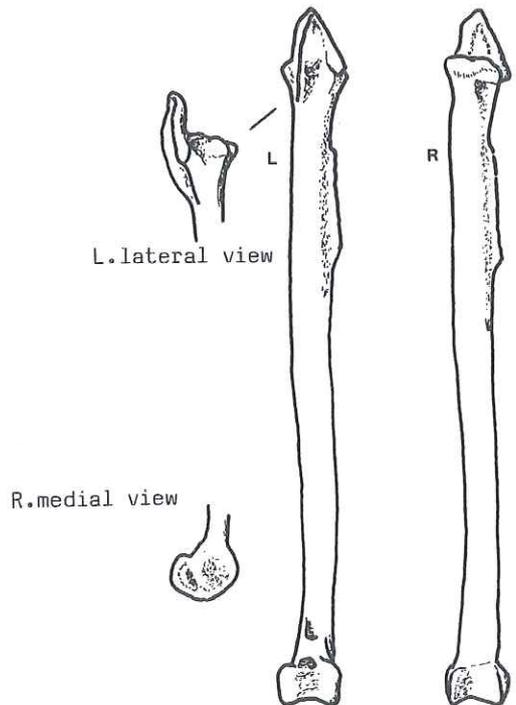


Puffin



Great Auk

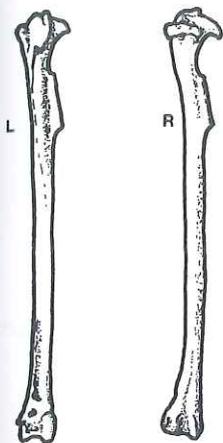
raised cnemial crest in Auks



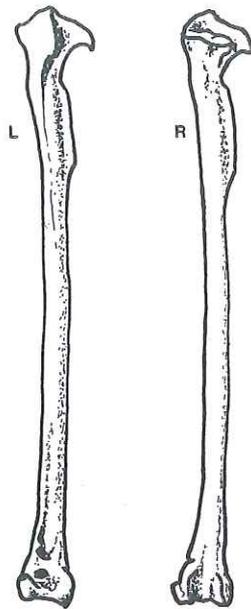
Guillemot

TIBIO-TARSUS

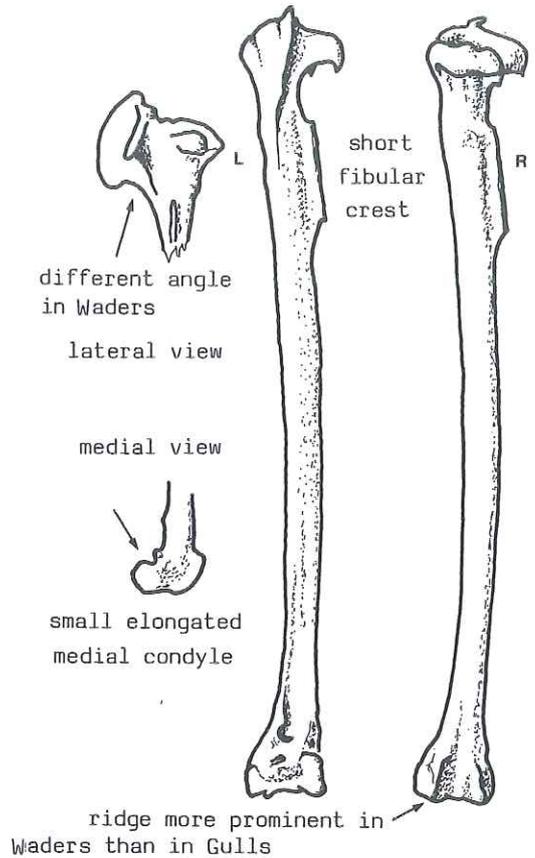
note characteristic shapes of cnemial crest and distal medial condyle



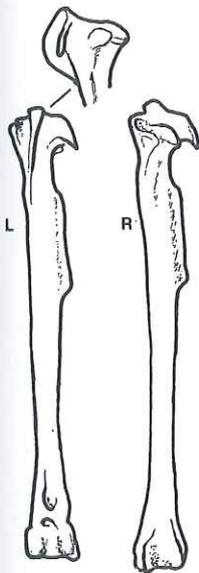
Snipe



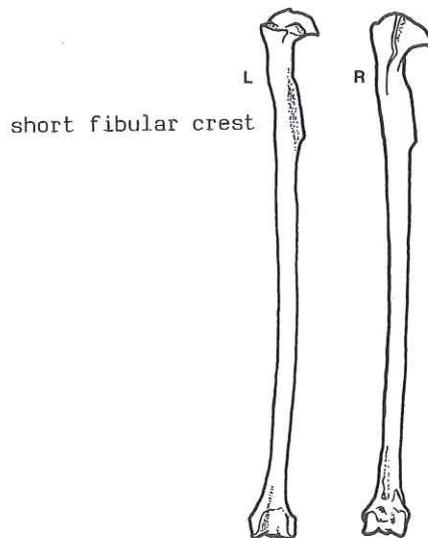
Godwit



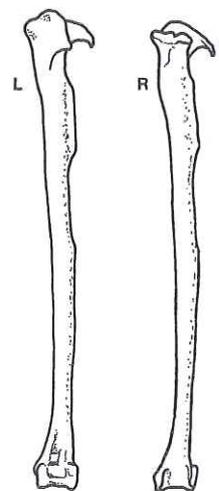
Curlew



Woodcock

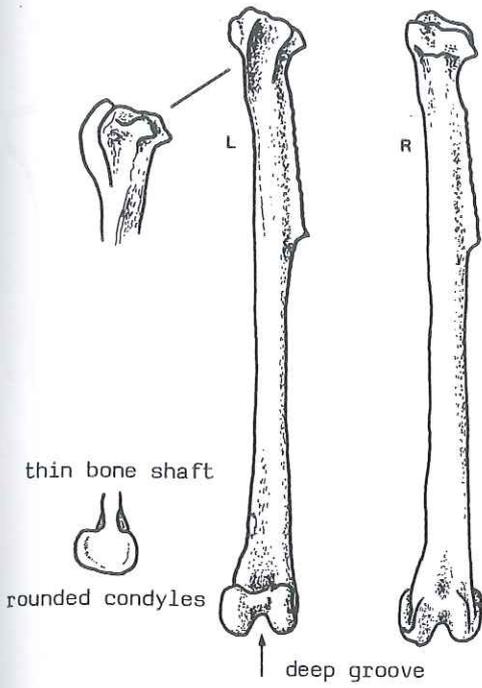


Lapwing

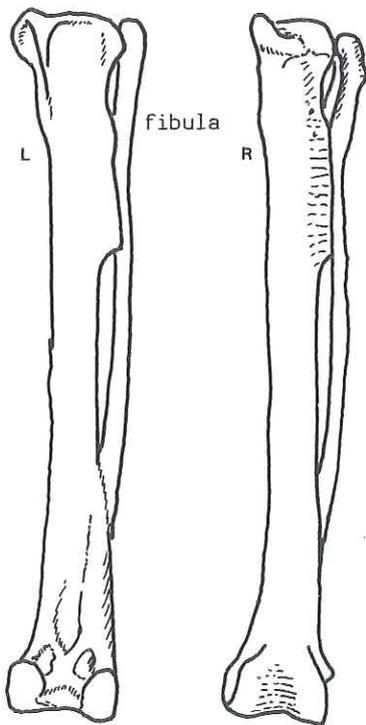


Golden Plover

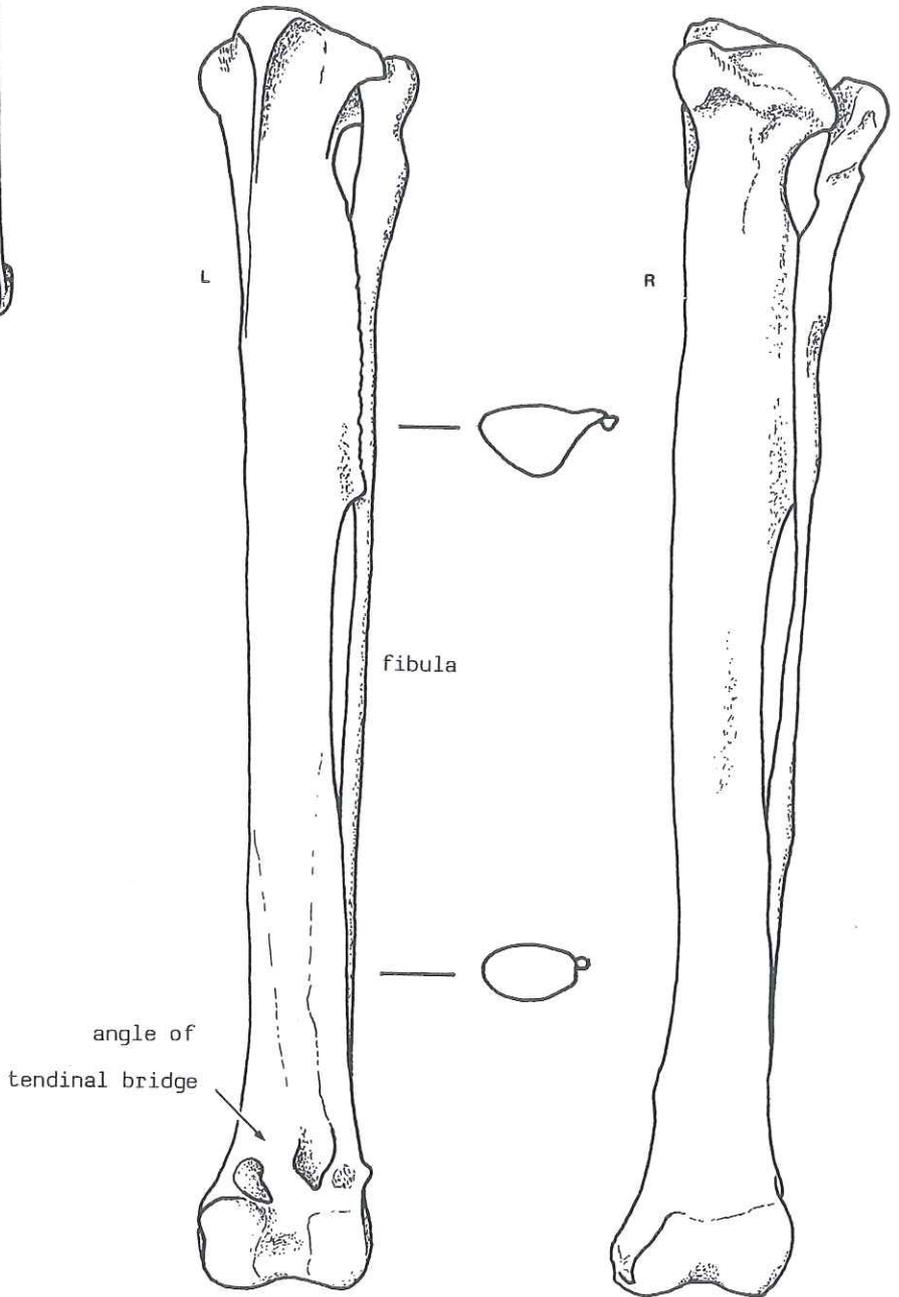
TIBIO-TARSUS



Tawny Owl



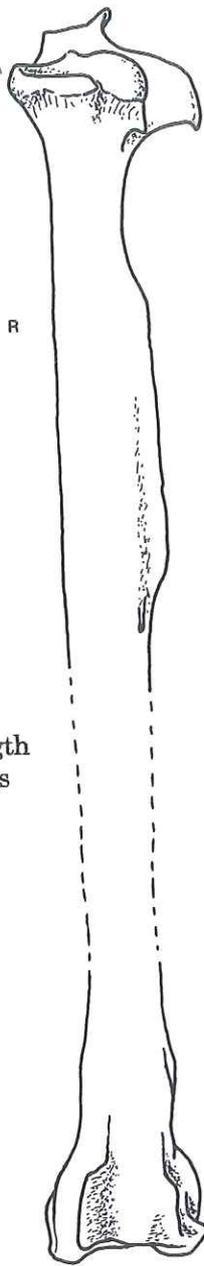
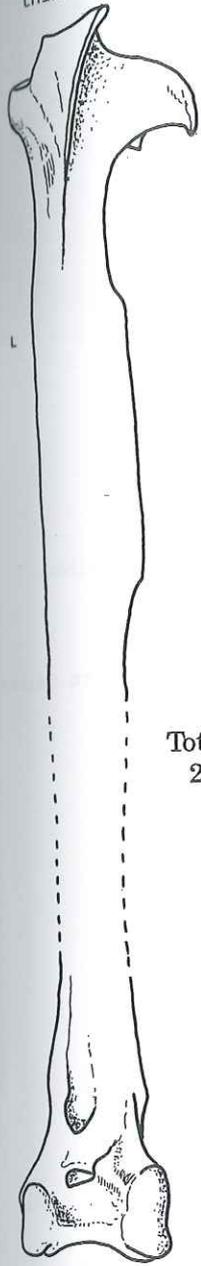
Peregrine Falcon



White-tailed Eagle

TIBIO-TARSUS

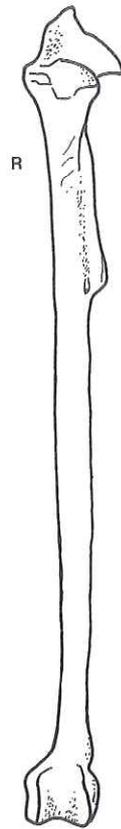
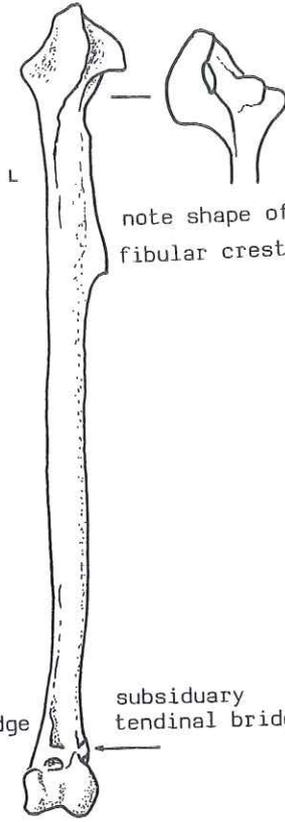
thin crest



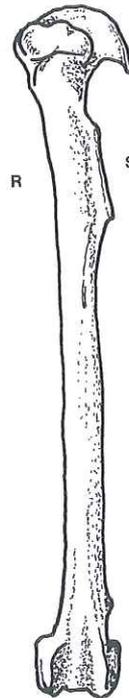
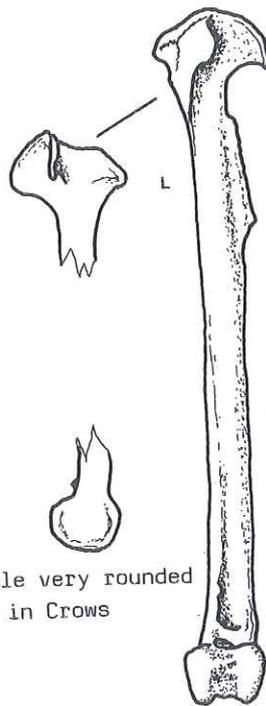
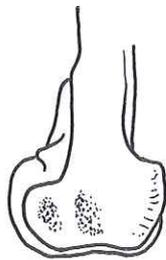
Total length
28.6 cms

Crane

large thin cnemial crest



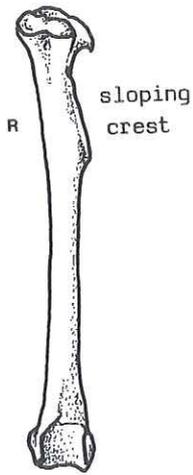
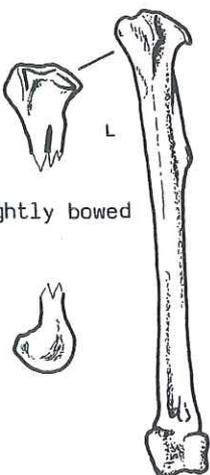
Coot



short crest

Crow

slightly bowed

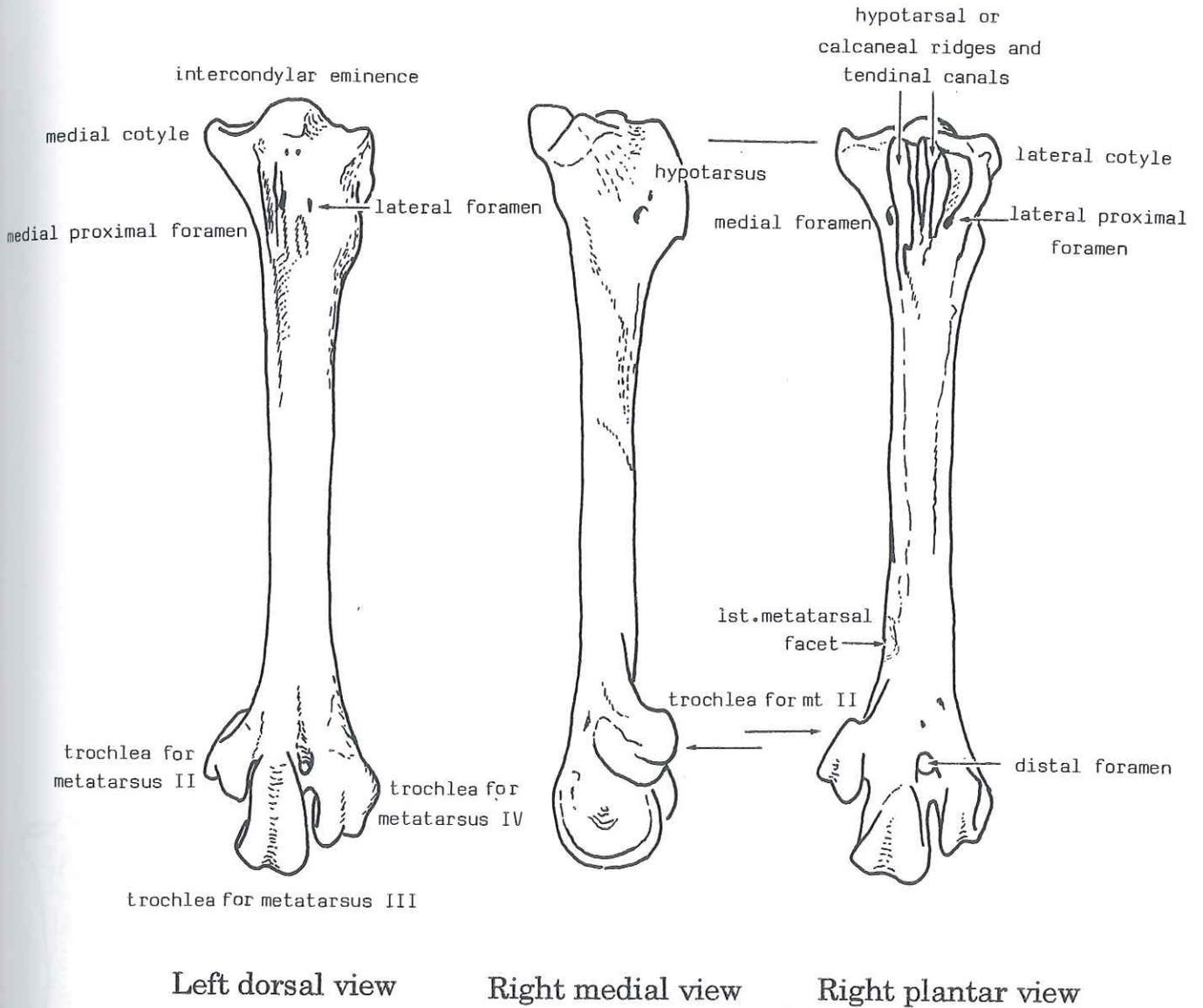


sloping crest

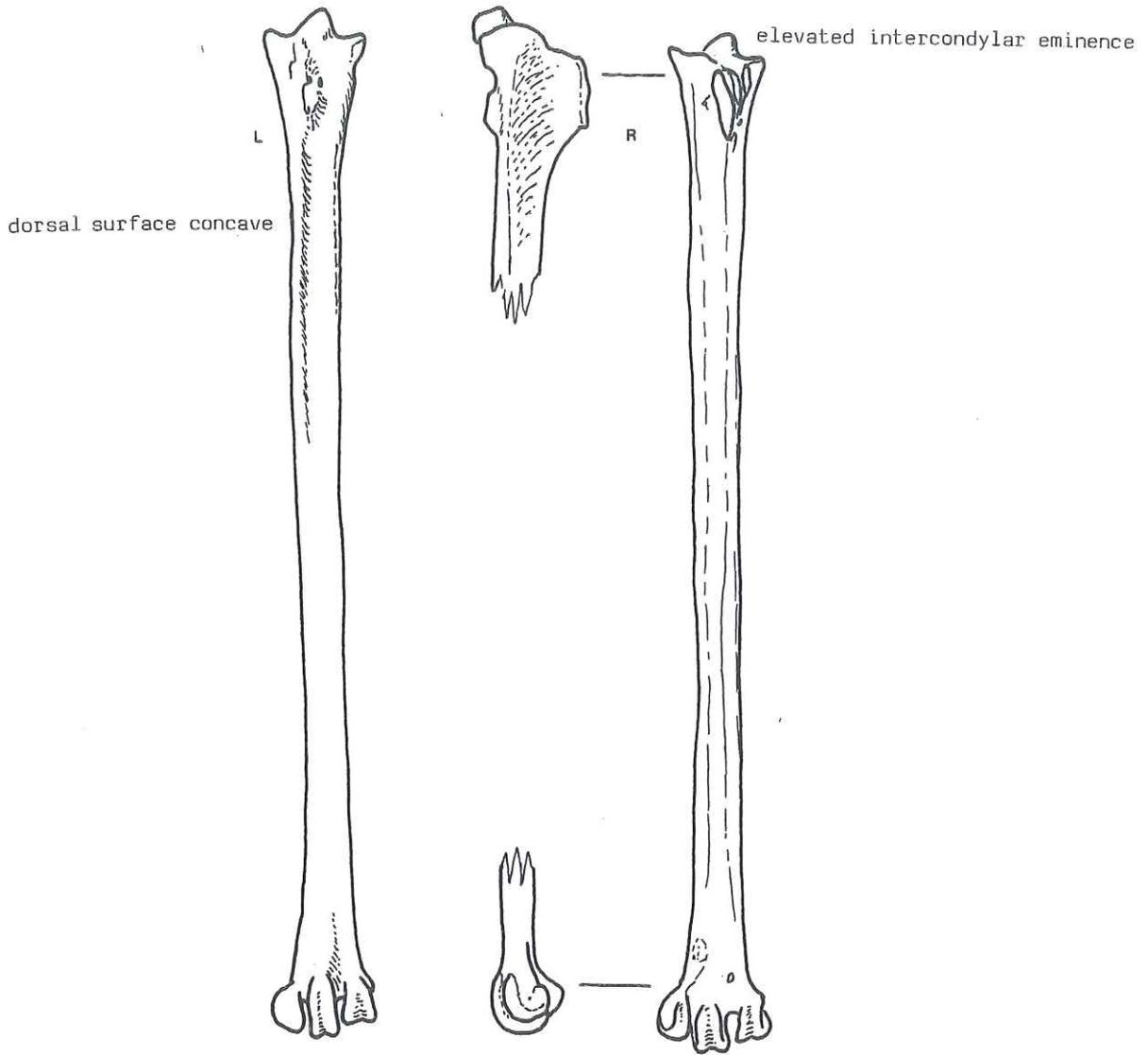
Wood Pigeon

TARSO-METATARSUS

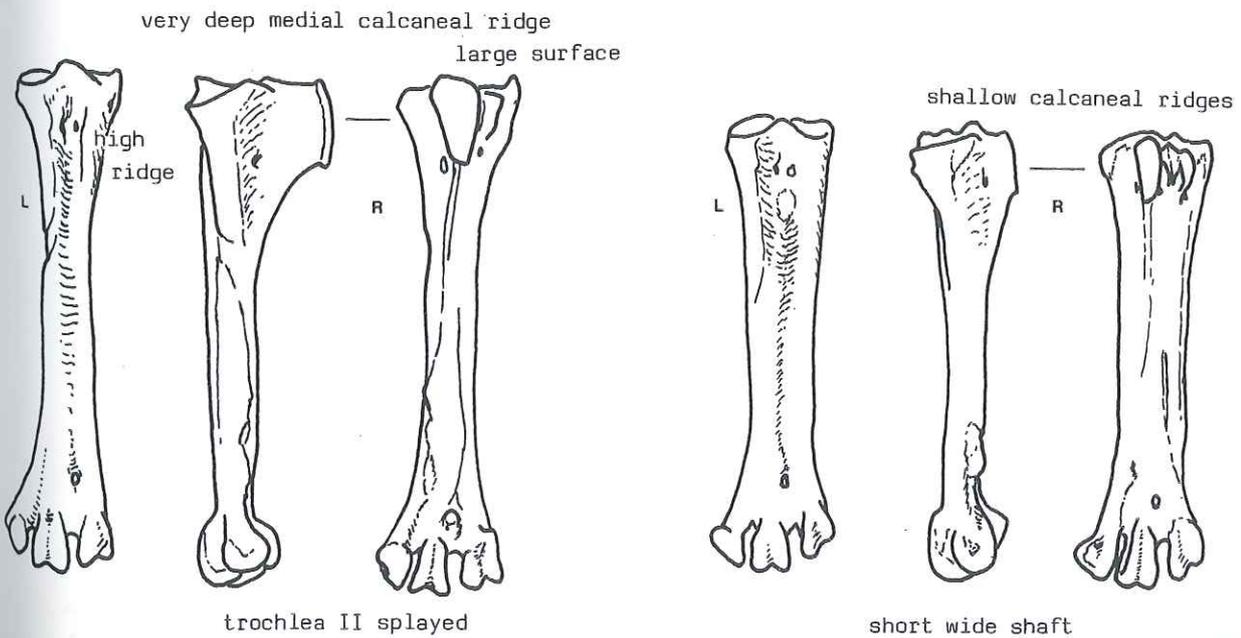
Mute Swan



TARSO-METATARSUS



Grey Heron

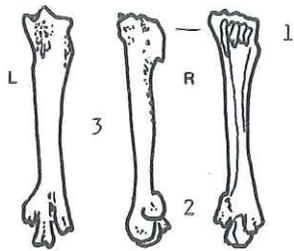


Cormorant

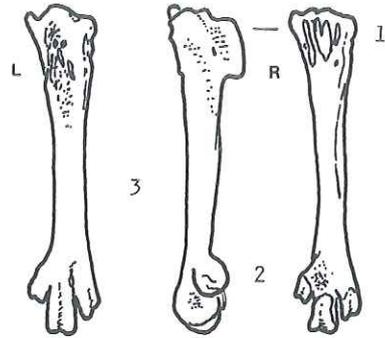
Gannet

TARSO-METATARSUS

relatively short shaft in Ducks

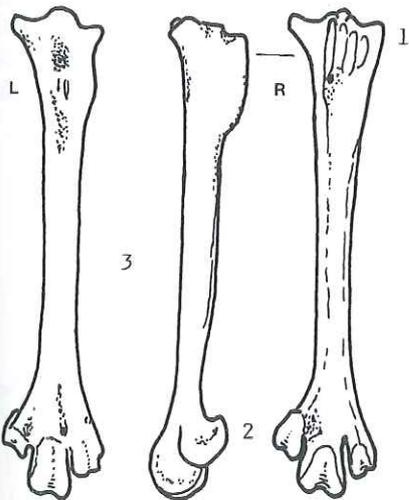


Teal

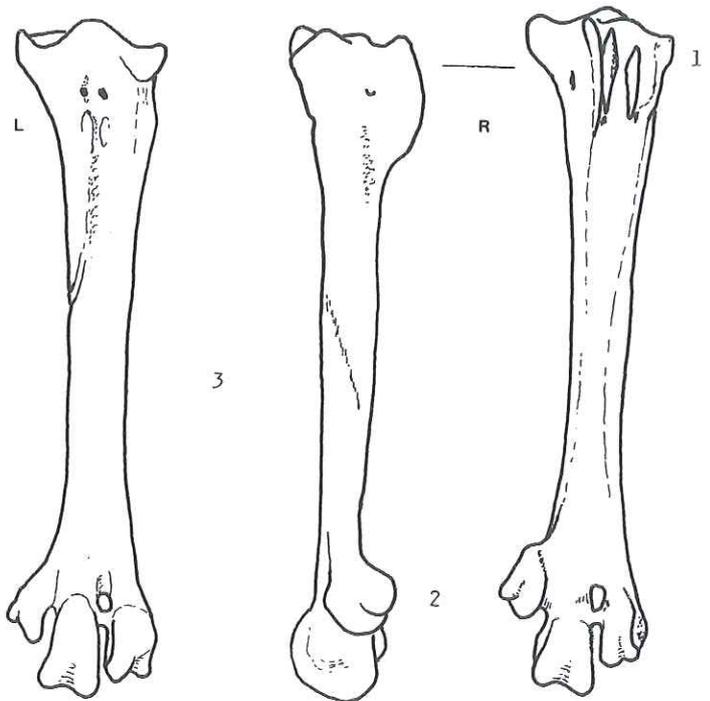


Mallard

- 1 four calcaneal ridges, medial ridge longest
- 2 trochlea II rounded compared with Galliformes
- 3 bone shaft squarish in cross-section in Geese and Ducks

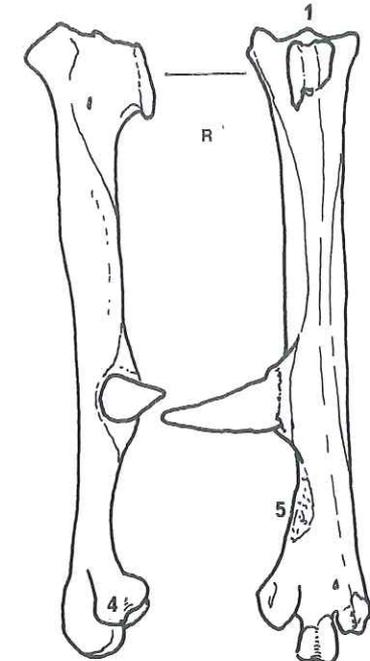
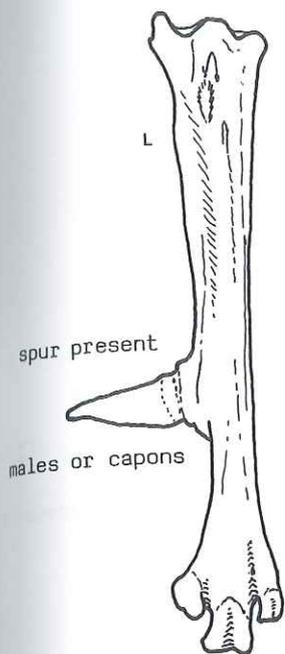


Brent Goose

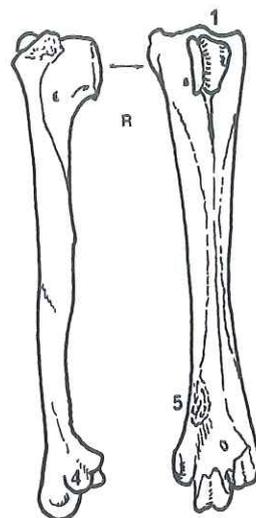
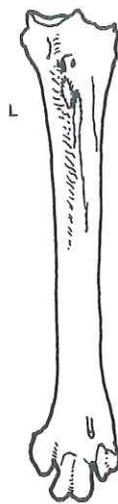


Domestic Goose

TARSO-METATARSUS

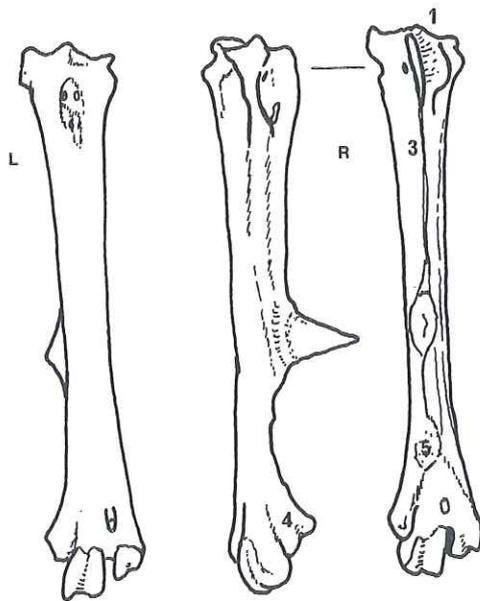


Domestic Fowl

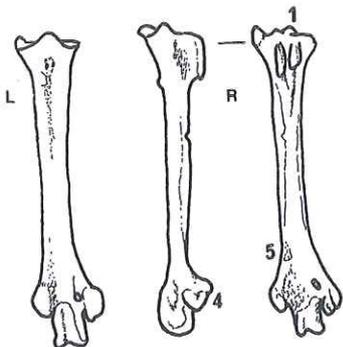


Bantam

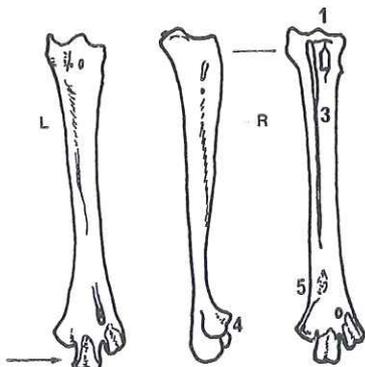
1 prominent calcaneal ridges in Galliformes
 2 one enclosed tendinal canal in Domestic Fowl and Pheasant
 3 medial calcaneal ridge continues down shaft in Pheasant and Partridges
 4 trochlea II bilobed in Galliformes
 5 marked facet for 1st. metatarsus in Galliformes



Pheasant

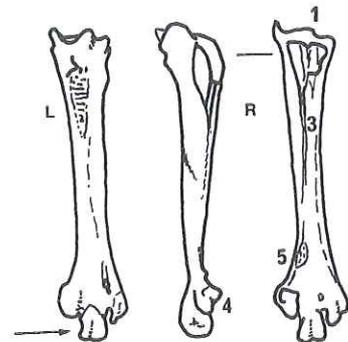


Red Grouse



longer narrower articulation

Partridge

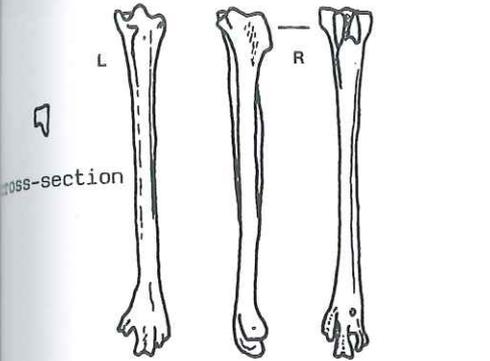


short wider articulation

Red-legged Partridge

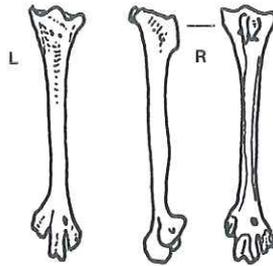
TARSO-METATARSUS

lateral surface
wider than medial

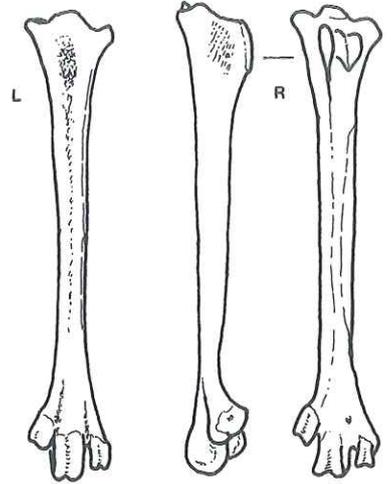


shaft very flattened medio-laterally

Manx Shearwater



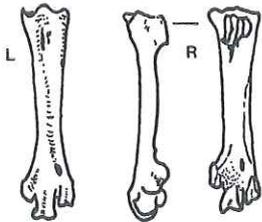
Kittiwake



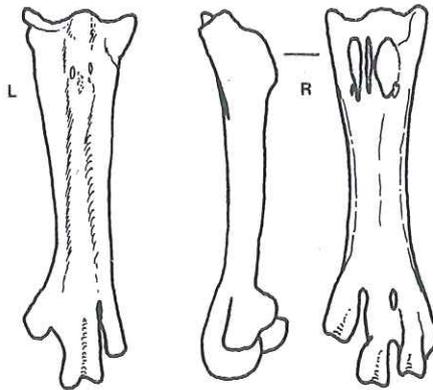
Herring Gull

In Gulls:

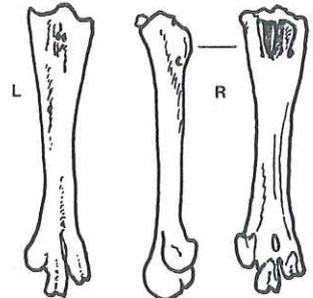
- 1 large proximal foraminae in deep fossa
- 2 medial calcaneal ridge relatively large



Puffin



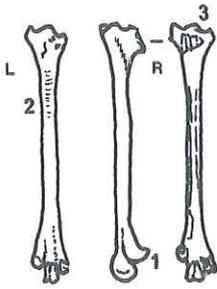
Great Auk



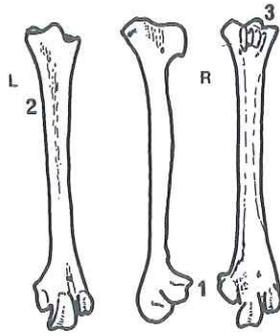
Guillemot

poorly developed calcaneal ridges
short wide flattened bone shaft in Auks

TARSO-METATARSUS

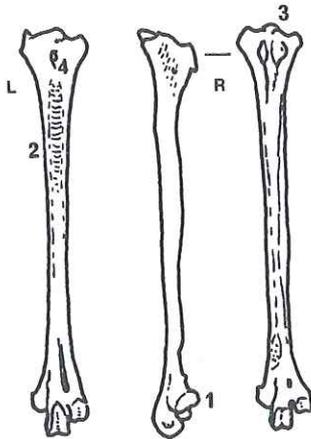


Snipe

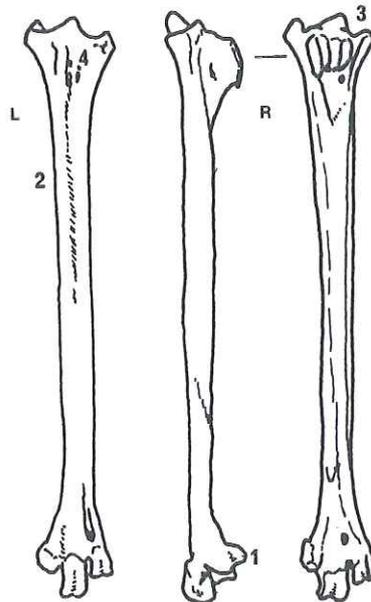


Woodcock

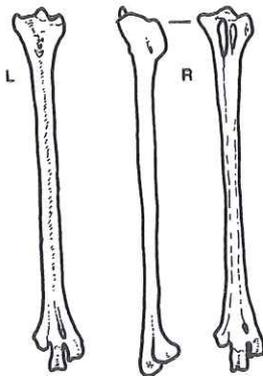
All Waders:
 1 trochlea II projects posteriorly
 2 concave dorsal surfaces
 3 calcaneal ridges of similar length
 4 small proximal foraminae



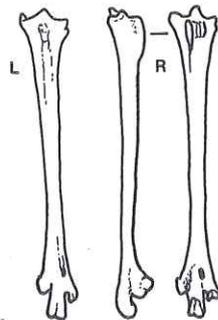
Godwit



Curlew



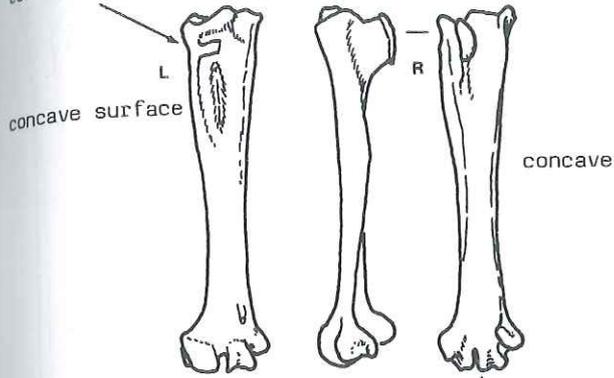
Lapwing



Golden Plover

TARSO-METATARSUS

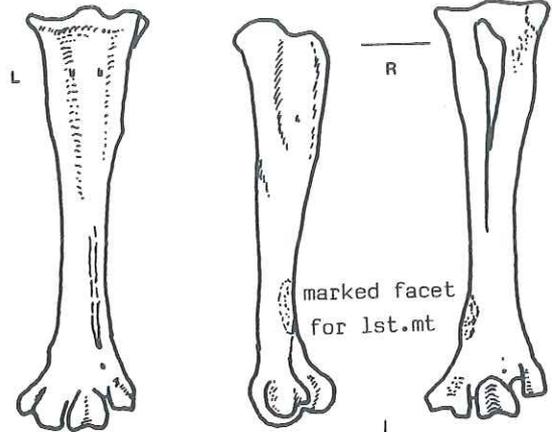
tendinal bridge (present only in Strigidae and Rallidae)



Tawny Owl

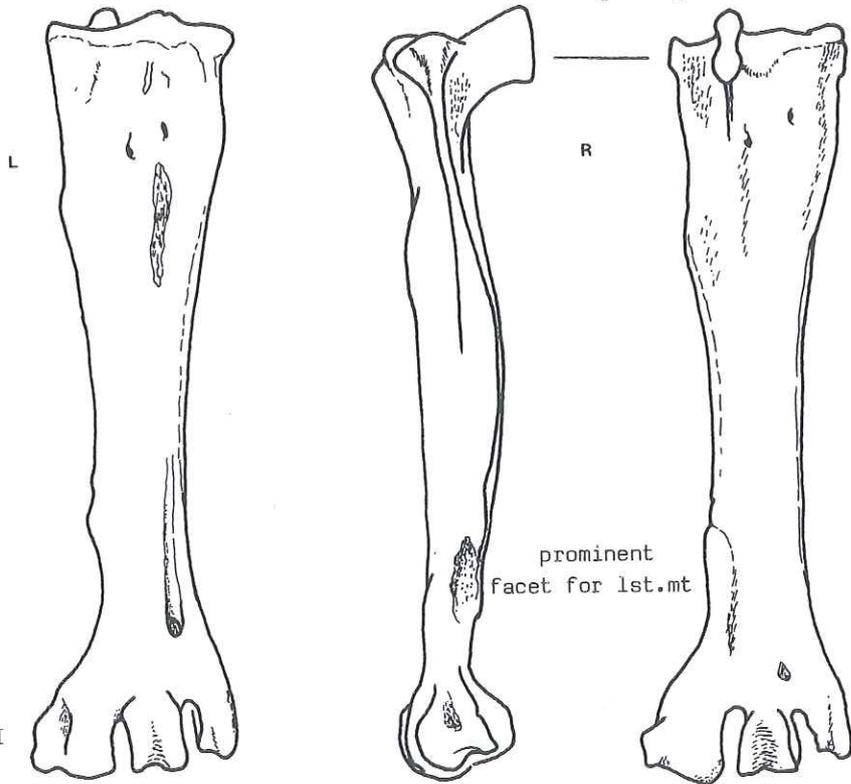
note curvature of distal end
characteristic feature of Birds of Prey

wide proximal end



Peregrine Falcon

large single calcaneal ridge



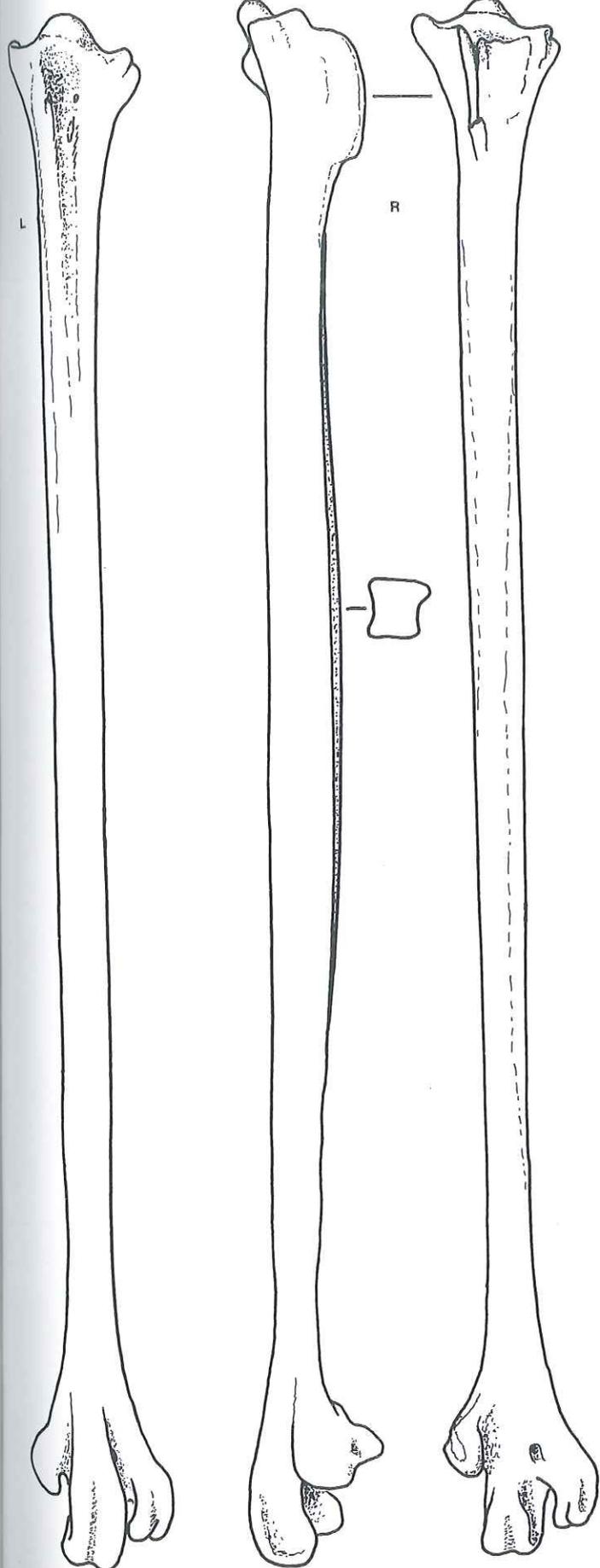
large trochlea II

prominent
facet for 1st.mt

note trochleae of Birds of Prey are level

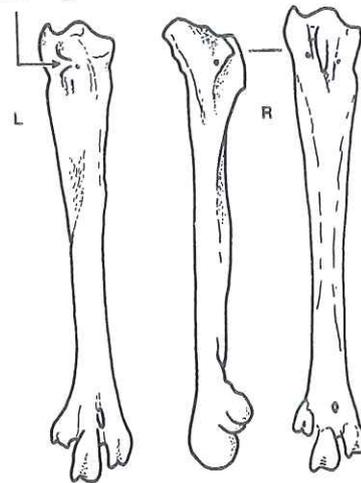
White-tailed Eagle

TARSO-METATARSUS



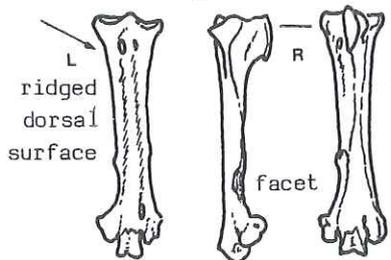
Crane

small tendinal bridge
(Strigidae and Rallidae only)



Coot

bone thin medially



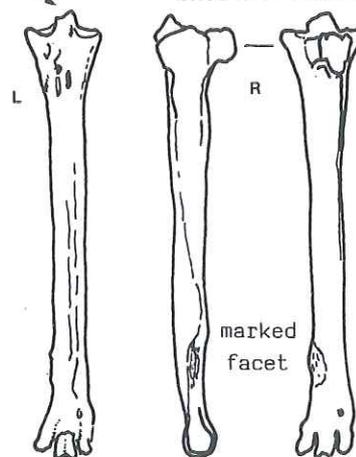
ridged dorsal surface

facet

short wide flattened shaft

Wood Pigeon

elevated intercondylar eminence
enclosed tendinal canals



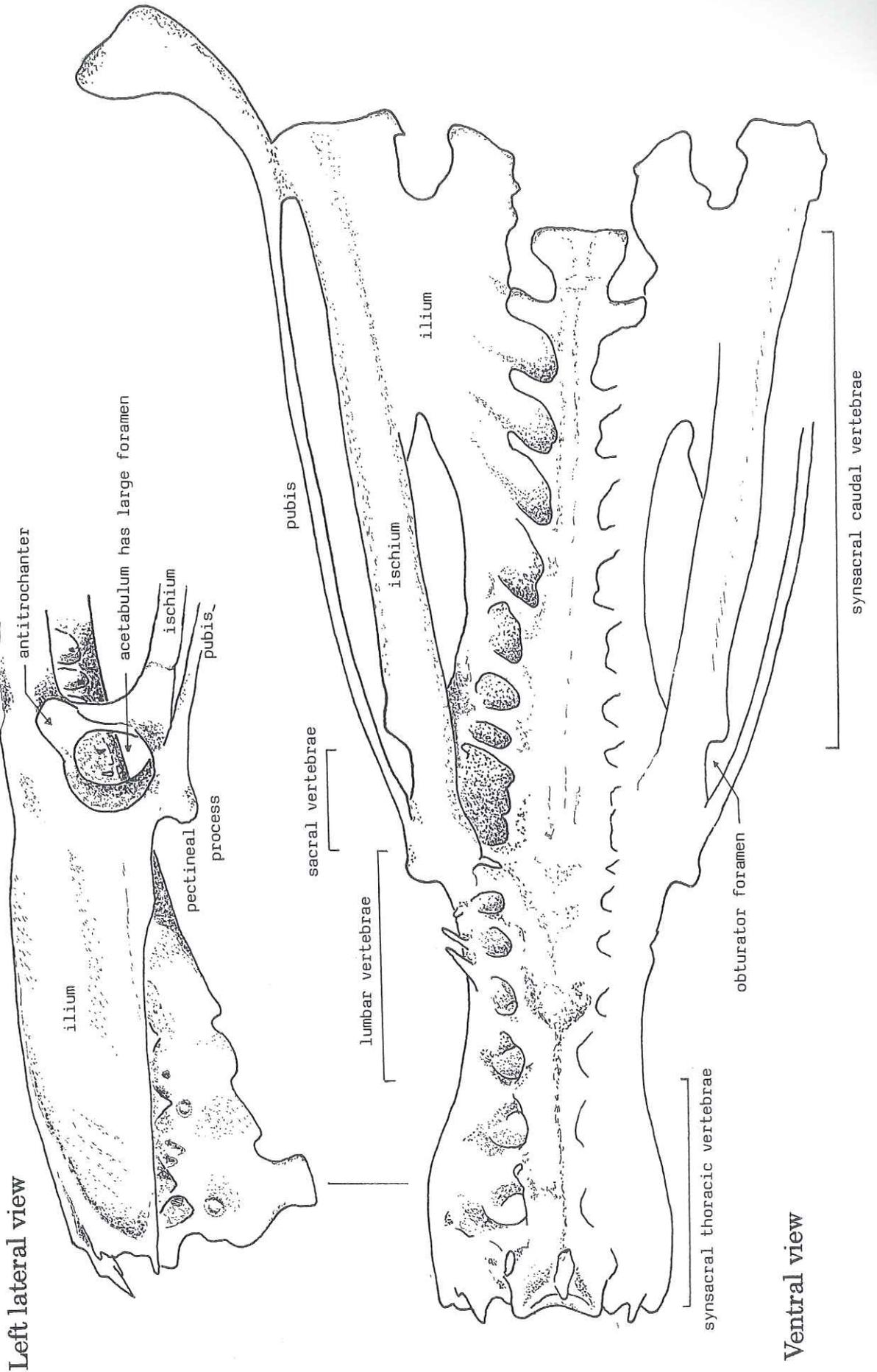
marked facet

trochleae small and level
(characteristic of Passeriformes)

Crow

SYNSACRUM and PELVIS

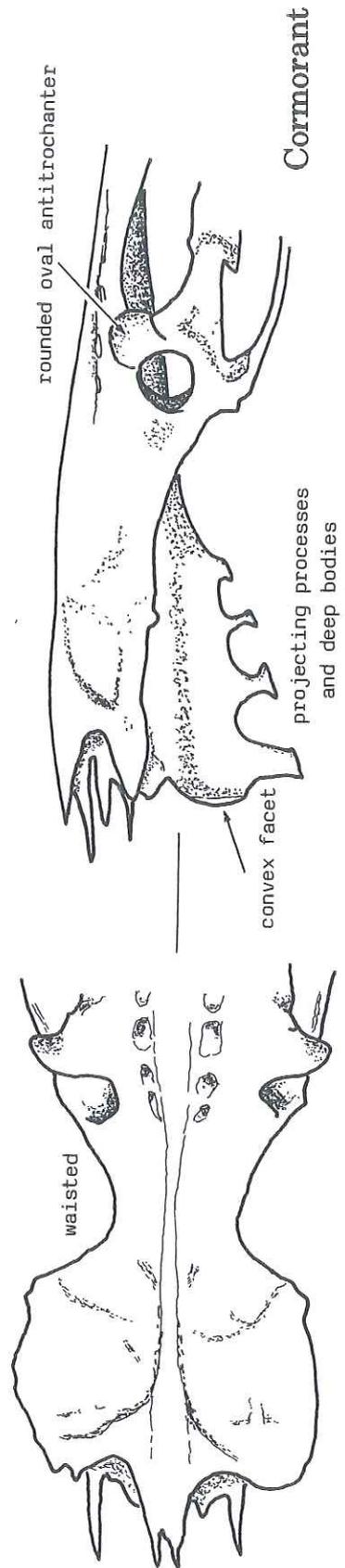
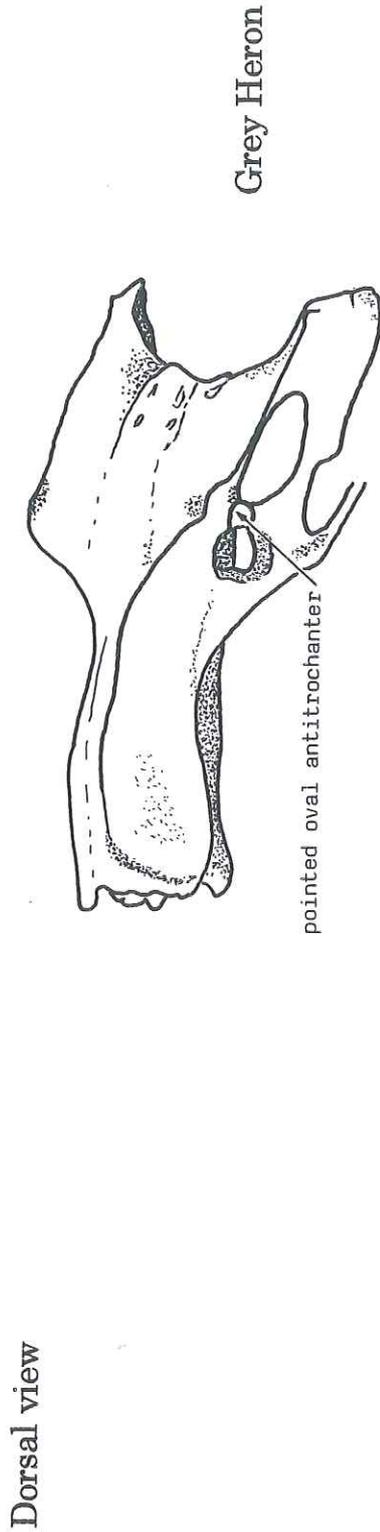
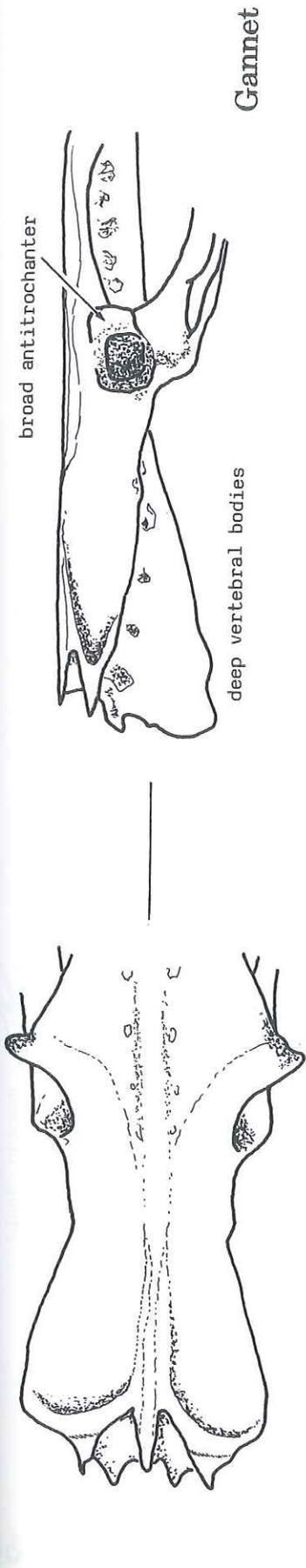
Mute Swan

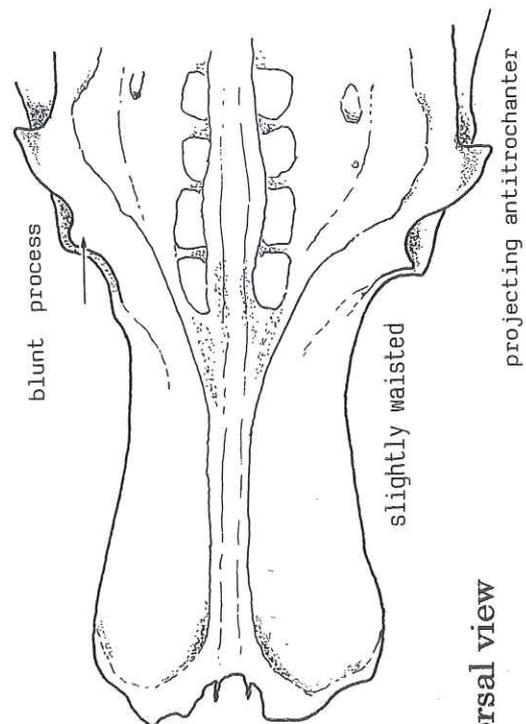


Left lateral view

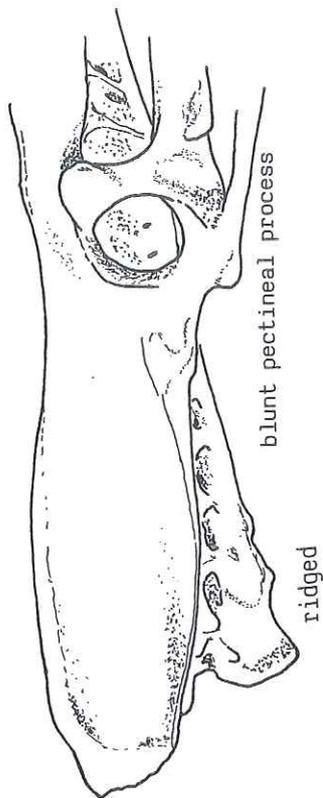
Ventral view

SYNSACRUM and PELVIS

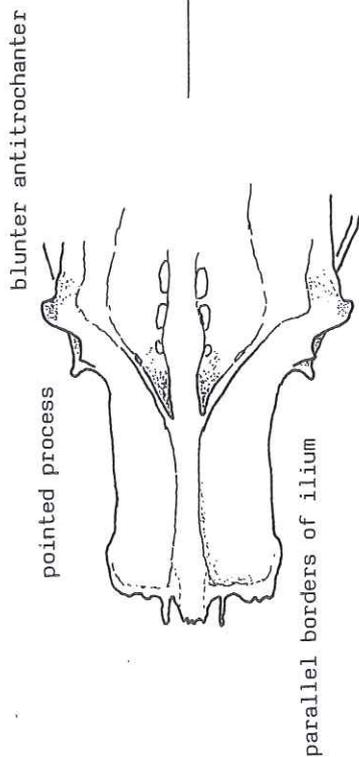




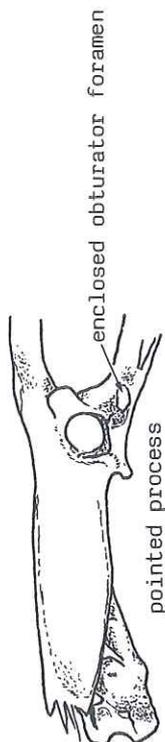
Dorsal view



Domestic Goose



Ventral view of synsacrum

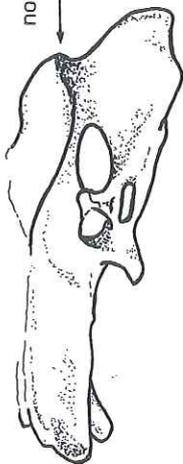


Mallard

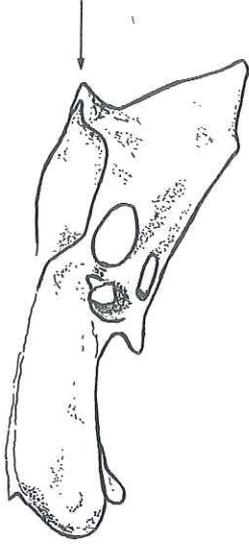


SYNSACRUM and PELVIS

Partridge



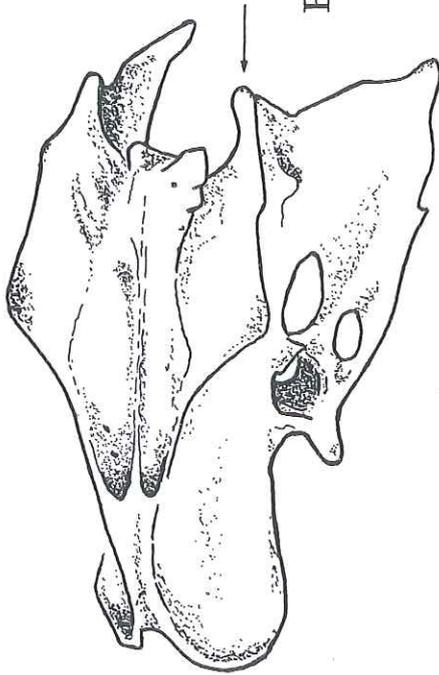
Red-legged Partridge



All Galliformes:

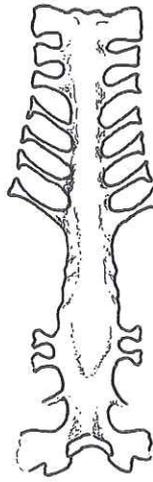
- 1 short broad pelvis
- 2 pointed pectineal process
- 3 short synsacrum
- 4 broad transverse processes of final synsacral caudal vertebrae

Bantam



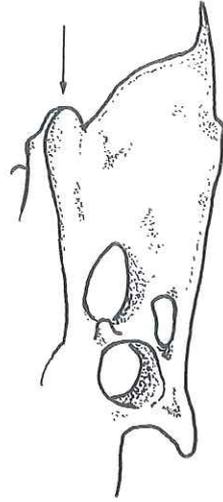
Red Grouse

broad sacral vertebrae

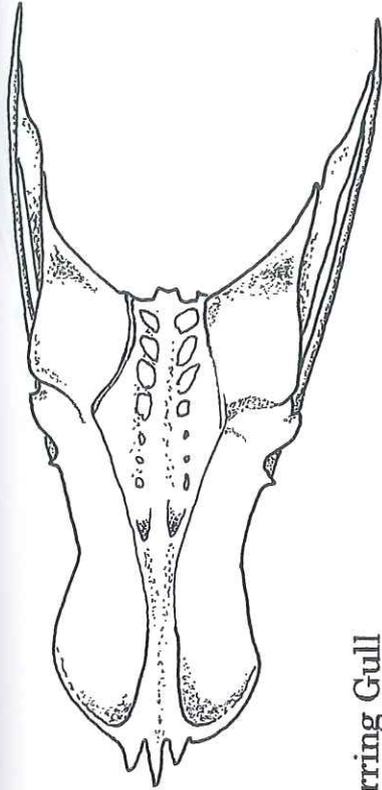


broad processes of final synsacral caudal vertebrae

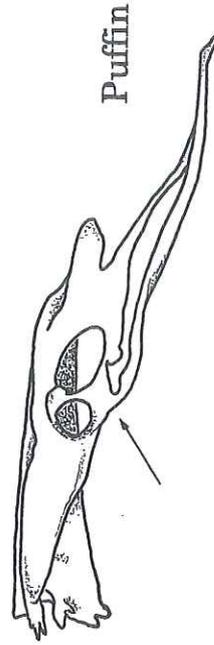
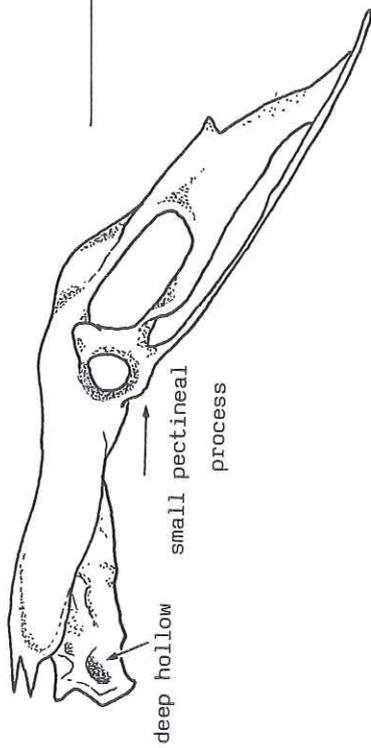
Pheasant



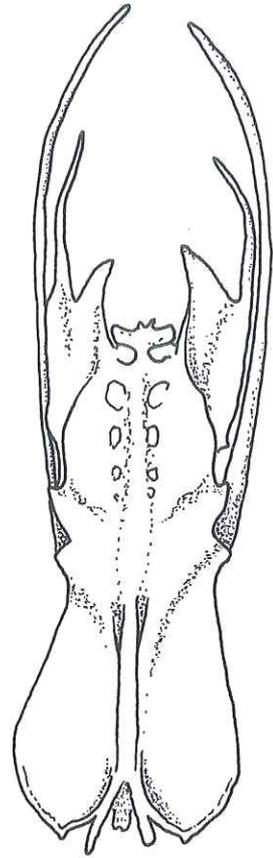
SYNSACRUM and PELVIS



Herring Gull

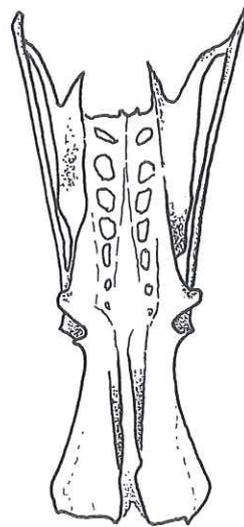
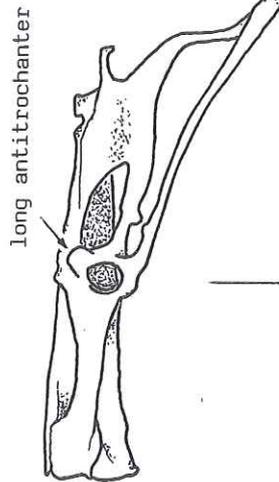


no obvious pectineal process in Auks



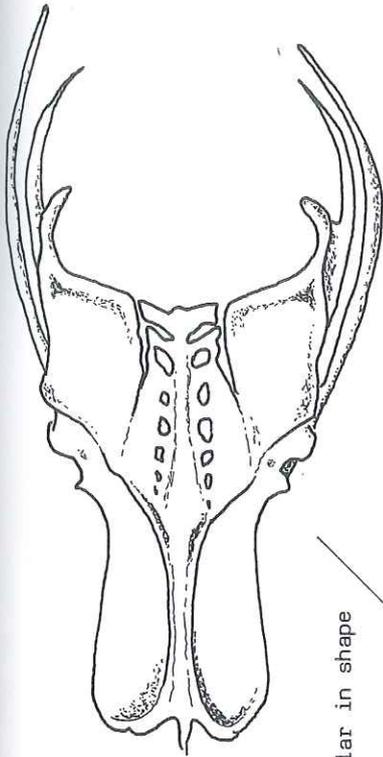
narrow fiat pelvis

Guillemot



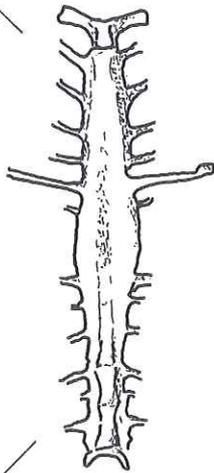
Manx Shearwater

SYNSACRUM and PELVIS

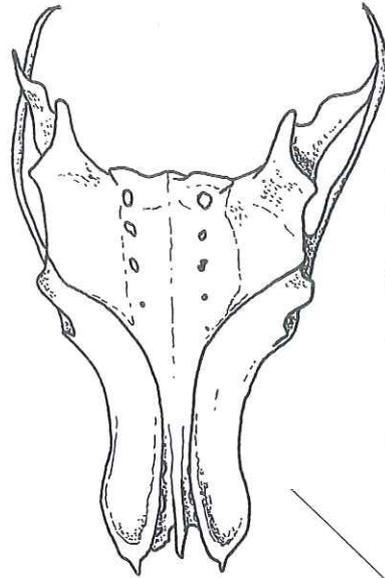


Curlew

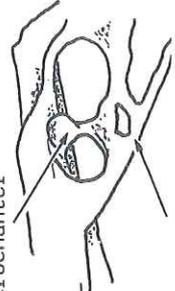
all Waders are similar in shape



Ventral view of synsacrum



long oval antitrochanter

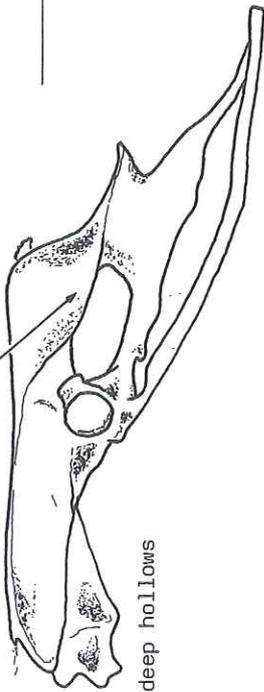


enclosed obturator foramen



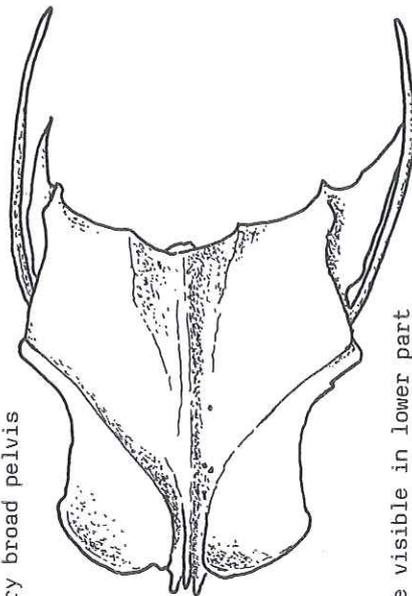
Crow

overhanging ridge

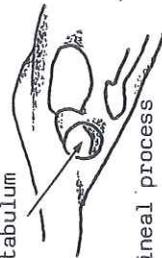


deep hollows

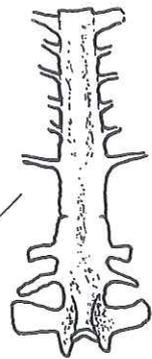
very broad pelvis



shelf of bone visible in lower part of acetabulum

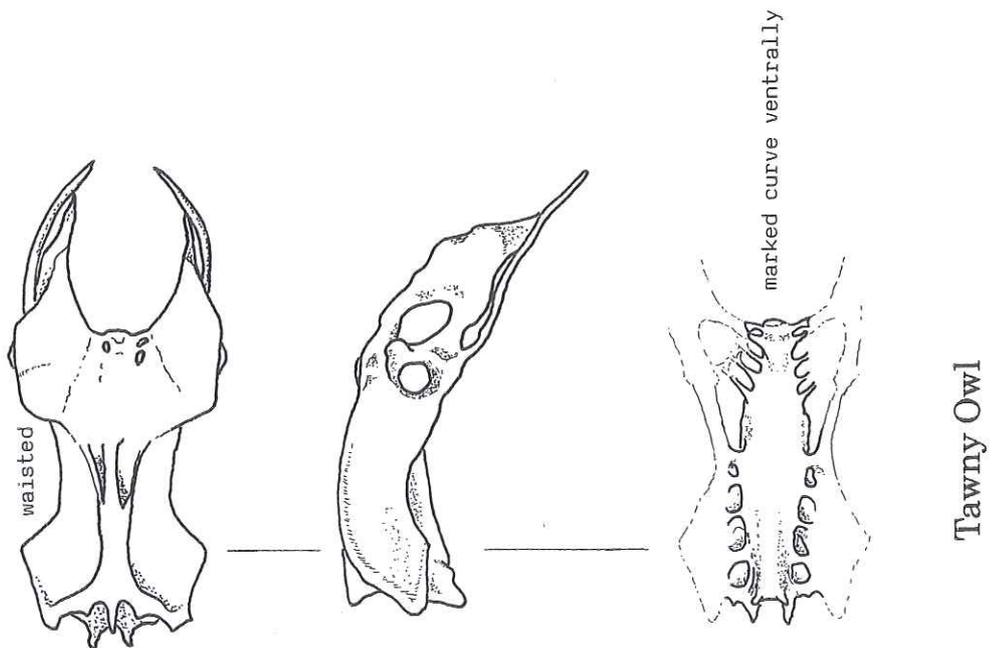
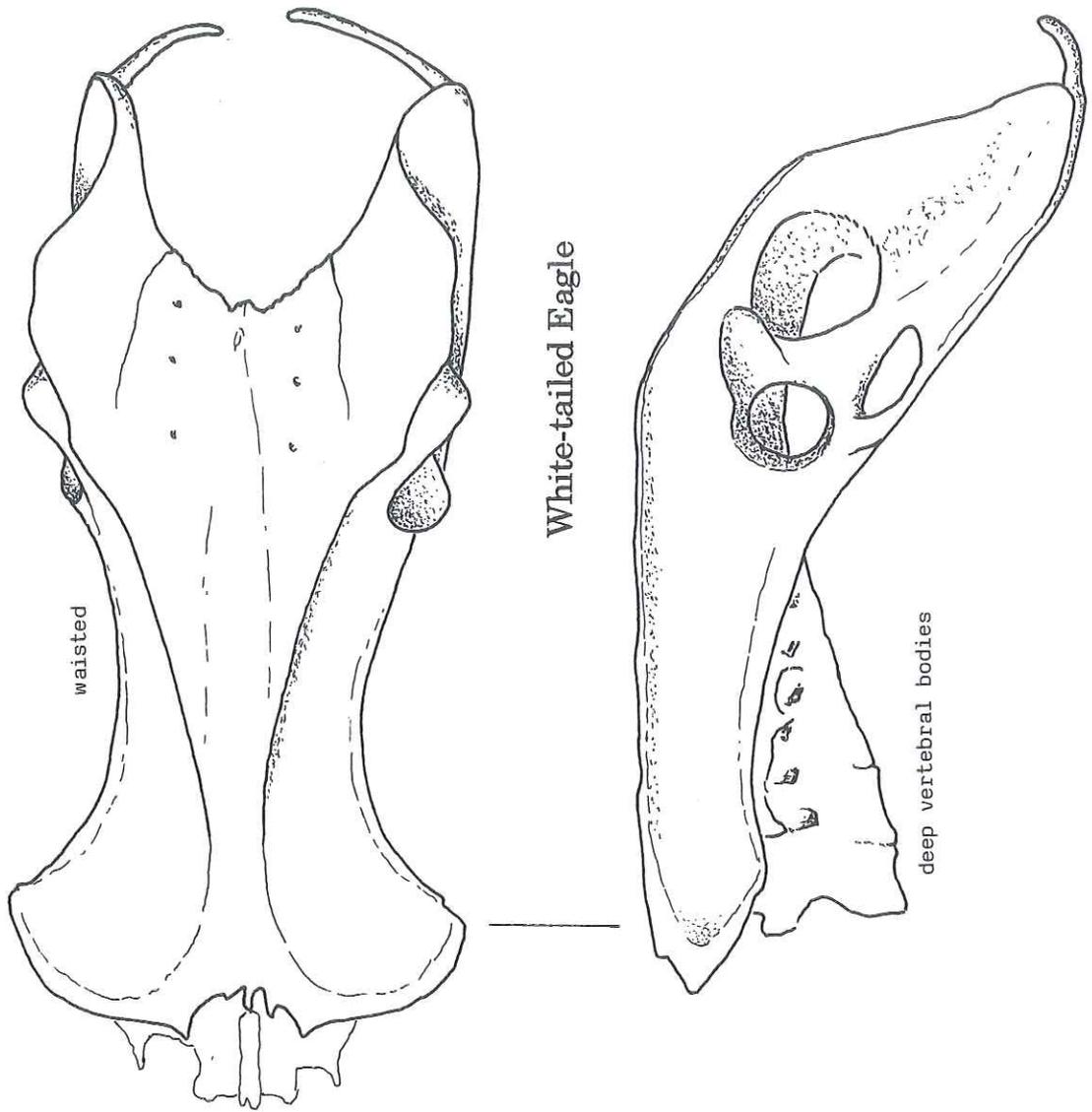


no pectineal process



Wood Pigeon

SYNSACRUM and PELVIS

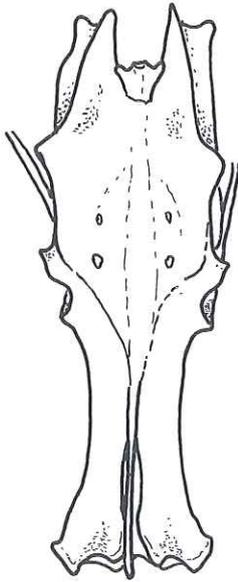


SYNSACRUM and PELVIS

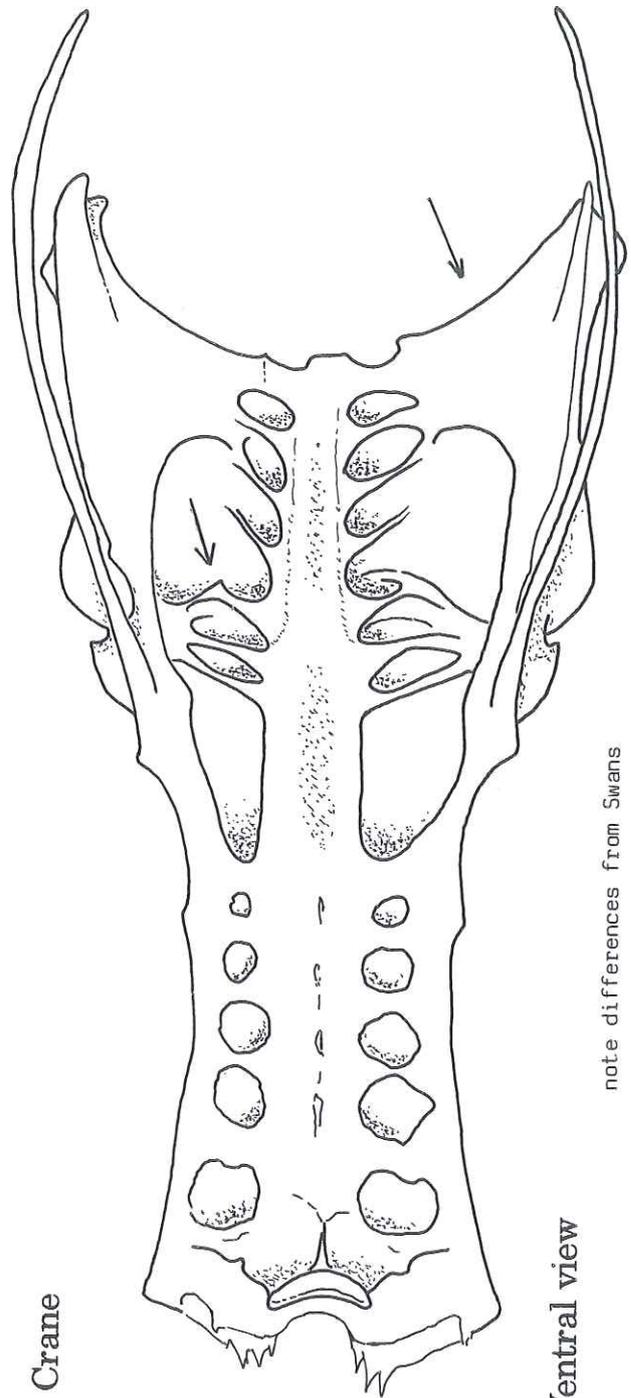
note square shape



Coot



ilium has truncated ends



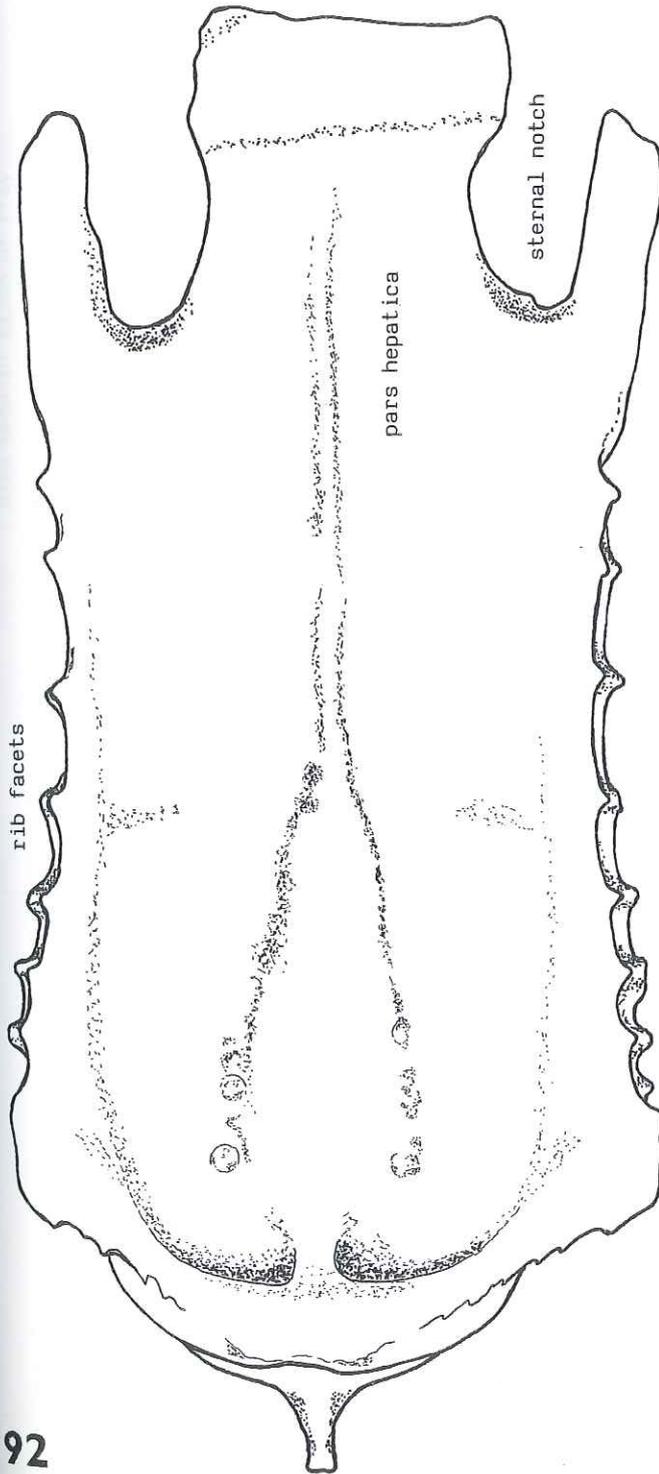
Crane

Ventral view

note differences from Swans

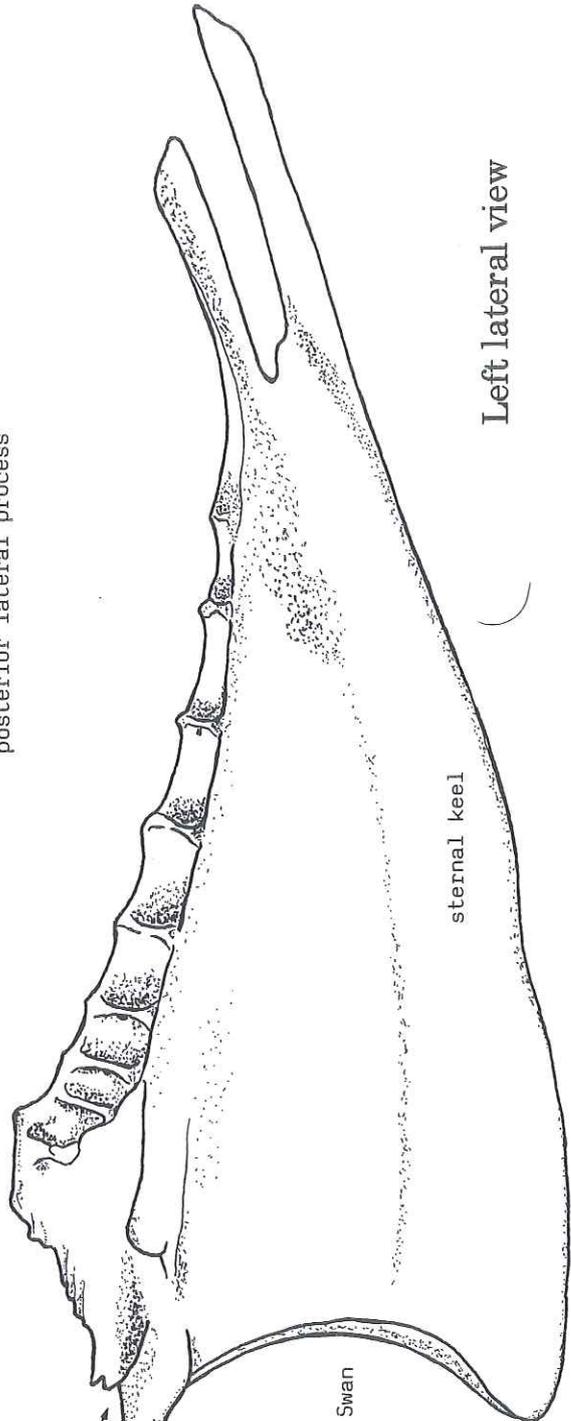
STERNUM

Mute Swan



Dorsal view

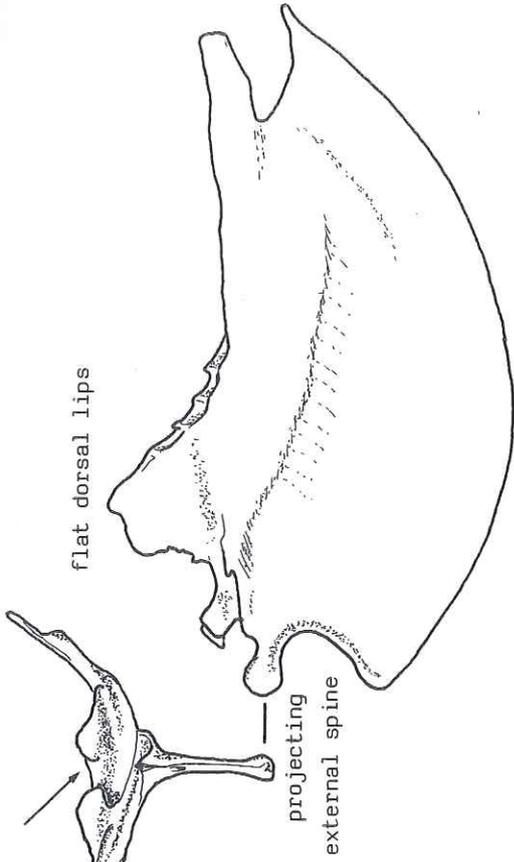
posterior lateral process



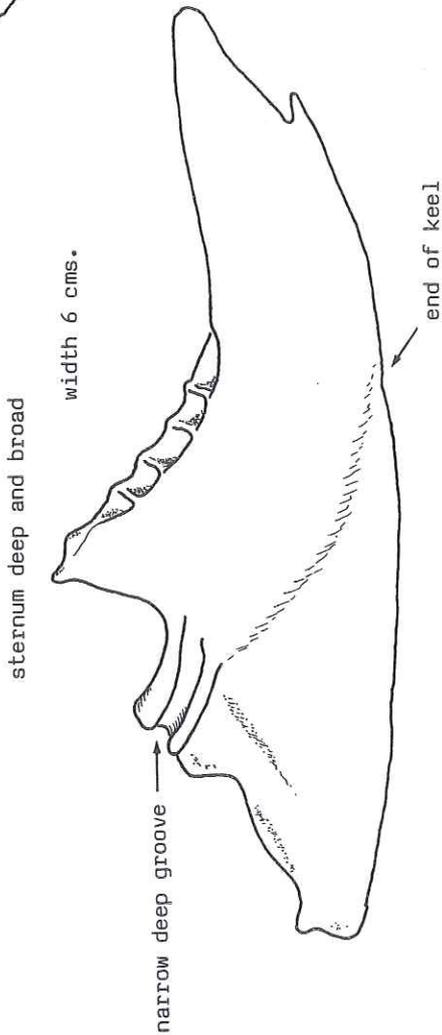
Left lateral view

STERNUM

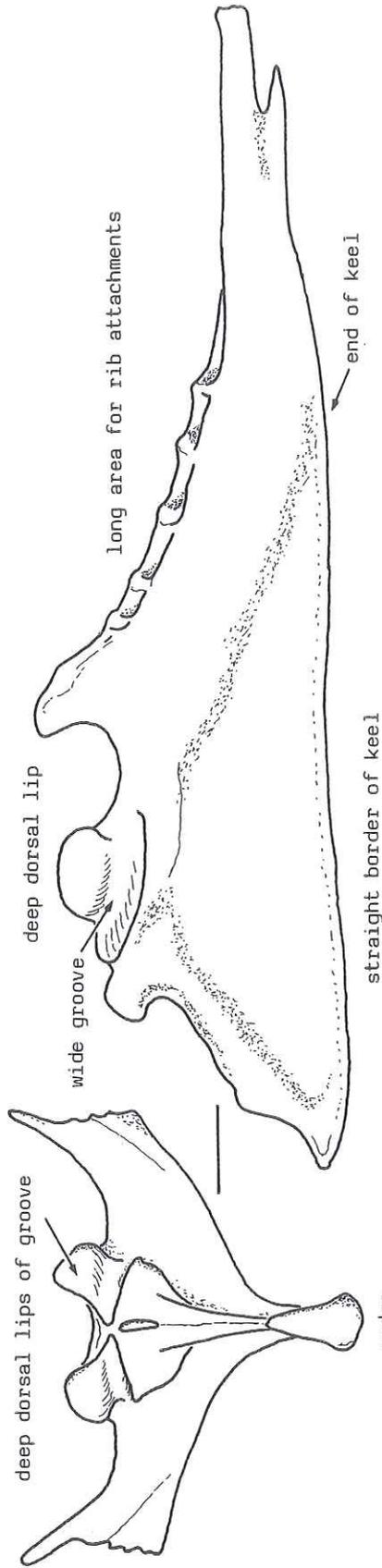
note asymmetrical coracoidal groove
also seen in Birds of Prey



Grey Heron



Cormorant

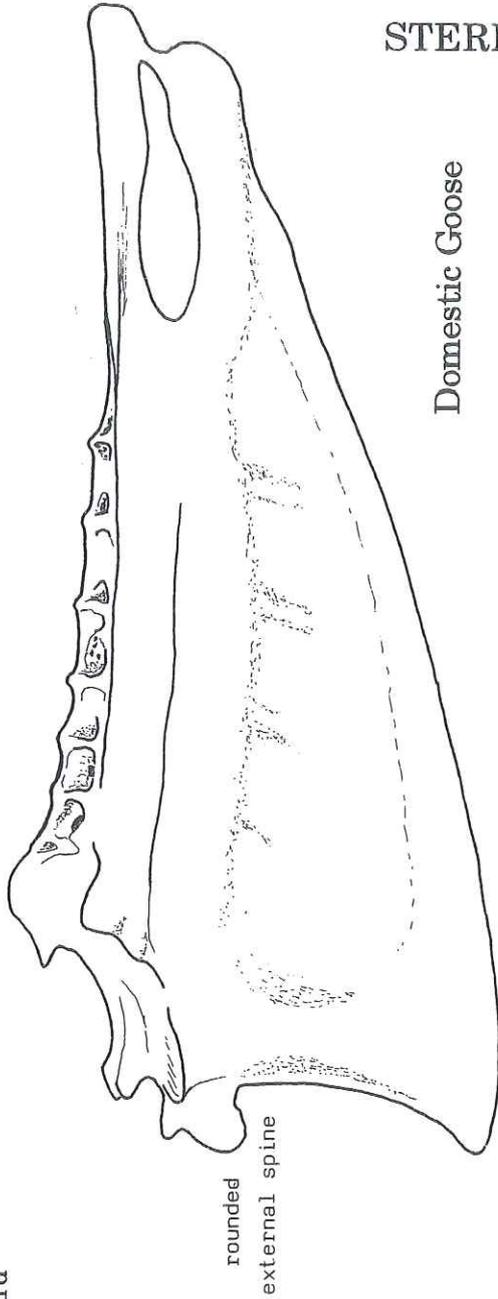


Gannet

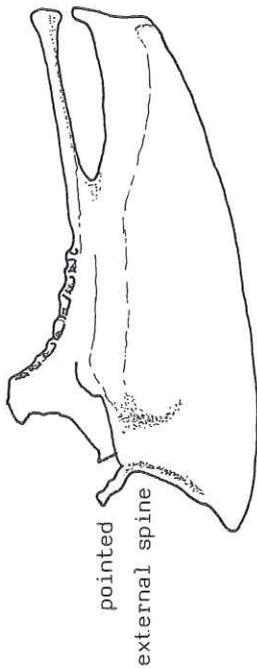
Geese and Ducks:

- 1 anterior margin of keel slightly curved forward
- 2 long area for rib attachments
- 3 external spine different shape

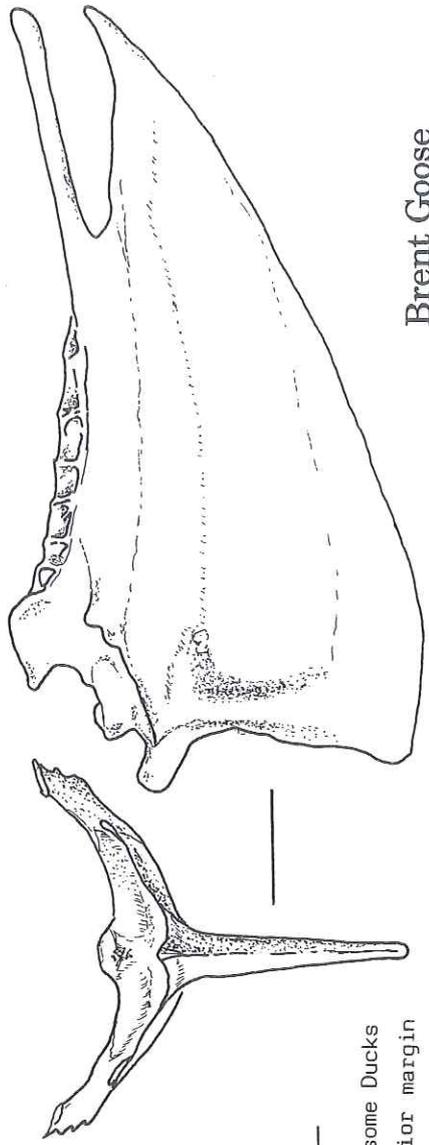
STERNUM



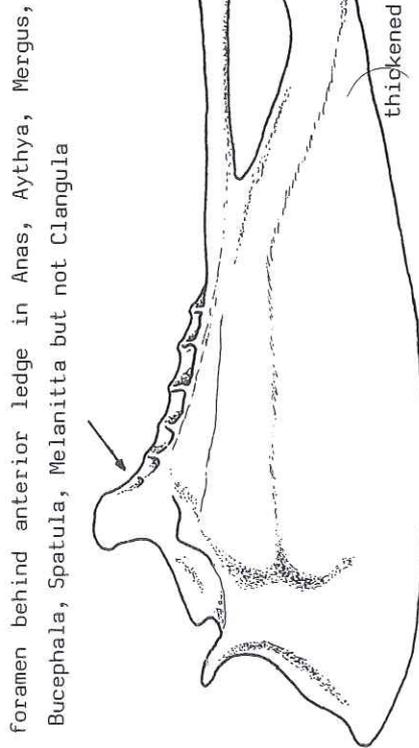
Domestic Goose



Teal

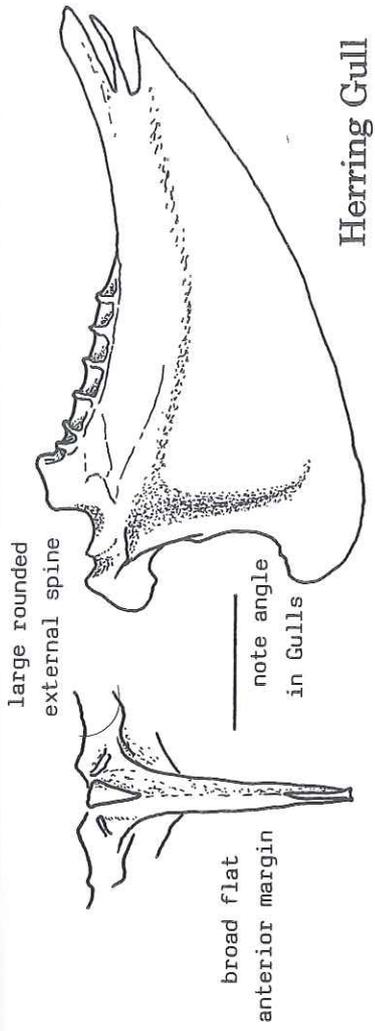


Brent Goose



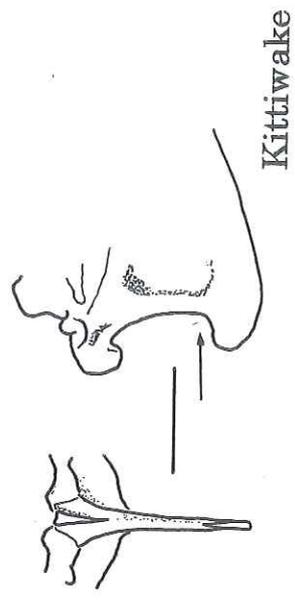
Mallard

Anterior view

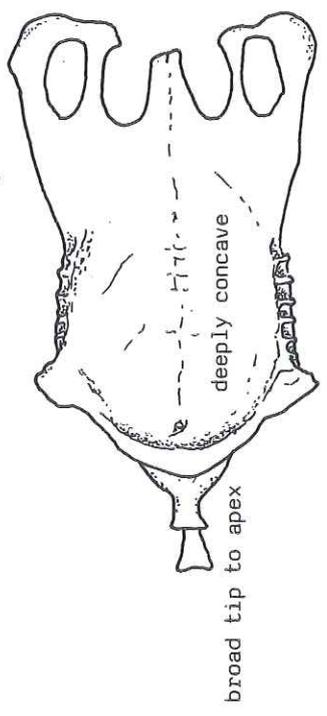
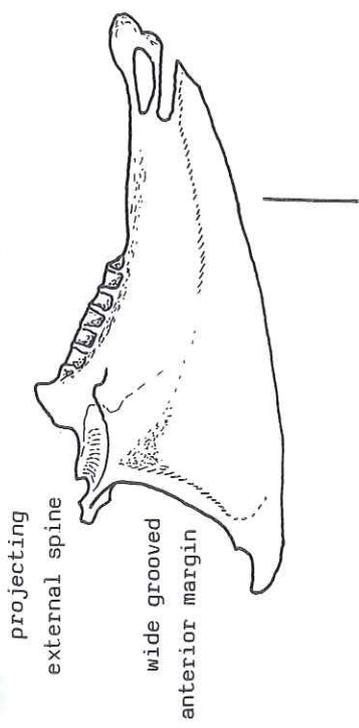


Herring Gull

STERNUM

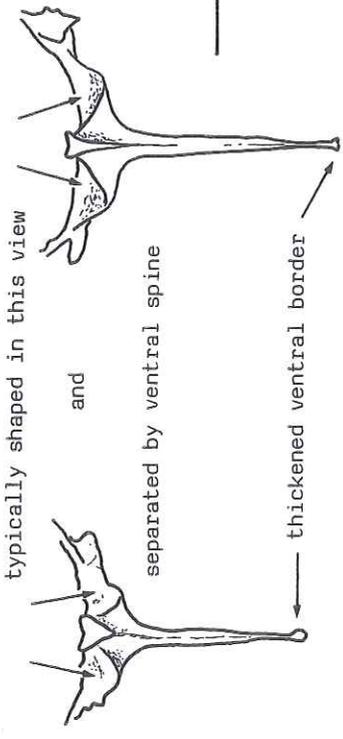


Kittiwake

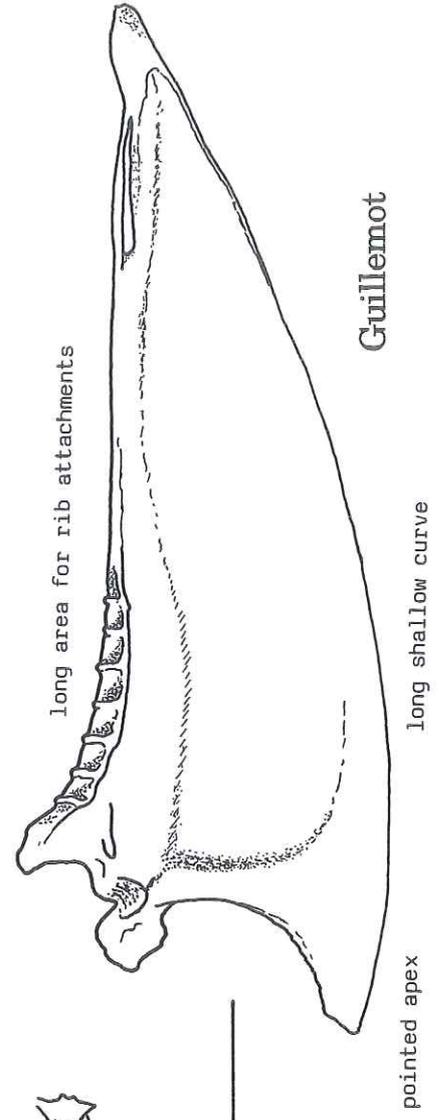


Manx Shearwater

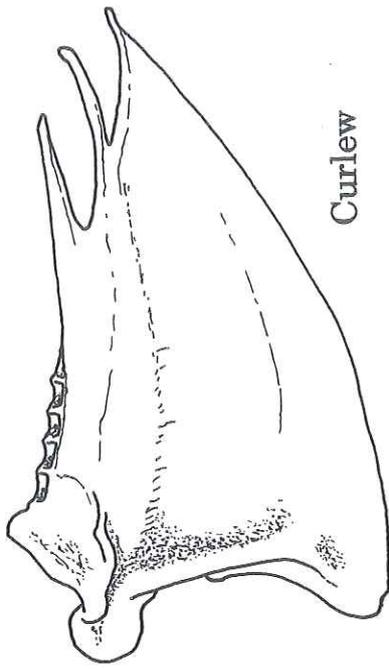
in Auks
coracoidal grooves
typically shaped in this view



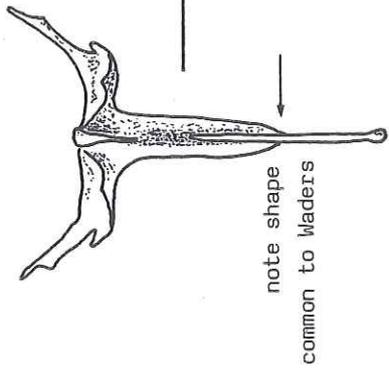
Puffin



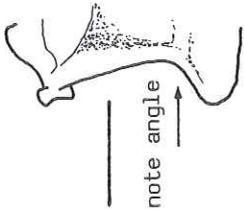
Guillemot



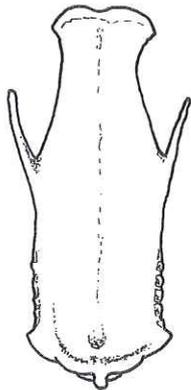
Curlew



note shape
common to Waders



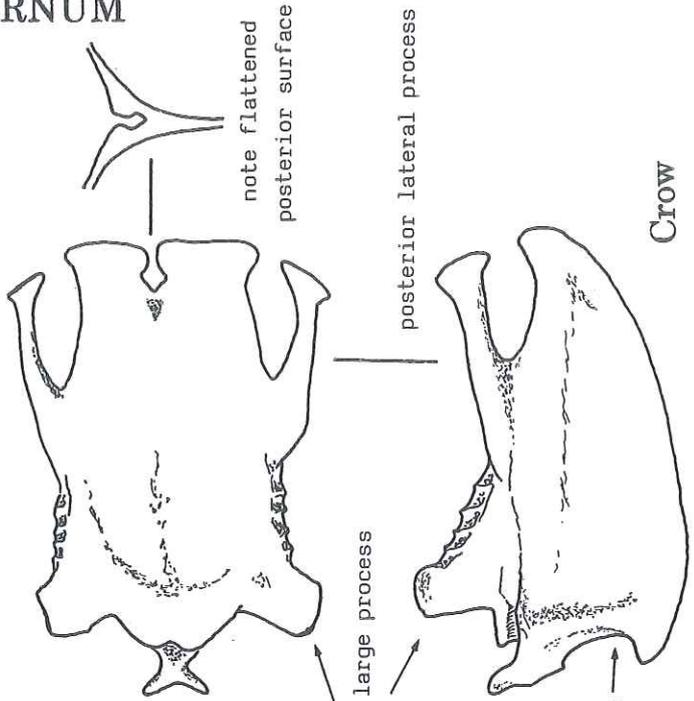
note angle



Snipe

relatively deep keel in Waders
Golden Plover, Lapwing and Woodcock similar to Curlew

STERNUM



Crow

bifurcated external spine

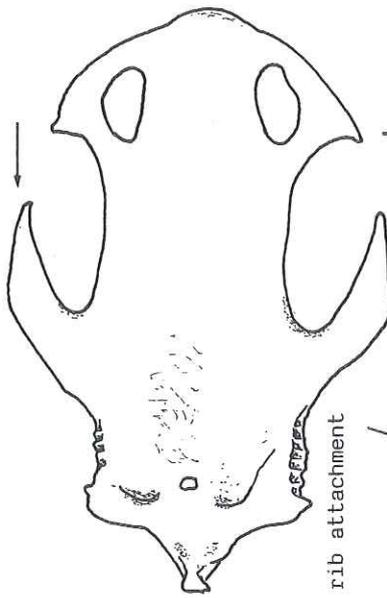
note flattened
posterior surface

posterior lateral process

large process

note angle

posterior lateral process



Wood Pigeon

short area for rib attachment

both spines project
internal

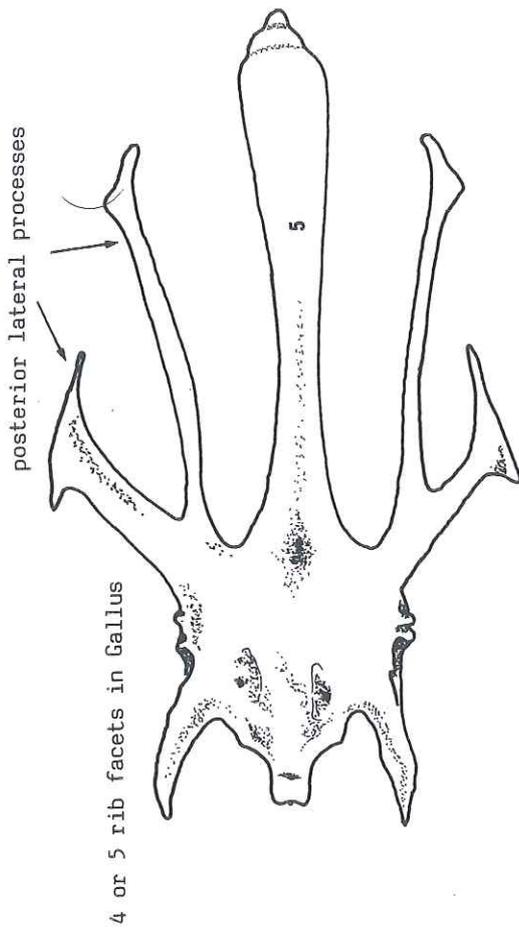
deep groove

external

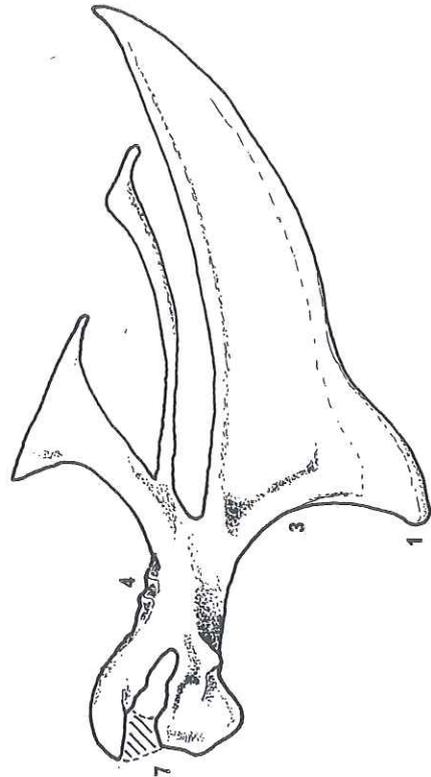
deep keel

curved apex

STERNUM



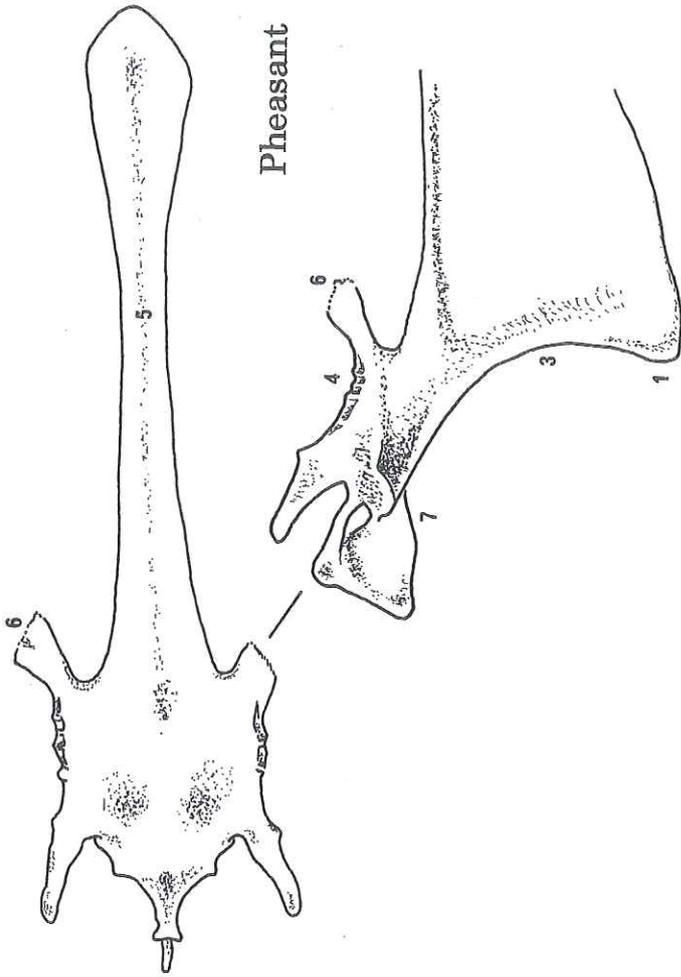
Domestic Fowl
Bantam



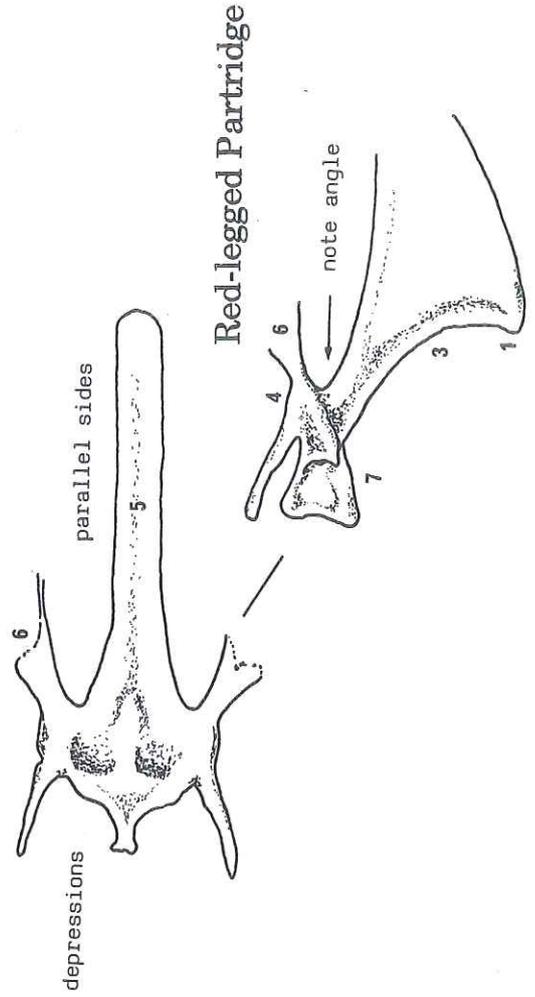
Galliformes:

- 1 keel posterior to rostrum
- 2 keel has wide grooved anterior margin
- 3 keel anterior margin is deeply concave
- 4 short area for rib attachments
- 5 narrow pars hepatica
- 6 bifurcated posterior lateral process
- 7 characteristically external and internal spines often fuse (shown by shading)

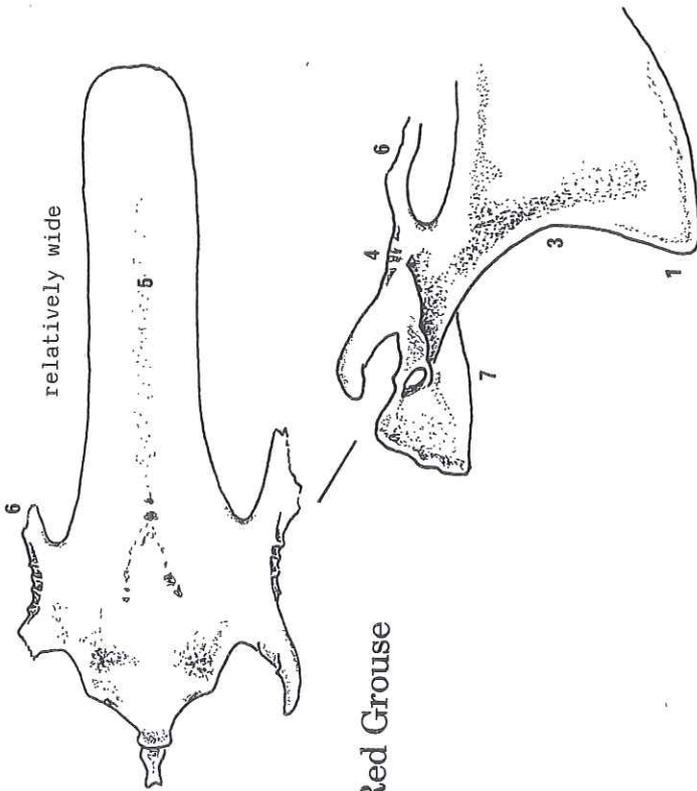
STERNUM



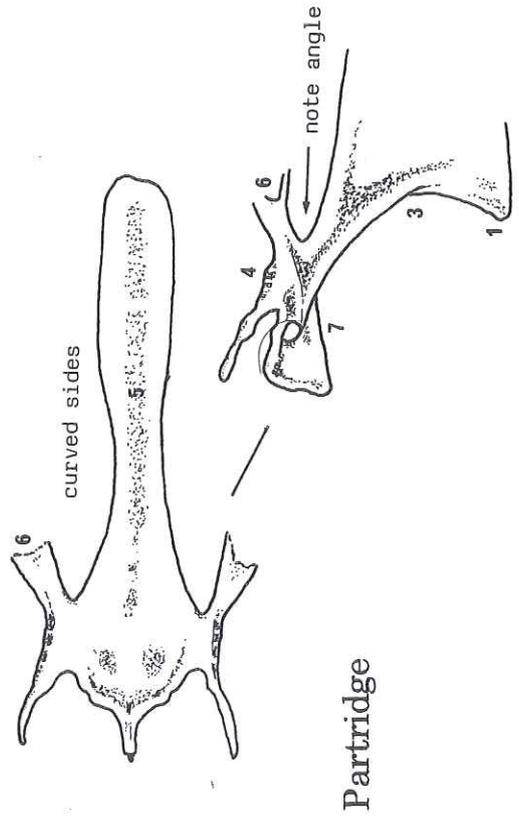
Pheasant



Red-legged Partridge

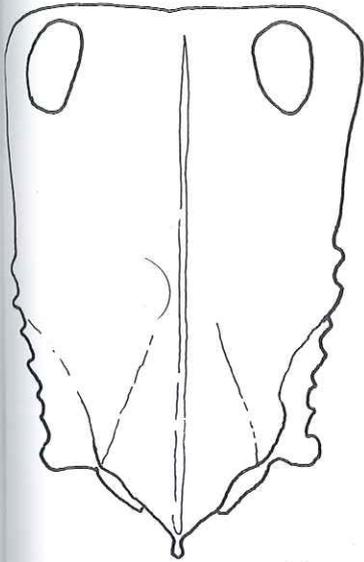


Red Grouse

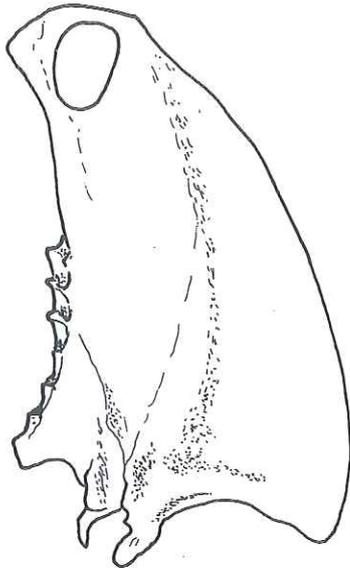


Partridge

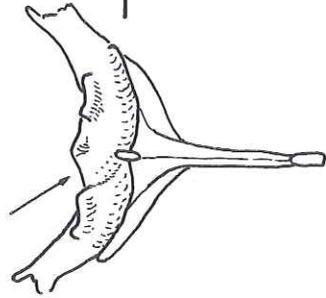
STERNUM



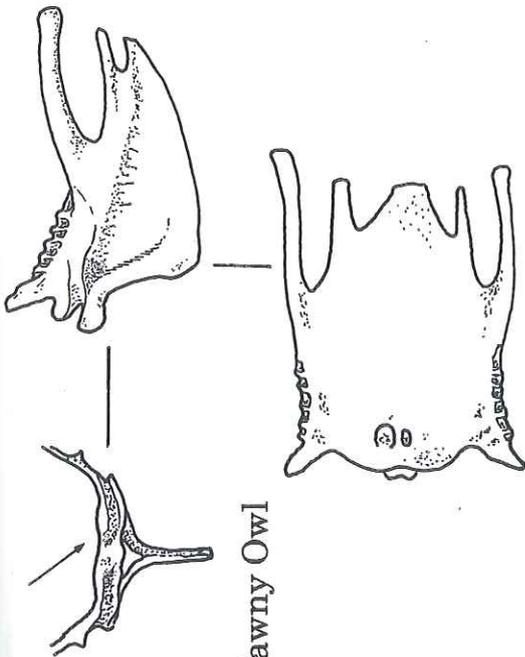
Peregrine Falcon



White-tailed Eagle



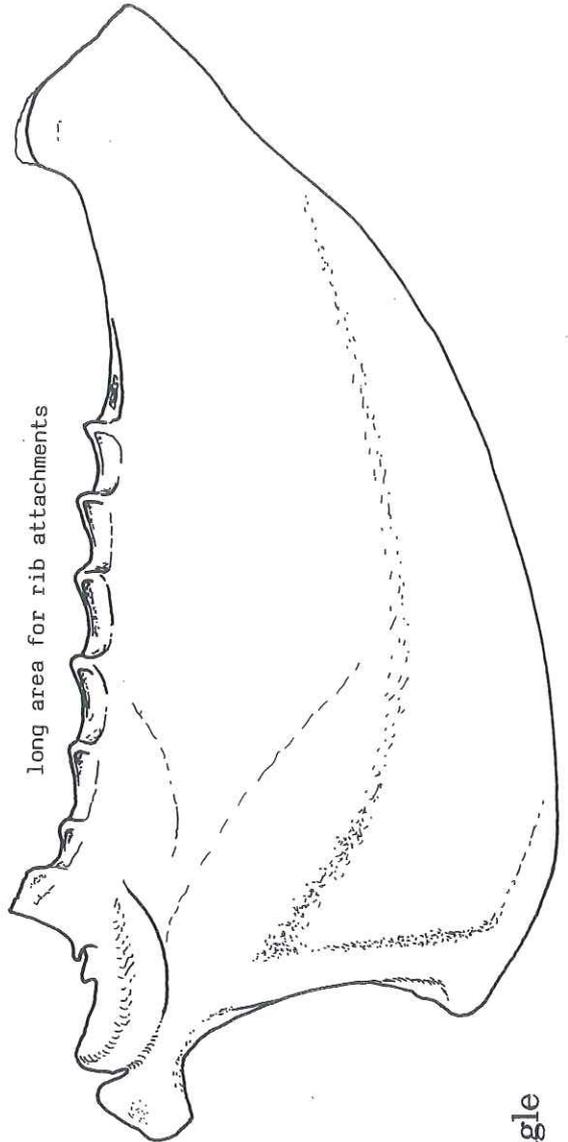
Tawny Owl



Birds of Prey:

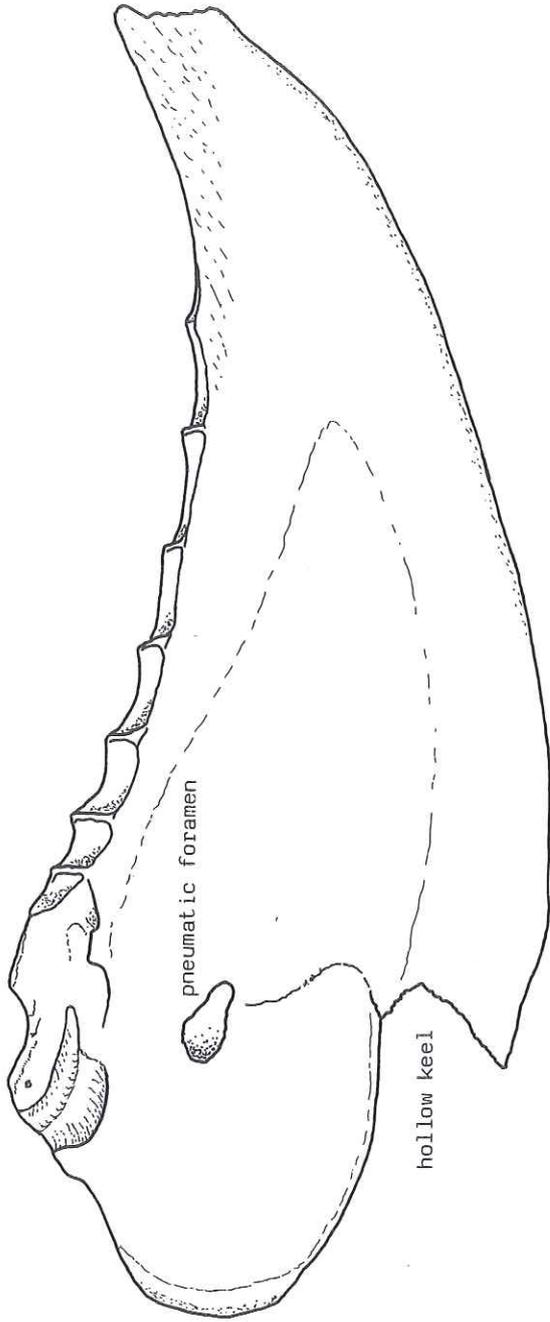
1 short broad sternum

2 asymmetrical coracoidal grooves (cf. Heron)

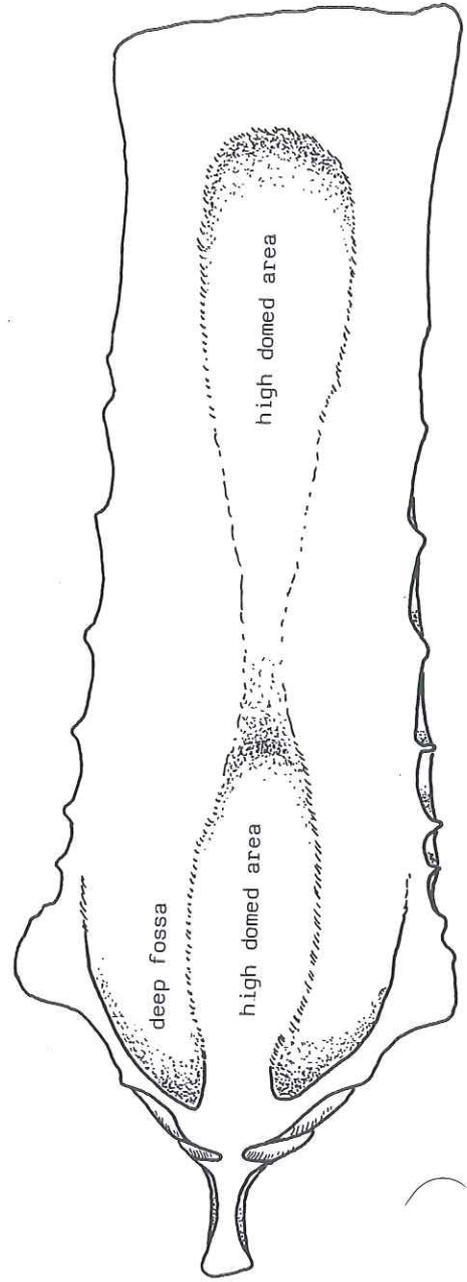


long area for rib attachments

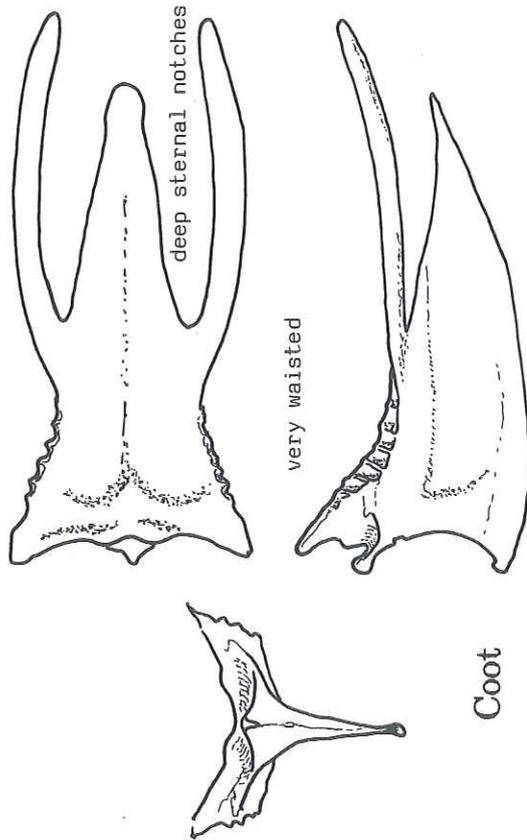
STERNUM



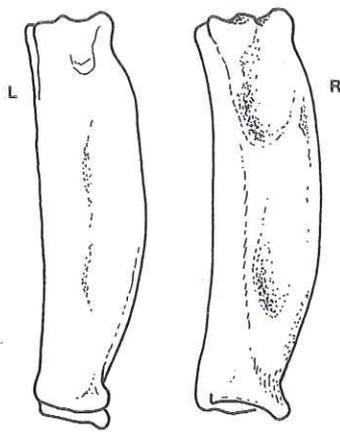
Crane



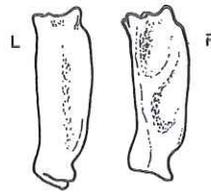
STERNUM



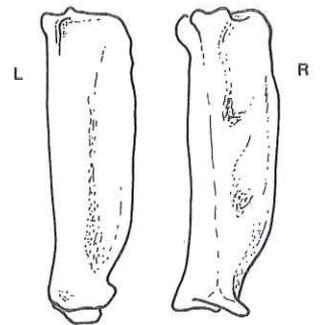
PROXIMAL PHALANX OF MAJOR DIGIT
(FIRST PHALANX)



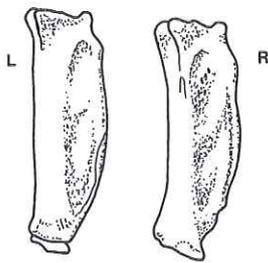
Mute Swan



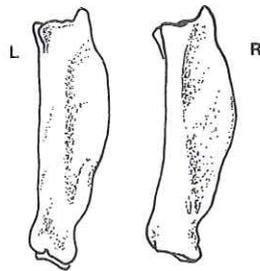
Mallard



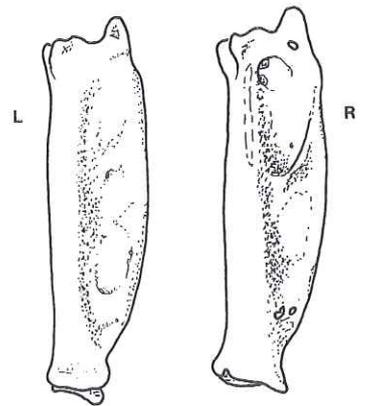
Domestic Goose



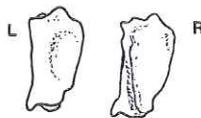
Grey Heron



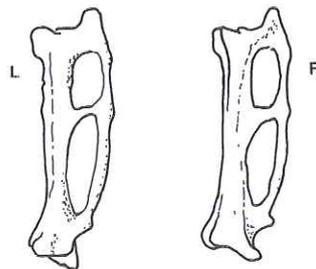
Cormorant



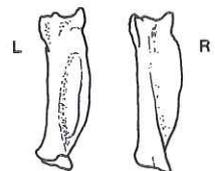
Gannet



Pheasant

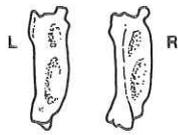


Herring Gull

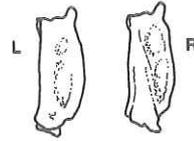


Guillemot

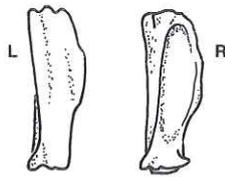
PROXIMAL PHALANX OF MAJOR DIGIT
(FIRST PHALANX)



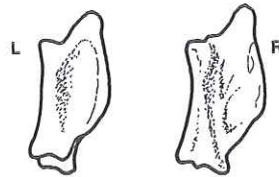
Woodcock



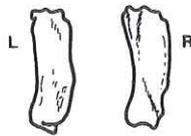
Lapwing



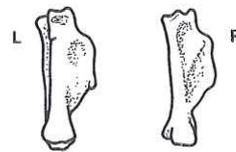
Crow



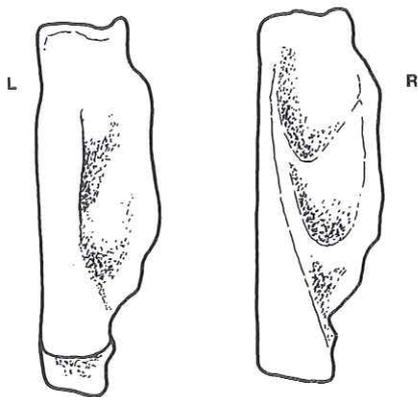
Wood Pigeon



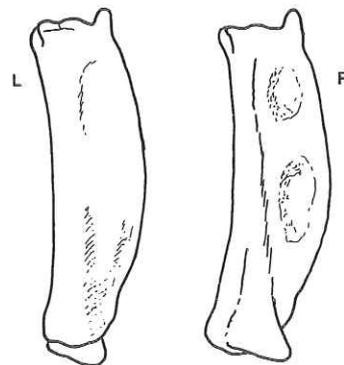
Coot



Tawny Owl



White-tailed Eagle

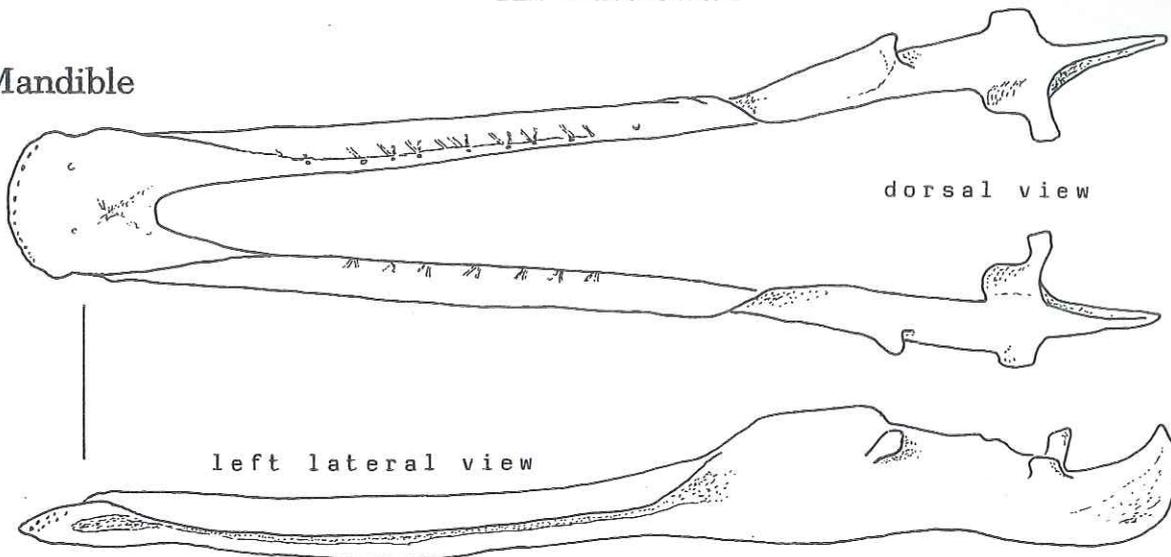


Crane

A VARIETY OF BONES

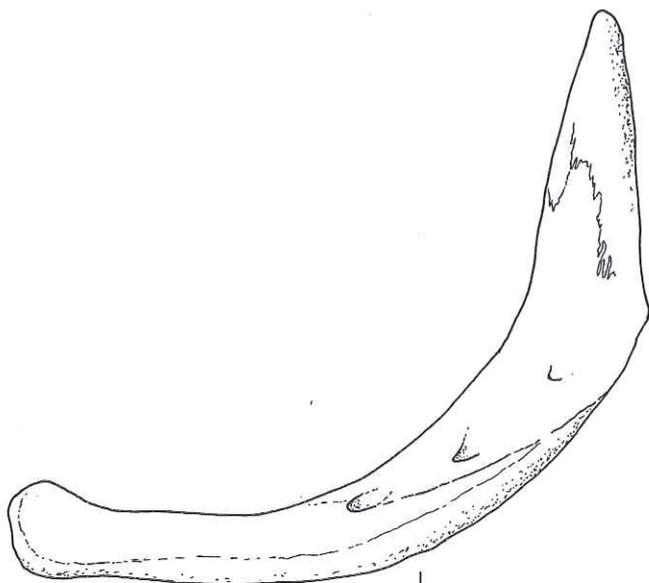
All Mute Swan

Mandible



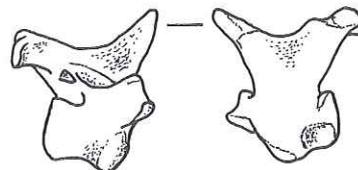
dorsal view

left lateral view



Furcula ("Wishbone")

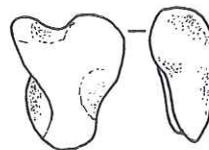
Quadrato



medial view

lateral view

Scapholunar



(radial carpal)

Cuneiform

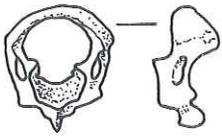


(ulnar carpal)

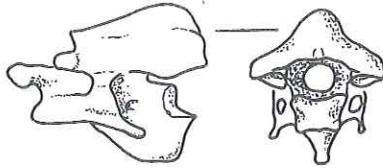
A VARIETY OF BONES

All Mute Swan

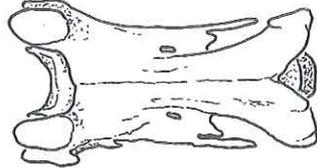
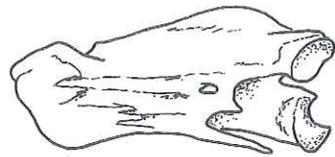
Vertebrae



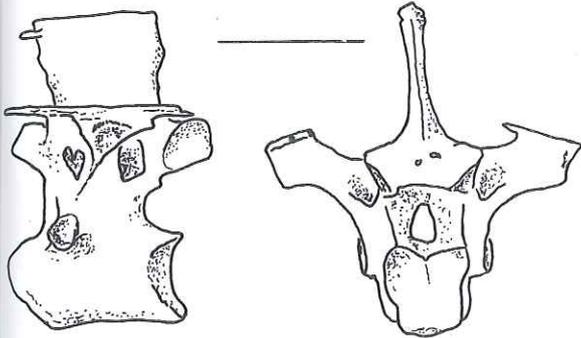
Atlas



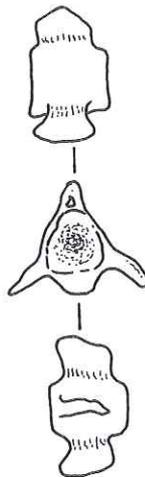
Axis



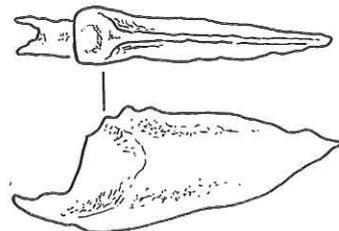
Cervical vertebra



Thoracic vertebra



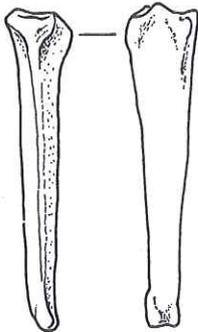
Caudal vertebra



Pygostyle

Wing

DISTAL PHALANX OF MAJOR DIGIT



(distal phalanx of minor digit is smaller but similar)

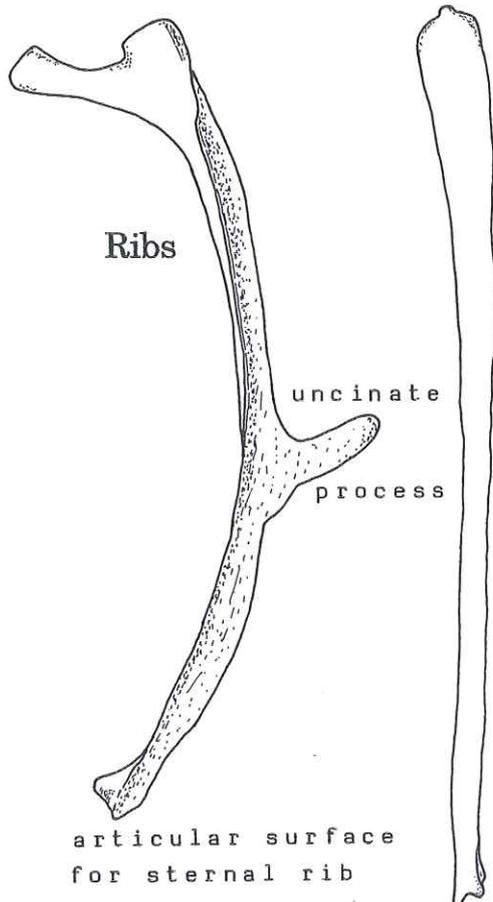
Foot



posterior phalanx of foot



other phalanges



Ribs

articular surface for sternal rib

Sternal ribs

costal facet



sternal facet

MEASUREMENTS

Metrical analysis is important for distinguishing closely related species as well as for separating the sexes, and is useful for the analysis of both wild and domestic birds. There have been a number of important comparative studies of related species and families in which size as well as shape has been used to distinguish species, of which the most useful series are those from the University of Munich.

There have been numerous studies of size variation in domestic fowl and wider investigations of the Galliformes by Erbersdobler (1968) and MacDonald (1992). The size ranges of some of the swans have been investigated by Northcote (1981) and Bacher (1967), and of the geese by Bacher (1967) and Bramwell (1977). Ducks are notoriously difficult to separate, but there are useful measurements of modern collections in the research of Woelfle (1967) and Pieper (1982). Among the species less common on archaeological sites, a set of data on the Manx Shearwater, *Puffinus puffinus*, has been

recorded (Serjeantson, Irving & Hamilton-Dyer 1993) and metrical work has been done on the pelicans by Lorch (1992) and herons by Kellner (1986). Gruber (1990) has carried out research on the storks, Otto (1981) and Schmidt-Burger (1982) on some of the raptors and Harrison & Cowles (1977) have considered cranes. There are still many families however in which the size ranges of individual bones have never been investigated.

Consistent recording and use of metrical data will lead to more reliable identifications. The adoption of computer recording, which is now almost universal, allows measurements to be recorded and also disseminated more easily. A selected set of the principal measurements which have been found useful by the Munich researchers and others are shown (Figures 6 and 7) and a key is given in Table 3. The drawings are based on those of the domestic fowl; measurement points vary for other species. The abbreviations are those used of von den Driesch (1976).

Table 3 Measurements

CORACOID (Fig. 6a)

- GL Greatest length
- Lm Length of the medial side
- Bb Basal breadth
- Bf Breadth of the articular facet

SCAPULA (Fig. 6b)

- GL Greatest length
- Dic Greatest cranial diagonal

HUMERUS (Fig. 6c)

- GL Greatest length
- Bp Greatest breadth of proximal end
- SC Smallest breadth of the corpus
- Bd (Greatest) breadth of the distal end

ULNA (Fig. 6d)

- GL Greatest length
- Bp Breadth of the proximal end
- Dip Diagonal of proximal end
- SC Smallest breadth of corpus
- Did Diagonal of distal end

RADIUS (Fig. 6e)

- GL Greatest length
- SC Smallest breadth of shaft
- Bd Greatest breadth of distal end

CARPO-METACARPUS (Fig. 6f)

- GL Greatest length
- L Length of metacarpus II
- Bp Greatest breadth of proximal end
- Did Diagonal of distal end

SYNSACRUM & PELVIS (Fig. 7a)

- GL Greatest length
- LS Length of sternum
- LV Length along the synsacral vertebrae
- SB Smallest breadth of the Partes Glutea
- BA Breadth in the middle

FEMUR (Fig. 7b)

- GL Greatest length
- Lm Medial length
- Bp Greatest breadth of the proximal end
- Dp Greatest depth of the proximal end
- SC Smallest breadth of the corpus
- Bd Greatest breadth of the distal end
- Dd Greatest depth of distal end

TIBIO-TARSUS (Fig. 7c)

- GL Greatest length
- La Axial length
- Dip Diagonal of proximal end
- SC Smallest breadth of corpus
- Dd Depth of the distal end

TARSO-METATARSUS (Fig. 7d)

- GL Greatest length
- Bp Greatest breadth of proximal end
- SC Smallest breadth of corpus
- Bd Greatest breadth of distal end
- Spur Length of spur

Figure 6 Measurement points: a coracoid, b scapula, c humerus, d ulna, e radius, f carpo-metacarpus

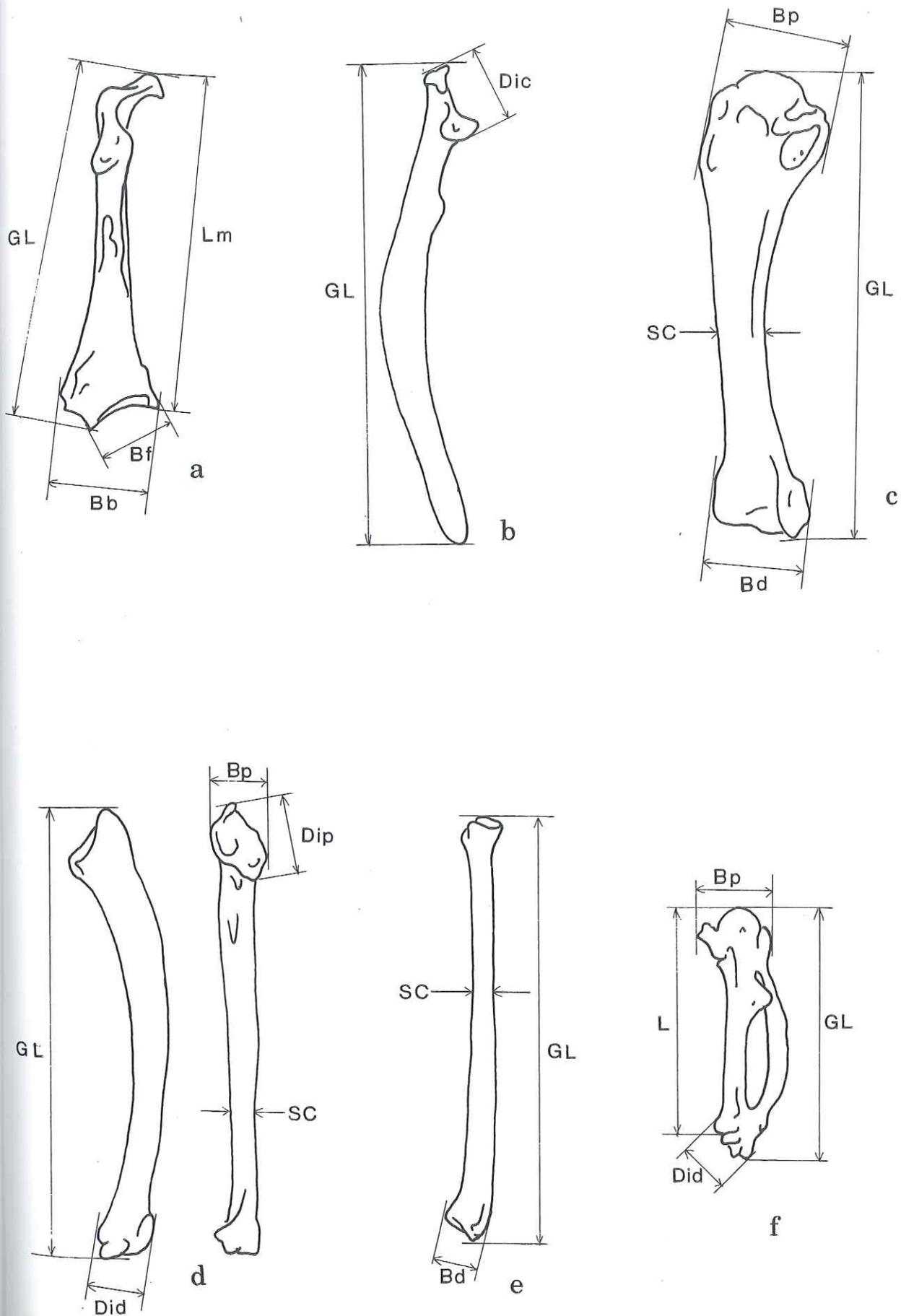
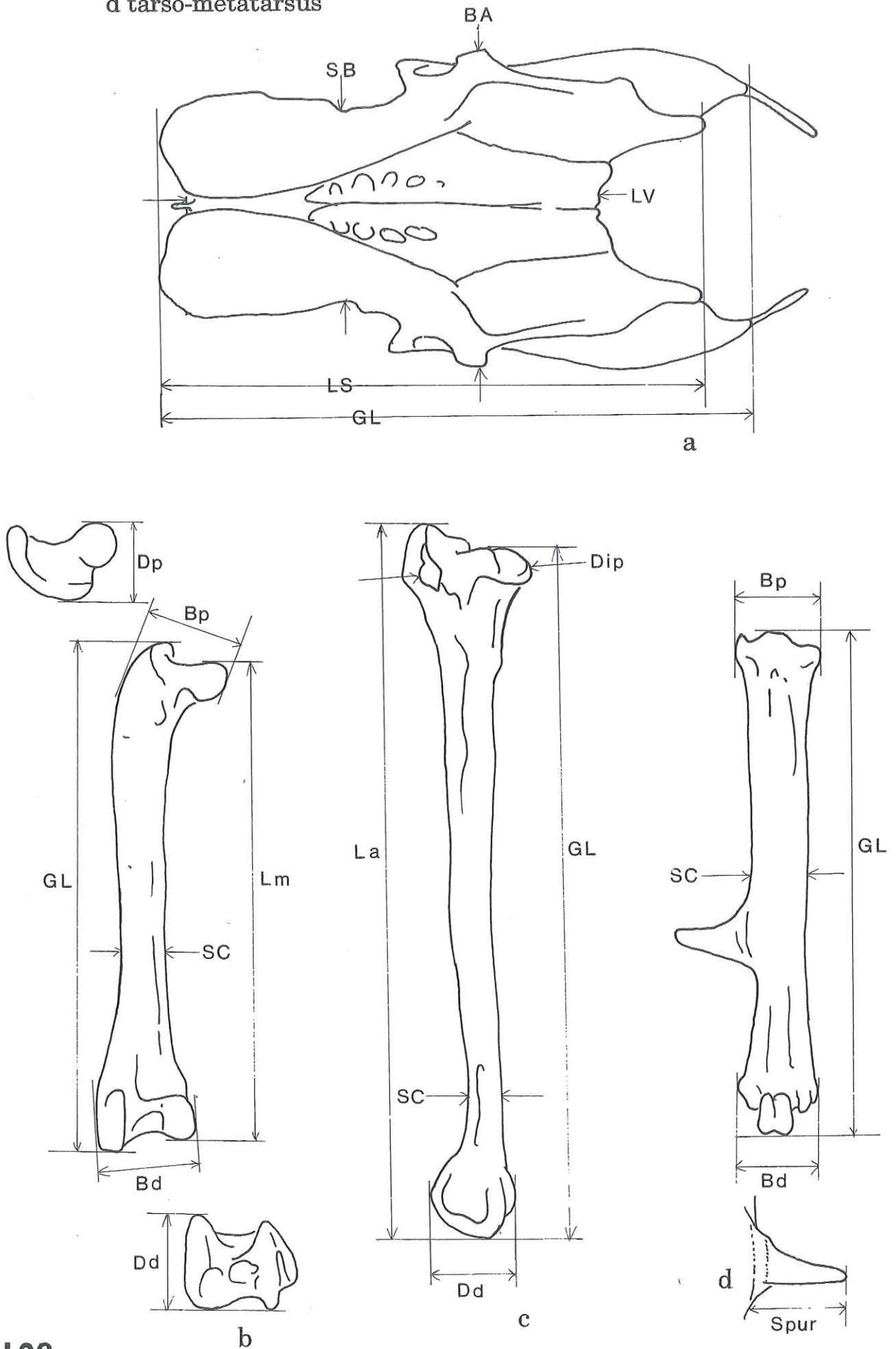


Figure 7 Measurement points: a pelvis, b femur, c tibio-tarsus, d tarso-metatarsus



RECORDING BIRD BONES

As with mammal bones, interpretation of the material depends not only on identification of species but also on the modifications which the bones have suffered. A record of the parts of the bones which survive is important for quantifying and analysing the modifications which have taken place, whether these are the result of human butchery, or damage from other species such as raptors or carnivores. The recording method used at the Faunal Remains Unit, University of Southampton, includes database fields in which the part of the bone recovered is recorded. The method is based on that developed at the Centre for Extra-Mural Studies Birkbeck College London, for recording mammal bones (Serjeantson 1991).

Each bone is divided into eight nominal "zones" or areas. A standard number of eight was chosen, as this gives greatest consistency in recording the main limb bones, which are those for which fragmentation patterns are usually of most interest. The zones on each bone are shown (Figures 8 and 9) and are defined in table 4. Zones 1-4 are used for the proximal end and Zones 5-8 for the distal end of the main bones of the wing and leg. Zones 1,3,5 and 7 are used for the medial or dorsal side and zones 2,4,6 and 8 for the lateral or ventral side. For midline bones such as the furcula (Fig. 8g), sternum (Fig. 8h) and synsacrum (Fig. 9b), zones 1,3,5 and 7 are used for the left half of the bone and 2,4,6 and 8 are used for the right half. Eight zones is excessive for small birds and small bones, and these are recorded as four zones only: proximal end, proximal shaft, distal shaft and distal end. Zones are recorded as present ('1') or absent ('0').

Other zone recording methods have been published for mammals (eg Watson 1979, Dobney & Rielly 1988). The principal is similar for birds, and the main difference is that a uniform number of zones per bone is used. Though this is somewhat arbitrary for irregular bones such as the sternum, it makes computer recording consistent to enter and use.

The recording of zones, even for small bones, has two important uses. It indicates whether the bone is complete or damaged and also shows which parts of the bone are present. This in turn allows calculation of Minimum Number of bone Elements (MNE) (Grayson 1984), based on the most frequent part of the bone present. A Minimum Number of Individuals (MNI) can then be calculated from this.

Figure 8 Zone recording method: a humerus, b coracoid, c scapula, d ulna, e radius, f carpo-metacarpus, g furcula, h sternum

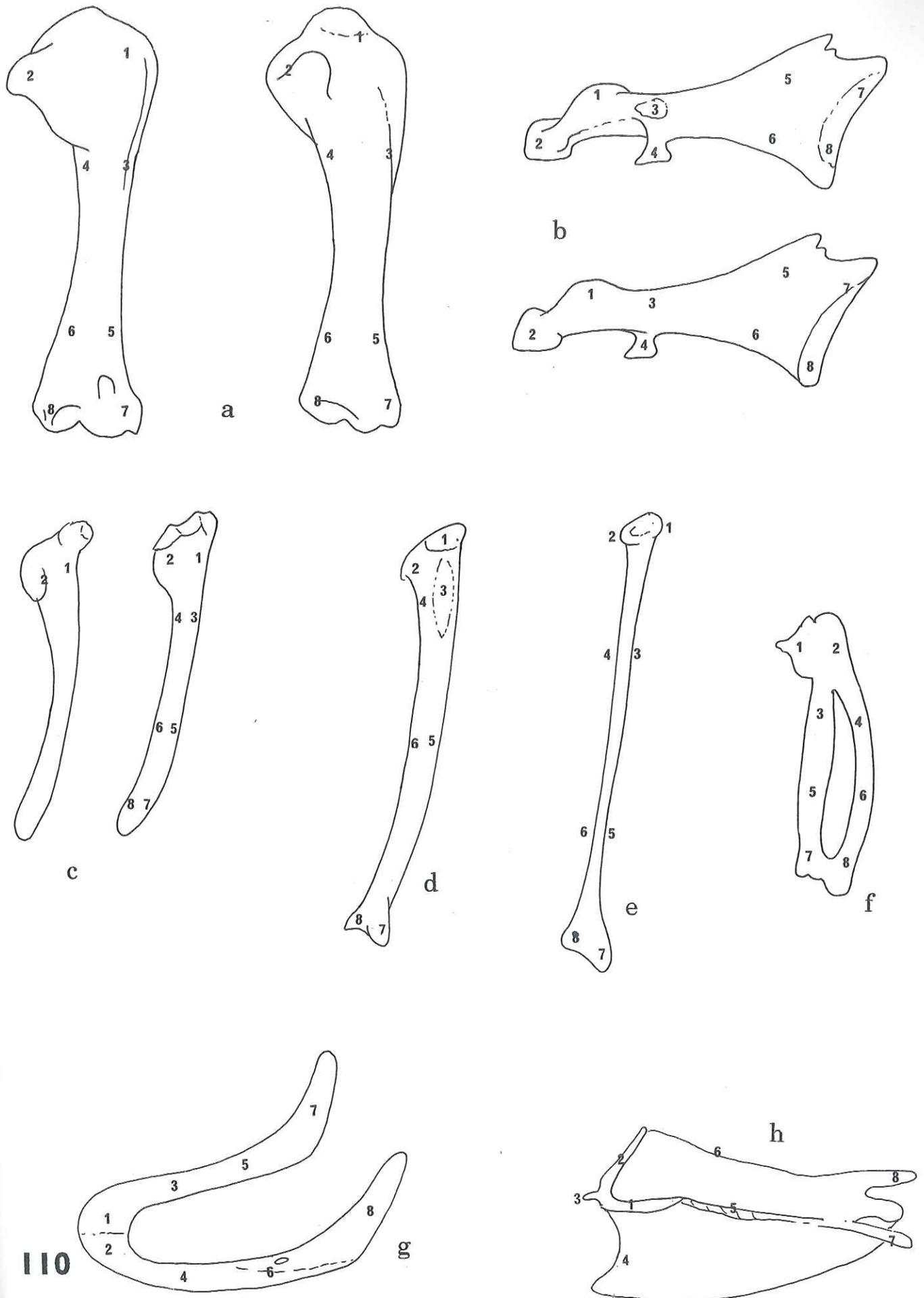


Figure 9 Zone recording method: a pelvis, b synsacrum, c femur, d tibio-tarsus, e tarso-metatarsus

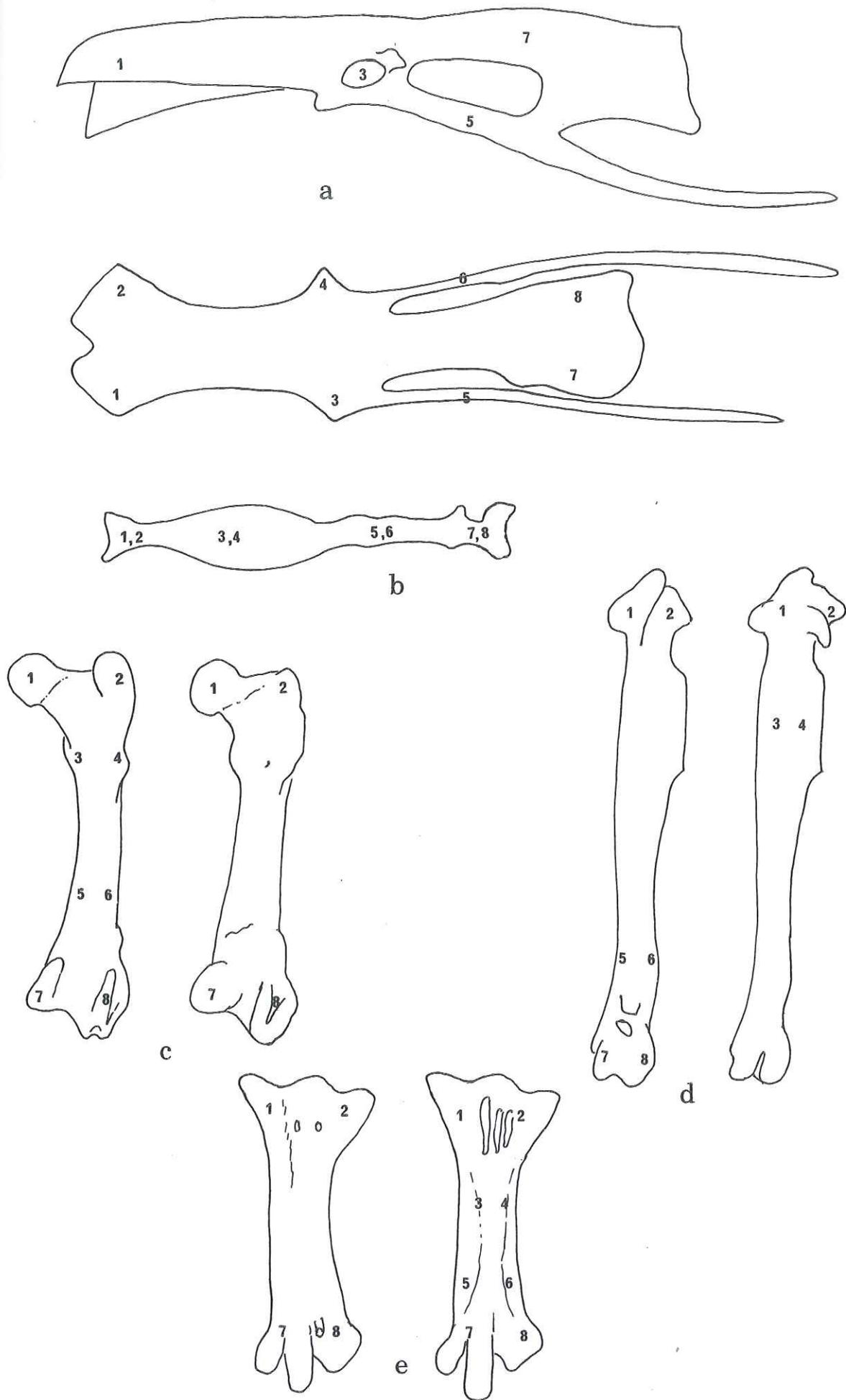


Table 4 Definition of zones

HUMERUS (Fig. 8a)

- 1 proximal end, including head
- 2 proximal end, including fossa
- 3 proximal shaft, including deltoid crest
- 4 proximal end, ventral, including bicipital crest
- 5 distal shaft, dorsal
- 6 distal shaft, ventral
- 7 distal end, including dorsal epicondyle
- 8 distal end, including ventral epicondyle

CORACOID (Fig. 8b)

- 1 articular facet
- 2 acrocoracoid process
- 3 proximal shaft, including scapular facet
- 4 proximal shaft, including procoracoid process
- 5 distal shaft, dorsal
- 6 distal shaft, ventral
- 7 sterno-coracoid process
- 8 sternal facet

SCAPULA (Fig. 8c)

- 1 acromion
- 2 glenoid facet
- 3+4 blade, proximal
- 5+6 blade, distal
- 7+8 blade, distal

ULNA (Fig. 8d)

- 1 proximal articular end, including dorsal cotyla
- 2 proximal end, including prominence for anterior articular ligament
- 3 proximal shaft, including depression for brachialis
- 4 proximal shaft, including quill knobs
- 5 distal shaft, dorsal
- 6 distal shaft, ventral
- 7 distal end, including dorsal condyle
- 8 distal end, including ventral condyle

RADIUS (Fig. 8e)

- 1+2 proximal articular end
- 3+4 proximal shaft
- 5+6 distal shaft
- 7 distal end, including ligamental prominence
- 8 distal end, ventral

CARPO-METACARPUS (Fig. 8f)

- 1 proximal end, including extensor process
- 2 proximal end including carpal trochlea
- 3 major metacarpal, proximal shaft
- 4 minor metacarpal, proximal shaft
- 5 major metacarpal, distal shaft
- 6 minor metacarpal, distal shaft
- 7 distal end, including facet for major digit
- 8 distal end, including facet for minor digit

FURCULA (8g)

- 1+2 interclavicle
- 3 body, proximal, left
- 4 body, proximal, right
- 5 body, distal, left
- 6 body, distal, right
- 7 extremity, distal, left
- 8 extremity, distal, right

STERNUM (Fig. 8h)

- 1 left coracoid groove
- 2 right coracoid groove
- 3 rostrum
- 4 apex of keel
- 5 left rib facets
- 6 right rib facets
- 7 pars hepatica, left
- 8 pars hepatica, right

PELVIS (Fig. 9a)

- 1 left ilium
- 2 right ilium
- 3 left acetabular region
- 4 right acetabular region
- 5 left pubis
- 6 right pubis
- 7 left ischium
- 8 right ischium

SYNSACRUM (Fig. 9b)

- 1+2 synsacral thoracic vertebrae
- 3+4 synsacral lumbar vertebrae
- 5+6 synsacral sacral vertebrae
- 7+8 synsacral caudal vertebrae

FEMUR (Fig. 9c)

- 1 femoral head
- 2 trochanter
- 3 shaft, proximal medial
- 4 shaft, proximal lateral
- 5 shaft, distal medial
- 6 shaft, distal lateral
- 7 distal end, medial condyle
- 8 distal end, lateral condyle

TIBIO-TARSUS (Fig. 9d)

- 1 cranial cnemial crest
- 2 proximal articular surface
- 3 shaft, proximal medial
- 4 shaft, proximal including fibular crest
- 5+6 shaft, distal
- 7 distal articular end, including internal condyle
- 8 distal articular end, including external condyle

TARSO-METATARSUS (Fig. 9e)

- 1 proximal articular end, including medial cotyle
- 2 proximal articular end, including lateral cotyle
- 3 proximal shaft, medial
- 4 proximal shaft, lateral
- 5 distal shaft, including facet for 1st metatarsal
- 6 distal shaft, lateral
- 7 trochlea for MTII
- 8 trochlea for MTIV

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The bibliography has been updated in this edition. As in the earlier edition, it includes not only those papers referred to in the text but also major publications on identification, interpretation and former bird distributions.

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This manual shows the main skeletal elements of 32 species of birds, all drawn at 1:1 scale and annotated with notes to aid identification. It is intended as an aid to teaching the identification of bird bones from archaeological sites. It can be used by an archaeozoologist unfamiliar with bird bones to give an indication of the family or group of families of bird bones from archaeological deposits. The species chosen are those which are common on archaeological sites in Britain, but as it can be used as a guide to family and size it is also more widely applicable.

It has been updated since the first edition by the inclusion of additional species and bones, a brief guide to bird bone measurement points, and a description of the recording method for bird bones used at the Faunal Remains Unit, University of Southampton.

Alan Cohen has recently retired as a Medical General Practitioner in London. He holds the University of London Diploma in Archaeology, and has worked for the past twelve years as an amateur on the identification of mammal and bird bones from archaeological sites. He is currently working as a volunteer for the Department of Prehistoric and Romano-British Antiquities at the British Museum. Dale Serjeantson is currently a Research Fellow at the University of Southampton and the director of the Faunal Remains Unit there, which is funded by English Heritage. She is an archaeologist who has researched and taught the study of faunal remains from archaeological sites for 15 years, and has published papers on the role of wild and domestic birds in early economies.

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