INTRODUCTION

Volume 5 sees the start of coverage of the passerines (Order Passeriformes)—the largest and most diverse order of birds, comprising well over half the world's known bird species. In the HANZAB region, there are some 382 species in 39 families, which will be dealt with in three volumes. This volume deals with 118 species in eight families, including the largest family of birds in Australia, the Meliphagidae.

It has been nearly 20 years since the Council of the RAOU formally decided, on 28 February 1981, to begin production of a *Handbook of Australian Birds*. While progress was at first slow, the deadline for launching the first volume of what had by then become the *Handbook of Australian, New Zealand and Antarctic Birds*, at the International Ornithological Congress in Christchurch, New Zealand, in December 1990 became a major spur to work on the project. That goal was met, and with the completion of Volume 4 and our coverage of the non-passerines, *HANZAB* had dealt with a total of 564 species, nearly two-thirds (60%) of the total species currently recorded in the HANZAB region. With the completion of this volume, those figures increase to 682 species and 72% of the total.

HANZAB holds, with few exceptions, the first attempts to integrate all information available on the biology of bird species of the Australasian and Antarctic regions. From the start, the major goals of *HANZAB* have been, firstly, to summarize all that we know of the birds of the HANZAB region and in doing so to make clear what we do not know; and secondly, to provide detailed descriptions of the plumages and other external morphology of the birds of the region, allocating and describing all sources of variation observed. We see the work's most important function as stimulating further studies and synthesis, and encouraging publication of existing information and the results of new research. The success of this goal can in part be judged by the many citations of *HANZAB* in the primary literature, particularly the journals *Emu*, *Notornis* and *Australian Bird Watcher*.

A full introduction to the series was given in Volume 1, covering the scope, arrangement and presentation of the series. Since then there have been a number of amendments and clarifications to each section and associated glossaries. Such changes have been discussed in the introductions to the respective volumes. While in this volume we have largely followed the style and layout of the preceding volumes, we have made some further adjustments and have provided some information not included in earlier volumes. We have taken the opportunity, at the start of the passerine volumes, to revise fully introductions to some sections where there have been more substantial changes from the approach outlined in Volume 1. Such aspects are discussed below for each section.

TREATMENT AND PRESENTATION The bulk of the book is set out in standard systematic form with brief introductory remarks for taxa above the level of genus, written from the point of view of Australia, New Zealand and Antarctica (see description of the HANZAB region below), and detailed accounts for each species. The only order introduction in this and subsequent volumes, for the Passeriformes, characterizes the sorts of birds within the Order, lists the constituent families in the HANZAB region and outlines taxonomic arrangements that differ from ours. A few morphological and behavioural characters common or frequent in the Order are also summarized. Introductions for families usually cover the types of birds concerned, number of sub-taxa and informal groupings such as superspecies, world distribution and representation in our region, and chief morphological and behavioural characters common or frequent in the family. Some aspects of behaviour, such as resting postures, comfort behaviour, including head-scratching, bathing and preening, and thermoregulation are characteristic of whole families rather than of individual genera or species; they are discussed or mentioned here rather than in the species accounts where they do not fit in easily and would need to be repeated time and again.

The species accounts are divided into sections for Field Identification, Habitat, Distribution and Population, Threats and Human Interactions, Movements, Food, Social Organization, Social Behaviour, Voice, Breeding, and Plumages, Bare Parts, Moults, Measurements, Weights, Structure and Geographical Variation; in some circumstances, additional sections for Ageing, Sexing and Recognition follow Structure. Each account concludes with a full list of references. Throughout the work, detailed descriptions and summaries are largely confined to data collected in the HANZAB region (see below) and extralimital data are not usually presented in any detail, though important useful references are cited. We do, however, present a little more detail from New Guinea sources where there is little or no information for Australia or New Zealand. Details of the scope of each section, with an explanation of conventions and abbreviations used and problems specific to those sections, were discussed fully in introductions for each section in Volume 1 and revised introductions for most sections appear below.

Breeding species receive full treatment in these sections. For non-breeding migrants, the sections on Social Organization, Social Behaviour and Breeding are omitted. For species that are accidental to the HANZAB region, only the sections on Field Identification, Habitat, Distribution, Movements and Plumages and related matters are covered. In these categories, some species, such as introduced species, may have a reduced treatment for Plumages and related matters if there is an adequate summary published elsewhere (see the introduction to Plumages and related matters). For species that have become extinct since European settlement, we summarize as much as we know of the biology of the species, and prepare as full an account for Plumages and related matters as possible with the material available in museums or elsewhere. However, for many extinct species, there is little or no information on the biology of the birds and few specimens available to us, so we have been able to do little.

Lastly, some species receive only a brief treatment, with a summary paragraph outlining the occurrence or claimed occurrence in the HANZAB region. Such species include: vagrants

to the wider region covered in *HANZAB* but beyond the generally recognized limits of Australia and New Zealand and their territories (for example, in this volume, two species vagrant to South Georgia from the Americas); unverified reports or claims for the region; and failed introductions to the HANZAB region. Where there are many failed introductions within a family, they may all be dealt with together.

Some abbreviations and conventions are used throughout the work; others are applied only to a particular section. All abbreviations and conventions are listed on pages 45–49. The rest of this introduction largely uses those abbreviations and conventions.

THE *HANZAB* REGION The region covered by *HANZAB* is: Aust. within the limits of the Continental Shelf, including the reefs and islands of the Coral Sea, N to 10 S or the Qld–New Guinea political border, whichever lies farther N, but excluding the e. end of New Guinea and adjacent islands above 10 S; the Aust. external territories of Cocos-Keeling, Christmas (in the Indian Ocean)[1], Lord Howe, Norfolk, Heard and Macquarie Is; NZ and its islands, from the Kermadec Grp in the N to Campbell I. in the S and the Chatham Grp in the E; the Antarctic Continent; and the subantarctic islands, including Marion, Prince Edward, Iles Crozet, Iles Kerguelen, the islands of the Scotia Arc: South Georgia, South Sandwich, South Orkney and South Shetland Is, and the subantarctic territories of Aust. and NZ already mentioned. The boundaries of the region are shown on the various end-paper maps.

TAXONOMY AND NOMENCLATURE **Birds** The publication of the ground-breaking *Directory of Australian Birds: Passerines* by Schodde & Mason (2000 [abbreviated throughout this volume as DAB]) has provided a substantial base from which to further investigate the variation in species and, of greater import, the subspecies of Aust. birds, and has greatly assisted us in the preparation of this volume. For the first time in contemporary ornithology in the Aust. region, DAB presents a complete listing and analysis of the terminal taxa of Aust. passerine birds.

As in Volumes 3 and 4, for families and species we continue to follow the arrangement and nomenclature of Christidis & Boles (1994) and amendments (Christidis & Boles In prep.); the latter will incorporate several changes published in DAB. The departures from Christidis & Boles (1994) recognized in this volume are: separation of Short-tailed Grasswren *Amytornis merrotsyi* from Striated Grasswren *A. striatus*; recognition of Kalkadoon Grasswren *Amytornis ballarae* as a species separate from Dusky Grasswren *A. purnelli*; and separation of Western Wattlebird *Anthochaera lunulata* from Little Wattlebird *A. chrysoptera*. In this and subsequent volumes, details of subspecies and subspecific nomenclature essentially follow DAB except in cases where it conflicts with species limits set out in Christidis & Boles (1994, In prep.). However, even in those instances, subspecific treatment of DAB is always discussed within the texts and reasons for departure from DAB are given.

The arrangements of the few species recorded in the wider HANZAB region that were not included within the above publications were determined in consultation with L. Christidis (representing Birds Australia's Taxonomic Advisory Committee and a member of the *HANZAB* Steering Committee), based on the principles and sources used by Christidis & Boles in compiling their 1994 publication. For NZ species, scientific nomenclature follows OSNZ (1990) except in cases where it conflicts with Christidis & Boles (1994, In prep.).

English names follow those of Christidis & Boles (1994); English names for species endemic to NZ follow those of OSNZ (1990).

Plants and animals other than birds All scientific names, other than those of birds, were checked against the following references; for those groups for which volumes have been published, we have used the multi-volume series the *Flora of Australia*, the *Fauna of Australia* and the *Zoological Catalogue of Australia*. **Plants** For Aust., Hnatiuk (1990), ABRS (1993) and, for specific families, George (1986, 1989), Chippendale (1988) and Orchard (1995, 1998); for NZ, Allan (1961), Poole & Adams (1963), and Moore & Edgar (1970); and, more generally or outside these areas, Wallis & Airy Shaw (1973). We have retained *Eucalyptus* as a single genus, though we have often placed the subgeneric name *Corymbia* in brackets after *Eucalyptus* for species of bloodwoods. **Animals** GENERAL INVERTEBRATES: Marshall & Williams (1972). MOLLUSCS: Vaught (1989). SPIDERS: Main *et al.* (1985). INSECTS: Taylor *et al.* (1985); Lawrence *et al.* (1987), Campbell *et al.* (1988), Common (1990), CSIRO (1991), Naumann (1993), Lawrence & Britton (1994) and Nielsen *et al.* (1996). FISH: Paxton *et al.* (1989), Eschmeyer (1990) and Gommon *et al.* (1994). AMPHIBIANS AND REPTILES: Cogger *et al.* (1983) and Cogger (1992). MAMMALS: Bannister *et al.* (1988) and Strahan (1995).

[1] Note that in the texts, Christmas I. refers to the Aust. territory in the Indian Ocean unless followed by '(Pac.)', which then indicates the island in the central Pacific Ocean.

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CUT-OFF DATES FOR TEXTS Most texts for this volume were prepared between Apr. 1998 and the end of 1999, with editing and refereeing extending to mid-2000. It is not, however, simple to give an overall cut-off for all sections and texts because preparation of different sections took place at very different rates. By and large, we have not been able to include in detail material either published, in press (i.e. submitted to and accepted by a journal but not yet published) or in preparation (i.e. submitted to a journal but not yet accepted) after mid-1999, though we have tried at least to cite important papers that appeared after completion of the texts and to incorporate what information we could.

Unfortunately, during review of the texts, especially of the Maluridae, referees supplied a number of papers in press or in preparation. The pressure to ensure texts were finalized by the end of May 2000 meant that we could not include much of this information. We have tried to cite any papers in press, and to comment on major discrepancies between new data and older information within our texts that resulted from such papers. We are grateful to our referees for making this information available and apologize to them for not including it as fully as we would like.

FIELD IDENTIFICATION The object of this section is to set out methodically those characters by which a species may be identified in the field, even without the help of illustrations. Despite that, however, the colour illustrations prepared for *HANZAB* are an invaluable visual aid to identification, showing all significant variation in plumages, bare parts and other aspects of external morphology, whether that be age- or sex-related or geographical variation. The colour illustrations show the major identification features and, as far as possible, closely related or confusion species are shown on the same colour plate or series of plates.

While the only significant change from Volume 4 is the omission of some general information on habitat and vocalizations from the final paragraph (see below), there have been quite a few adjustments since Volume 1. We have thus taken the opportunity to revise the introduction to this section.

We try to avoid duplication between Field Identification and the sections of Plumages and related matters, concentrating on those aspects of external morphology that are important to the **field** identification of the species. However, field identification is not simply the separation of one species from another: field identification of sexes and different ages are vitally important in studies of other aspects of ecology, including patterns of movement, population dynamics and social organization (e.g. age at first breeding) and behaviour. Many species present considerable difficulties in ageing and sexing in the field. In recent years, many detailed specialist identification papers and guides have appeared, covering waders, gulls and other difficult groups, and many field identification problems previously considered almost impossible to resolve (e.g. separation of stints in juvenile plumage) are now possible or even routine in some instances. Resolution of these difficult identification problems has come about largely through adoption of the so-called 'new approach' to identification (see Grant & Mullarney 1989), with its emphasis on topography and moult of birds as well as traditional skills of bird identification. With widespread use of telescopes and specialist identification guides, birdwatchers are nowadays scrutinizing birds more closely than ever before and in much greater detail, as they attempt not only to identify a bird to species but also to determine its age, sex and stage of moult where possible. We have attempted to summarize all characters important in identification, ageing and sexing.

The sections of Plumages and related matters are complementary to the Field Identification section and need to be consulted for more detailed information on the external morphology of species, such as the patterns of individual feathers or feather-tracts, and complete details of moult and geographical variation. An exception is made for those few very rare vagrant species or introduced species where only a brief Plumages account is given (this usually only when extralimital summaries are already available, e.g. in BWP); in these cases, the Field Identification accounts are usually more detailed than is normally the case. For a full review of the new identification techniques, plumages, topography, judgement of size and structure and other aspects of the new approach, see Grant & Mullarney (1989).

The presentation of field identification is in three paragraphs: the first provides a general summary of size, structure and plumages, followed by the detailed descriptions of the species in question; the second paragraph discusses separation from similar species; and the last paragraph discusses general field behaviour.

The first paragraph opens with estimates of TOTAL LENGTH, WINGSPAN and WEIGHT as a guide to the size of the bird. As in other volumes, it was difficult to obtain accurate values for TOTAL LENGTH and WINGSPAN and to establish relative size within genera or families. For the passerines of the HANZAB region, there is very little published information in the primary literature, and the sources and accuracy of data given in field guides and secondary sources (which are usually single figures or ranges) are largely unknown. Usually we present a figure for sexes and any subspecies combined unless the differences are marked and data are available; the paucity of data often makes it impossible to do anything else but combine data. For nearly all species in this volume, we have presented data from museum specimens for birds collected in the HANZAB region; in some cases, we have used published data where the sources, sample sizes and methods of measuring are known; as a last resort, we have used data from other published sources. Where we have five or more measures from museum skins in which we have confidence, or have data from a published primary source, we have presented the data as a mean, with a range given in

brackets; where we have fewer than five measures, or the data has come from a secondary source, we have given an approximate figure or a range only. The main published sources for total length and wingspan are: Pizzey (1980), NPIAW (1982), Schodde (1982), Slater *et al.* (1989), Pizzey & Knight (1997), Longmore (1991) and Heather & Robertson (1997). The figure for WEIGHT is usually the combined mean of the data presented in the Weights section; occasionally, an approximate figure is given when there are too few data or variation appears great. In all cases, the Weights section should be consulted for fuller details. For relative size within genera or families, we have had to determine this based upon the measurements we have been able to obtain. In light of the difficulties encountered during preparation of this and previous volumes, we strongly encourage bird banders, museum workers and others to help obtain and make available accurate measurements of length, wingspan and weight for A'asian birds, which would be invaluable for use in the last two volumes of *HANZAB*.

The first paragraph then proceeds to give a rough indication of the size of the bird being described, usually in comparison with similar species or some common species within the range of the species under consideration. A general comparison of shape, structure and jizz is also made, with a broad indication of the proportions of head and neck, body and tail. Such details are given as comparisons because all such aspects are difficult or impossible to accurately determine in isolation (e.g. see Andrew & Rogers [1994]). Whether sexes are separable, by size or plumage, and any seasonal changes in adult plumage, are then given, followed by a summary of outstanding characters of plumage or other features of adult plumage, especially if they are diagnostic. A brief summary of whether juveniles and immatures are separable, and their distinguishing characters are then given.

These introductory summaries are then immediately followed by detailed descriptions of field characters of each sex and age that can be distinguished in the field, concentrating on the overall appearance of the birds and characters important in identification. As necessary, descriptions are given of adult male and female, breeding and non-breeding, and juvenile and immature plumages, as well as morphs and phases. After the first mention of a character, it is not usually repeated, only the differences being emphasized. Downy young are described only for precocial species.

The second paragraph **(Similar species)** sets out those similar species that may cause confusion in the field. We have tried as far as practicable to make consistent comparisons between species in the same way: presenting details of the species under consideration, comparing and contrasting characters with those of potential confusion species. At times, where finer detail than is provided in the preceding description is required to distinguish similar species, such detail is often only given in the discussion of similar species, where comparisons can be directly made with the characters of the similar species. Where aspects of behaviour, vocalizations or habitat use are particularly important or useful in separation of similar species they are also discussed here.

The final paragraph tries to give an outline of less concrete aspects of identification and is in general the weakest part of the section. There is very little information available on aspects of gait, swimming, flight and so on, which one assumes are perfectly obvious and well known but can be difficult to describe and rarely are in published sources. There is much scope for improvement here, because contributors and editors had a good deal of trouble in covering these aspects, even as a general outline. Where previously we also summarized aspects of habitat and voice in this paragraph, we have now left this to the opening paragraph of those sections, or discussed them under similar species where particularly relevant. Some fuller information on various aspects may be found in other sections, such as Food, Social Behaviour and Social Organization.

References are not usually given in this section, though we have occasionally provided references for some particularly difficult identification problems.

GLOSSARY

GAPE-STRIPE: In some smaller honeyeaters, a narrow contrasting pale stripe running back across sides of head from gape; comprised of bare fleshy gape and feathered moustachial stripe.

INNERWING-COVERTS: Secondary coverts. Used mainly to refer to those coverts visible on the folded wing of a standing bird.

INNERWING: Secondaries and secondary coverts combined (including tertials and their coverts).

LINING OR WING-LINING: Primary and secondary coverts of underwing.

MOULT-CONTRAST: An obvious difference in colour and wear between adjacent feathers of different ages.

OUTERWING: Primaries and primary coverts combined.

PRIMARY PROJECTION: On a folded wing, the distance primaries project beyond the longest tertial compared with the length of the exposed tertials.

SADDLE: The mantle, back and scapulars together.

SECONDARY BAR: Contrasting dark band on inner upperwing, formed by dark bases of secondaries.

UNDERBODY: Ventral body plumage, not including underwing and undertail.

UNDERPARTS: Underbody, underwing and underside of tail combined (cf. sections on Plumages and related matters section; see Glossary there).

UPPERBODY: Dorsal body plumage, not including upperwing and uppertail.

UPPERPARTS: Upperbody, upperwing and upperside of tail combined (cf. sections on Plumages and related matters section; see Glossary there).

WING-POINT: In the Field Identification accounts, refers to that part of the wing-tip visible beyond the longest tertial on a folded wing (see also Primary projection). For birds in the hand, refers to the longest primary on the folded wing.

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HABITAT The problems in assembling the habitat texts were discussed in the introduction to Volume 1 and have proved to be common to all subsequent volumes. For nearly all of the species in the HANZAB region that we have dealt with so far, it has proved difficult, and sometimes impossible, to assemble even a general overview of use of habitat by birds, let alone an analysis of the critical variables of habitat for each species. There are few comprehensive studies on habitat use by birds in the region and the texts in *HANZAB* are, for most species, the first attempt at collating and synthesizing the diversity of information contained in a wide range of published and unpublished sources.

In addition to the lack of systematic study and analysis of habitat, the difficulty of assembling an overview of habitat use by birds in the HANZAB region is exacerbated by the lack of consistent, or even accurate, classification of habitats by both amateur and professional ornithologists. While this is understandable in early literature, it is disappointing to find this perpetuated in more recent systematic studies or annotated lists, especially given the availability of systems of habitat classification covering wide areas and in widespread use in other disciplines, e.g. Specht's (1981) structural classification of vegetation formations in Aust. Happily, there are increasing numbers of studies that do adopt accepted systematic classifications of vegetation and other habitat variables.

Despite the problems just described, we have attempted to describe habitat with standard terms. For structural descriptions of rainforest and non-rainforest vegetation and descriptions of landforms, we have as far as possible used the definitions given in the *Australian Soil and Land Survey Field Handbook* (McDonald *et al.* 1984; also see AUSLIG 1990). Other terms we use commonly are given in the glossary associated with the introduction to Habitat in Volume 1 (and which is not repeated here). Equally, however, it is not always possible to convert the often vague and ill-defined descriptions found in the published literature (e.g. scrub) to standard terminology; where it is considered useful, we include such descriptions, usually without comment.

Given our experience in assembling habitat texts for this and previous volumes, particularly when dealing with the primarily terrestrial species of Volume 4 and the passerine volumes here and to come, we have changed the arrangement of this section. Previously, following the first paragraph, there were separate paragraphs that dealt with breeding, feeding and roosting and loafing habitats. These paragraphs have been abandoned in this and subsequent volumes because: (1) such habitats are almost always the same as those already described in the preceding paragraphs or, occasionally, a subset of them; and (2) because we usually have so few details of such habitats beyond some details of use of sites for these behaviours, and which are already summarized in Breeding (Site), Food (Behaviour) and Social Behaviour (Roosting). Finally, the information concerning human interactions and modifications to habitat, formerly in the last paragraph, has been moved to a new section, Threats and Human Interactions (see below).

The usual arrangement in this and remaining volumes is as follows. Unless there is very little information in total, the section opens with a brief introductory paragraph that summarizes: the main habitat types used by the species; the biogeographical settings of distribution, identifying the climatic zones in which the species occurs; and, if there is information available, the commonly inhabited landforms in which the species occurs. General references are provided here, but the references provided in the following more detailed analysis must also be consulted for a complete listing.

The introductory paragraph is then followed by a synthesis of the available information on use of habitat by the species, dealing firstly with those habitats used most often or commonly, through to those used only infrequently. Use of modified habitats (such as urban areas or farmland) is also discussed, either separately at the end of the paragraph, or integrated with the main discussion, depending on the frequency of use of such habitats. Occasionally, information is presented separately for different subspecies or different biogeographical or climatic regions (e.g. for widespread species). We have tried to cite all important primary sources, especially acknowledging sources of significant facts and studies of particular species or groups. It is impossible that such listings of references should be exhaustive. Lastly, where there are detailed studies, these are often now presented in a separate final paragraph and may include information on differential use of habitats in an area or region or details of studies of human impacts, such as fire or logging.

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DISTRIBUTION AND POPULATION The detailed descriptions of distribution need to be read in conjunction with the maps, which themselves obviate the need for much text. Because the maps can be presented at only a small scale, the text describes the mapped distribution of each species state by state or regionally, indicating whether the species is widespread throughout that range, scattered or patchily distributed; and gaps or continuities in distribution that may not be obvious from the maps are discussed.

The breeding range of a species is the most biologically important part of its total distribution yet for most species in the HANZAB region one of the chief difficulties in assembling both texts and maps is to distinguish between breeding and non-breeding ranges. For most terrestrial species of Aust. and NZ, general occurrence or range may usually be fairly assessed but breeding distribution and localities are often poorly known, even for colonially breeding species. The discussion of breeding distribution relies on the map and the preceeding discussion of overall distribution.

In compiling text and maps, a great many sources are used. For species occurring in Aust. and NZ, *The Atlas of Australian Birds* (Blakers *et al.* 1984) or *The Atlas of Bird Distribution in New Zealand* (Bull *et al.* 1985) form the basis for discussing and presenting both breeding and non-breeding ranges in the text and the maps. These known ranges are supplemented by records published since then (of special note are the *Atlas of Victorian Birds* [Emison *et al.* 1987] and *Birds of the Australian Capital Territory. An Atlas* [Taylor & COG 1992]), some unpublished records and, for Aust., data from the NRS. Annual bird reports for a variety of regions or states are a valuable source of information on local rarities, changes in range, annual fluctuations in general abundance, irruptions, and movements.

However, for Aust., *The Atlas of Australian Birds* is an imperfect record of breeding distribution because observers were not required to search for, or even submit, evidence of breeding (though it was encouraged); and many areas beyond the well-populated e. coast, SE and SW remained little visited; some areas may never have been visited for more than a few hours and not certainly when breeding may have occurred or in breeding habitat of a species within that block. Thus it is difficult to assess the significance of a breeding record or the lack of one in the *Atlas*. For all that, however, the *Atlas* remains the best record of breeding and non-breeding distribution in Aust. Combined with other sources, the text and maps are thus records of **known** non-breeding and breeding distribution, though for all but a few species they remain an incomplete record of these ranges. By taking the approach we have we hope to stimulate observation of breeding range and publication of such observations to fill the all-too-obvious gaps in our

knowledge. The *New Atlas of Australian Birds* currently underway should also provide much useful information.

For NZ, *The Atlas of Bird Distribution in New Zealand* (Bull *et al.* 1985) did not distinguish breeding distribution on the maps, stating that 'apart from pelagic species and migrant waders, most New Zealand species breed throughout their ranges and the exceptions are noted with the relevant maps'. Records of breeding are, however, summarized for each grid square in a microfiche appendix to the Atlas. The NZ Atlas suffers the same problems as the Aust. Atlas regarding recording of breeding distribution. Thus, breeding distribution for NZ is determined from published descriptions and records, and the microfiche records of the NZ Atlas.

Figure 1 shows the regions, divisions and districts of the various Aust. states that are used in conjunction with town and place names and geographical features to describe distribution. The end-paper map for NZ (inside rear cover) shows the regions of the main islands which are used to describe distriution there.

Vagrant and rare species For species new to Aust. and its territories or species listed on the Review List of the Birds Australia Rarities Committee (BARC, which was formerly the RAOU Records Appraisal Committee [RAC]), non-specimen records must be vetted and accepted by BARC before a species is included on the Aust. list or before a record is considered valid (see Palliser 1999 and Palliser & Eades 2000 for a copy of the Review List and the role of BARC). However, BARC does not review published records unless they have been submitted to them independently. This creates problems with sight-records published before the establishment of BARC or, before that, the RAC, which, by and large, have not been vetted.

For all such species, we have usually listed as acceptable only those sight- or sound-records that have been accepted by BARC. However, records of species on the Review List but published before the establishment of the RAC/BARC and that include an adequate description of a species are usually listed as acceptable. All early sight-records without description and all sight-records since the establishment of the RAC/BARC that have not been submitted to the BARC are listed as unverified or unacceptable.

Many unverified reports of rare or vagrant species are published in the *RAOU Newsletter* (till Dec. 1990) or *Wingspan* (in Twitcher's Corner), or in *OSNZ News*. These must be considered unacceptable records until they have been submitted to the BARC or relevant State authority in Aust., or the Rare Birds Committee in NZ. In the accounts these are usually listed as 'unverified', without reference. In Aust., records in State bird reports are accepted except for species on the BARC Review List.

Status The default for status of species and subspecies in Aust. is Garnett (1993), though for a few species we were able to include status from Garnett & Crowley (2000). For status in the various Aust. states, we used Stanger *et al.* (1998). International status of species came from Collar *et al.* (1994).

Populations For passerines of the HANZAB region there are few estimates of total population size, except for many endangered taxa. We have included estimates of densities or relative abundance where they are available, and the results of any long-term surveys conducted in Aust. and NZ.

Maps Presentation of maps remains as in previous volumes, with breeding areas shown in full red and areas of occurrence where breeding has not been recorded in half-tone red. Because we know little of the limits of breeding and non-breeding distribution of species in New Guinea and Indonesia, distribution in these regions has usually been shown in half-tone red, giving no indication of breeding range outside the HANZAB region. Maps of distribution appear for all species except: (1) extinct species; (2) those species that receive only brief paragraph treatment in the text (see Treatment and Presentation above); and (3) failed introductions to the HANZAB region.

We have not tried to show movements on maps.

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THREATS AND HUMAN INTERACTIONS For this and remaining volumes, we have decided to place all information relating to threats to a species, and the variety of human interactions recorded for a species, in a single place where previously this information was included in the last paragraphs of both Habitat and Distribution and Population. The overall status of species, and subspecies, is still retained in the section on Distribution and Population, immediately preceding this new section. Here we concentrate on summarizing those factors that are known to be or are potentially threatening to a species or subspecies. The information compiled by S. Garnett, G. Crowley and J. Brouwer in their various reports (Brouwer & Garnett 1990; Garnett 1993; Garnett & Crowley 2000) were invaluable in this respect, though few details from Garnett & Crowley (2000) were available at the time of publication of this volume of *HANZAB*.

The second part of this section considers all aspects of human interactions, ranging from use of modified habitats, such as use of urban areas or farmland and impacts of logging or fires, to more trivial aspects, such as collisions with windows and overhead wires.

Fuller details of the various aspects discussed in this paragraph are often contained within the Habitat or Distribution and Population sections, which need to be read in conjunction with the summaries in this section.

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MOVEMENTS This section describes the timing and geography of migration and other movements, or the lack of them. However, few species have been adequately studied using marked birds or at biologically useful scales for understanding movements by birds in the region. The texts in *HANZAB* are, for most species, the first attempt to collate and synthesize all information available on movements by bird species using the region, at least as far as landbirds of Aust. are concerned; Keast's

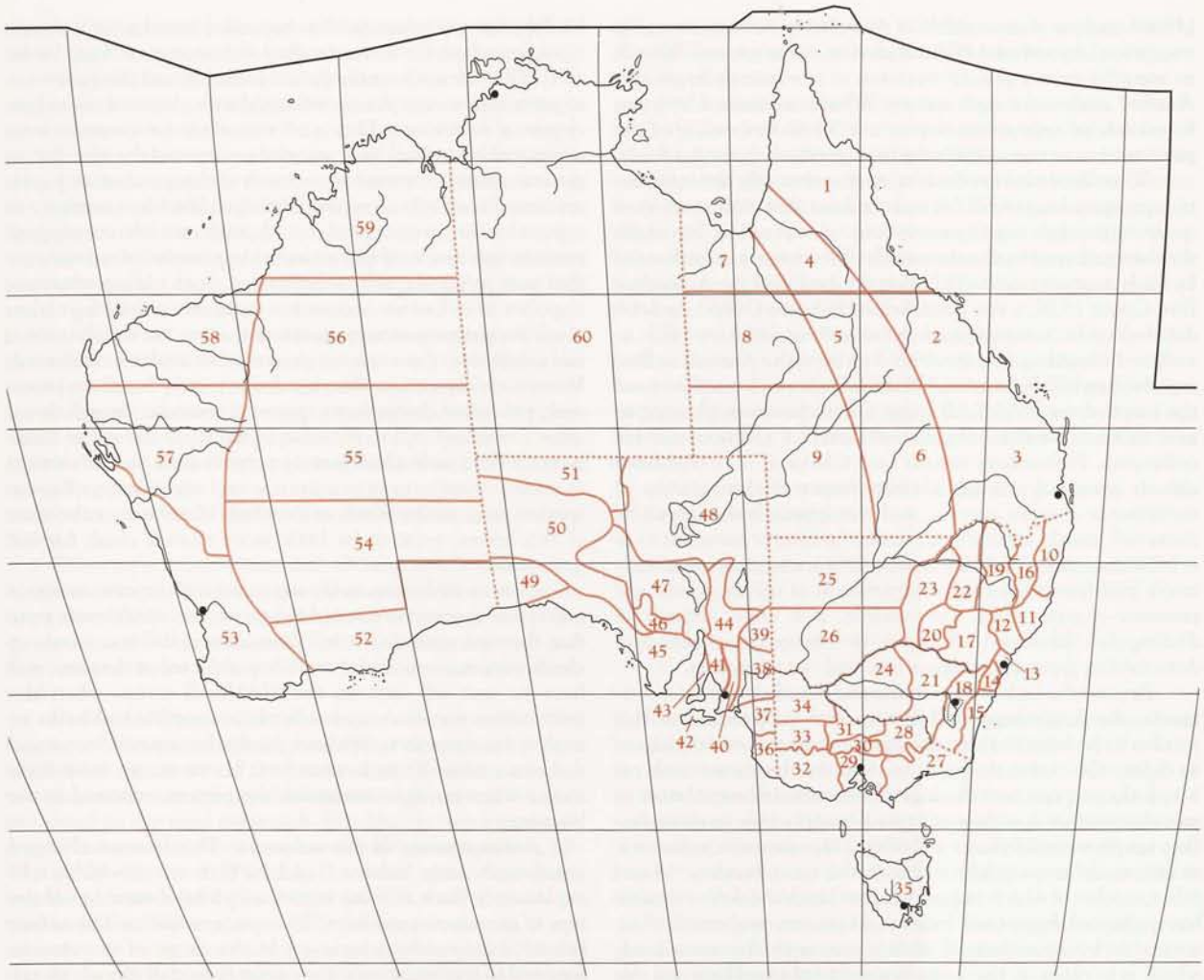

Figure 1 Divisions, districts and regions of Aust. states used, in conjunction with town and place names and geographical features, to describe distribution.

Queensland
(from Palliser 1985)
1. North-Eastern Region
2. Mid-Eastern Region
3. South-Eastern Region
4. North-Central Region
5. Central Region
6. South-Central Region
7. North-Western Region
8. Western-Central Region
9. South-Western Region

New South Wales
(from Morris *et al.* 1981 and NSW Bird Reps)
10. Northern Rivers Region
11. Mid-north Coast Region
12. Hunter Region
13. Sydney (formerly Central Coast) Region
14. Illawarra Region
15. South Coast Region
16. Northern Tablelands Region
17. Central Tablelands Region
18. Southern Tablelands Region
19. North-West Slopes Region
20. Central-West Slopes Region
21. South-West Slopes Region
22. North-West Plains Region
23. Central-West Plains Region
24. Riverina Region
25. Upper Western Region
26. Lower Western Region

Victoria
(from Wheeler 1967)
27. Gippsland
28. North-East District
29. Central District
30. North Central District
31. Northern Country or District
32. Western District
33. Wimmera
34. Mallee

Tasmania
35. Tasmania

South Australia
(from Parker *et al.* 1979)
36. Lower South-East Region
37. Upper South-East Region
38. Murray–Mallee Region
39. Lower North-Eastern Region
40. Mt Lofty Ras Region
41. Adelaide Plains Region
42. Kangaroo I.
43. Yorke Pen. Region
44. Flinders Ras Region
45. Eyre Pen. Region
46. Gawler Ras Region
47. L. Torrens–L. Gairdner Basin Region
48. North-East Region
49. Nullarbor Plain Region
50. Great Victoria Desert Region
51. North-West Region

Western Australia
(from Storr 1980, 1984, 1985a,b, 1986, 1987, 1991)
52. Eucla Division
53. South-West Division
54. South-Eastern Interior Region
55. Mid-Eastern Interior Region
56. North-Eastern Interior Region
57. Gascoyne Region
58. Pilbara Region
59. Kimberley Division

Northern Territory
60. Northern Territory

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(1968) analysis of movements of Aust. honeyeaters is a notable exception. As with the Habitat section, it has proved difficult to assemble even a general overview of movements let alone a detailed analysis for each species. What is assembled here can be considered only a first step in a fuller understanding of the patterns of movements of A'asian birds, particularly the landbirds.

What is needed are detailed studies that take the information presented in *HANZAB* and combine that with analyses of quantitative data from as many sources as possible, especially the data gathered by the thousands of volunteers co-ordinated by Birds Australia itself, including the data from the Australian Bird Count (ABC), the Nest Record Scheme (NRS), and the data held in both the original and new Atlases of Aust. birds, as well as the banding and recovery data from the Australian Bird and Bat Banding Schemes (ABBBS). Such a task is well beyond the scope of the *HANZAB* project. It is, however, pleasing to note that such work is being undertaken by P. Griffioen and his colleagues. Preliminary results (see Clarke *et al.* 1999) have already provided a much clearer picture of the patterns of movements of some species, and the approach developed by them will greatly advance our understanding of movements of at least some Aust. birds. Detailed studies need also to deal with major problems with the interpretation of survey, count and presence–absence data; for example, it is often difficult to distinguish seasonal changes in conspicuousness and detectability from movements into and out of an area.

Beyond the lack of systematic and detailed study of movements, the single biggest difficulty with preparation of this section is the failure of amateur and professional ornithologists to define the terms they use to describe the movements on which they report, and the lack of a standard nomenclature of movements that is widely accepted or applicable to all studies (e.g. see above and Pyke *et al.* 1989). Thus, the term 'sedentary' in one study may correspond with the term 'resident' in another, neither of which may correspond with the definitions we have adopted here (see below). However, without a clear statement by an author of what is meant by the terms used, which is so often in the case in annotated checklists and the like, there is little we can do other than report the observations. In assembling the texts, we collate and synthesize the available information on a species and in doing so the range of movements of a species may become apparent; we then state the patterns of movements shown by a species as defined by us. However, where no patterns emerge or there is little information, we are often forced to summarize movements as they are described in the literature without being able to state clearly how that relates to the categories we use.

Nomadism A further problem with definitions of movements of Aust. birds is the widespread and often indiscriminate use of the term 'nomadic' to describe movements. Certainly, within the HANZAB region, simple migration between a breeding area and a non-breeding one either appears not to take place in a clearly defined seasonal manner, except for a few species, or the movements that do take place are not well enough understood to explain clearly; the movements of some species do appear to be largely unpredictable. Further, while much movement does, of course, occur, it can be greatly influenced by many factors, not all of which are known or understood, including wet and dry conditions within a species' range, and local movements (sometimes with seasonal patterns) to take advantage of flowering of plants. The definition or description of much movement observed in Aust. being difficult and our knowledge imperfect, many such movements are called 'nomadic'. However, the idea that many, or even most, Aust. bird species are 'nomadic' has become somewhat of an overriding paradigm for understanding movements of Aust. birds.

With our work on the Aust. landbirds, and the passerines in particular, we are often confronted with claims of nomadism or partial nomadism. This is all too often the situation with annotated lists, checklists, regional reports and the like. Yet, in general, claims of nomadism in many of these and other papers are often based only on apparently unpredictable occurrence at a given locality or anecdotal records, with no understanding, or even in ignorance, of the wider scale patterns of movements that may influence such appearances. Such claims often extrapolate from **known occurrence** in an area to making claims about the **patterns of movements** of the species, which is often not justified on the evidence presented or analysis conducted. Many such claims are often no doubt merely based on previously published claims that a species is nomadic, though this is often not stated. All in all, most examples of use of the terms nomadic and nomadism merely perpetuate a lack of critical thinking of patterns of occurrence and movements of avian species, and, in the words of Stephen Marchant at the start of this series, seem to be little more than a cloak for our ignorance.

Considerably more study and analysis of the movements of individual species are needed before we can confidently state that they are nomadic. A full discussion of the true nature of claims of nomadism, and the validity of the use of the term, will have to wait till later in the *HANZAB* series, when the information for all Aust. landbirds is assembled and can be analyzed in its entirety. We have tried as far as possible to avoid the terms nomadic and nomadism. However, we have little choice when trying to summarize the patterns reported in the literature.

Arrangements of the accounts This has not changed significantly since Volume 1, and the texts are reasonably self-explanatory. Each account begins with a brief summary of the type of movements exhibited by a species as defined by us (see below), followed by a summary of the range of movements reported in the literature if they differ from that already given. If appropriate, a brief discussion of seasonal changes in range follows, noting breeding and non-breeding ranges and the seasons in which each is occupied. Details of any geographical variation in nature of movements, timing, routes, etc., if any, are given. The first paragraph then goes on to identify briefly other factors relevant to the overall patterns of movements seen in a species, such as altitudinal movements, associations with flowering plants, and response to droughts or floods, irruptions and the like. Lastly, observations on the nature of passage or other movements are briefly given.

Subsequent paragraphs then go on to describe in detail the patterns of movements observed, and introduced in the first paragraph, discussing geographical variation or seasonal differences in movements, and the factors that might influence them. For regular migrants (or partial migrants), the subsequent sections describe the direction and timing of departure from breeding areas, movements in the non-breeding season, direction and timing of return to breeding areas, and movements in the breeding season. For species that appear largely or wholly resident or sedentary we usually have few problems in summarizing the range of movements. As discussed above, all claims of nomadic movements need to be considered carefully and the true nature of such movements often await verification by more detailed studies.

If there is information available, we also discuss details of dispersal of young, where there are details on movements;

details of timing and behaviour of dispersal are usually left to Social Organization and Behaviour (see below).

As stated above, there are few species within the HANZAB region for which a comprehensive description of movements can be prepared and there are no species for which in-depth studies of movements across the range of the species are available. For many species, the paucity of real information on movements can make it difficult to reach any conclusions on their patterns of movements.

We have defined the following categories of movements:
MIGRATORY: all or most individuals moving between breeding and non-breeding ranges;
PARTLY MIGRATORY: some individuals migratory, others resident;
DISPERSIVE or NOMADIC: movements apparently random within suitable habitat, though this designation may reflect limited knowledge and mask regular migration or other patterns of movements by part or all of the population (see discussion above);
RESIDENT: most individuals non-migratory though some may move long distances;
SEDENTARY: most individuals not normally moving more than 50 km.

Other types of movement include eruptions from breeding areas, irruptions outside the normal range, aberrant migration (movement in the opposite direction to most members of the species), post-fledging dispersal, post-breeding dispersal and moult migration (movement from a breeding area to a moulting site).

Banding As in previous volumes, a summary of banding recoveries is given in the final paragraph of this section. Where appropriate, summaries of the results of other banding or radio-tracking studies or other published recovery records are also presented in the final paragraph. Banding recoveries are presented in categories of distance from banding site (<10 km, 10–49 km, 50–99 km, ≥100 km). For Aust., these figures are calculated from data supplied by the ABBBS, most of which are summarized in Baker *et al.* (1995). In some instances, it was necessary to incorporate additional recoveries, typically from the Recovery Roundup section of the journals *Corella* and *Australian Bird Bander*. Where a species could have been banded at islands of the sw. Pacific or New Guinea or both, these totals are also incorporated (because they could not easily be extracted from the calculations). Details are provided for all long-distance recoveries (i.e. ≥100 km) where they are available (see below). The information on recovery rate in distance categories is excluded from species with recent taxonomic splits and where there is subsequent uncertainty as to the specific identity of banded birds. Recoveries were summed for taxa that have been recently lumped but are recorded separately in the ABBBS database.

The banding paragraph begins with a statement giving the total number of birds banded in Aust. (and New Guinea and the sw. Pacific if a species also occurs there), between 1953 and 1997, and the total number recovered. These summary data are taken from the latest published report of the ABBBS (Baker *et al.* 1999), which includes all data held to 1997 at the time of publication.

For most species, the breakdown of recoveries into distance from banding site comes from two sources, which are presented separately. The first, and most important, is the list of recoveries extracted from the database on 1 Mar. 1999, and which includes all recoveries that had been entered from the inception of the computerized database in June 1984. The second source is the microfiche records of public recoveries from 1953 to June 1984. We have ignored some other sources of recoveries from within the ABBBS as they are not readily accessible and most or all would be birds re-trapped at or very near banding sites.

For a small number of species, only recoveries of birds banded since June 1984 (i.e. from the computerized database) were analyzed when determining breakdown of recoveries from banding sites. These were species that had over 1000 recoveries since June 1984, which was thought to be a large enough sample size to reflect the trends of recoveries. It was also not practical for us to extract and analyze data from the many records that had not been placed on computer. The different treatment of these species is indicated in the text.

The ABBBS database is large and dynamic, with over 3.5 million records to the end of 1997, including about 2 million records before computerization began in 1984. There is often a backlog of data from previous years that is being entered and the database itself is continually being checked for errors and amended.

LONG-DISTANCE RECOVERIES: Data are presented in the following summarized form:

Kenmore, se. Qld,	to	Wewak E., Sepik Province, PNG			
(1)		(2)			
(2825 km,	337 ,	3 months[D],	Mar.,	J,	M)
(3)	(4)	(5)	(6)	(7)	(8)

(1) Banding site; (2) recovery site; (3) minimum distance from banding site to recovery site (great circle distance); (4) direction from banding to recovery site (great circle); (5) number of months elapsed between banding and recovery; a superscript [D] indicates recovery of dead bird; (6) month of banding; (7) age at banding, if known (P = pullus; J = juvenile, 1 = 1 year old, blank = unknown or >1 year old); and (8) sex if known (M = male, F = female, blank = unknown).

Where appropriate, recoveries showing site-fidelity are also discussed. Longevity from banding records of wild birds is also given (if records >12 months).

No banding maps are presented in this volume.

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FOOD This section remains largely unchanged from our original approach. As stated in Volume 1, the description of food and feeding behaviour is open to many biases and much variation between place, time and individuals.

The first paragraph opens with a summary statement of the type of food eaten by the species. This is followed by a summary of feeding **Behaviour**, analyzed quantitatively where possible and discussing, after a brief introductory summary: size of feeding flocks, feeding associations and feeding territories; feeding heights, sites, and food sources; feeding methods, including search, attack and handling behaviour (see below); differences between sexes and interspecific comparisons; adaptations for feeding; pest status; and drinking behaviour. In unquantified studies it should be remembered that unusual feeding behaviour is more likely to be described in the literature.

Subsequent paragraphs discuss the results of **Detailed studies** of diet of adult birds, if any, usually with separate paragraphs for individual studies or localities. For each study, we state the location of the study, the sample size, and notes relating to aspects that may affect the analysis or presentation of the data, such as years or seasons in which data were colected, or whether birds were breeding or not.

These paragraphs contain detailed descriptions of the diet induding complete lists of food types eaten with whatever measures of quantity are available. Such data is undeniably dificult to read but to present it in less detail would severely limit its utility. Methods of describing the relative importance of types of food, each of which has both flaws and merits, indude the percentage of the total weight (wet or dry), percentage of the total volume, percentage of the number of food items or the percentage frequency of occurrence. Occasionally these measures have been combined into some form of index or presented as raw quantities but, wherever possible, the data has been re-analyzed into one of the four measures listed above. Analyses are prone to numerous forms of bias, such as differential rates of digestion, post-mortem breakdown, secondary ingestion (where stomach contents of the prey species are mixed with those of the bird) or incomplete sampling (particularly with regurgitation). These should be borne in mind when interpreting the results. Where possible precedence has been given to those analyses most likely to reflect the true intake (oesophageal over gizzard samples, multiple-flushed regurgitations over single-flushed regurgitations). It is also worth noting that records of food of adults during breeding periods may include food for young that is not consumed by adults themselves.

Following discussion of detailed studies, if any, we then list, with references, anecdotal records of foods eaten. The paragraph is headed either **Other records** or, where there are no preceding detailed studies of diet, the paragraph starts with the comment 'No detailed studies'.

Feeding and diet of **Young** are then discussed separately, though details of roles of parents and any helpers in feeding young or frequency of feeding are usually left to the Social Behaviour or Breeding sections. As with adult data, any detailed studies are discussed first, followed by anecdotal records.

The last paragraph, **Intake**, discusses dietary physiology, including daily intake of food, and size and nutritional or calorific values of food-items, when information on these aspects of diet have been published.

When summarizing the results of detailed studies or listings of other records, the main breakdown of items, with headings used only as needed, is: **Algae**, **Fungi**, **Plants**, **Animals** and **Other matter** (which lists non-food items, such as grit, plastics and so on). Under **Plants**, three main subsections are used—GYMNOSPERMS, MONOCOTYLEDONS and DICOTYLEDONS; under **Animals**, the main subsections are the major phyla, except for the Arthropoda, where the major classes are used as the main subsections. Below these subsection headings, families, and genera and species within families, are listed in alphabetical order. Note that for nectar-feeding species, anecdotal records of food eaten often do not specify the actual items eaten when birds are foraging at flowers. Throughout this volume, we have assumed that the food taken is nectar when references report feeding 'at flowers' or 'in flowers', though obviously the birds may be taking other food-items, such as insects. This problem is not confined to anecdotal observations, but detailed studies usually specify assumptions made. Throughout the series, flowers are not considered a food item unless a references clearly states that the flower was eaten.

In the HANZAB region, several non-nectar souces of carbohydrate are important sources of food for many groups of birds (e.g. honeyeaters [Meliphagidae]). They include(from Paton 1980): HONEYDEW, which is the sugary secretions of nymphal stages of psyllids (Psyllidae), aphids (Aphididae) and coccids (Coccidae); it consists of small polysaccharides with some glucose, fructose or sucrose and almost no protein; it can solidify. MANNA, which is the sugary fluid that exudes from damaged plant material (e.g. from insect attacks) and later crystallizes; it consists of c. 60% sugar, 16% water, some ash and 20% pectin and uronic acids. LERP, which is the protective covering produced by many Aust. psyllids, and is mostly carbohydrate.

Describing search and attack behaviours Remsen & Robinson (1990) present a classification scheme for the foraging behaviour of non-raptorial landbirds, discussing search behaviour, attack behaviour, foraging site, food taken and food-handling behaviour. This scheme is particularly useful for descriptions of attack behaviour and we have, as far as possible, standardized our descriptions using the terminology and definitions of Remsen & Robinson (1990; see below). However, it is not possible to categorize simply all forms of search behaviours used by landbirds, and there is considerable overlap between search and attack behaviour (see Remsen & Robinson 1990). In contrast, search behaviour is more readily categorized for some groups, such as the Falconiformes (see *HANZAB* 2 and below). Search behaviour is said to end once food or food-hiding substrates have been sighted and attacked. Variables of search behaviour that can be measured include: distance covered per unit time; number of stops per unit time; and number of attacks, including number of attacks per unit time. Birds can move between foraging sites by walking, hopping, jumping, leaping, running, climbing, gliding, fluttering or flying.

ATTACK BEHAVIOUR: (1) GLEAN: Pick food items from nearby substrates (including ground) that can be reached without full extension of legs or neck. (2) REACH: Completely extend legs or neck upward (Reach-up), outward (Reach-out) or downward (Reach-down) to reach food. (3) HANG: Use legs or toes to suspend body below feet to reach food that cannot be reached from any other perched position; includes: Hang-Up, Hang-Down, Hang-Sideways and Hang-upsidedown. (4) LUNGE: Manoeuvres that use rapid movements of legs rather than flight to approach and capture prey beyond range of attack by Reaching. (5) PROBE: Insert bill into cracks or holes in firm substrate to capture hidden prey. (6) GAPE: Insert bill into substrate as in Probe, but open bill to widen opening. (7) PULL: Grasp, pull or tear with bill, removing sections of substrate. (8) SCRATCH: Dislodge section of substrate with feet; mainly used by ground-foraging birds. (9) SALLY (includes snatch, hawk, hover-glean, hover, pounce of much literature): Fly from perch to attack a food item on any substrate, eventually returning to same or another perch. Sallying divided into: (A) *SALLY-STRIKE*: Attack in a fluid movement without gliding, hovering or landing, and aimed either at flying prey or stationary substrates. (B) *SALLY-HOVER*: Like sally-strike except that bird hovers at the target substrate at end of sally. (C) *SALLY-POUNCE*: Bird lands briefly at end of sally to take food from substrate; food either taken back to perch or eaten on the spot. (10) SCREEN: Attack in continuous flight. (11) FLUTTER-CHASE: Bird accidentally flushes or dislodges prey from a substrate and then chases prey. (12) FLUSH-PURSUE: Similar to Flutter-chase except bird uses manouevre deliberately to flush prey from hiding places and then pursues flying or falling prey.

For standard sources used for nomenclature for plants and animals, see Taxonomy and Nomenclature above.

Abbreviations Some special abbreviations are used in the detailed descriptions of food; these are listed on pages 45–46.

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SOCIAL ORGANIZATION AND BEHAVIOUR The aim of the two sections is to summarize observations and studies on: (1) the main characteristics of society, including types of associations and spatial separation between individuals or groups of birds (Social Organization); and (2) mutual interactions between individuals (Social Behaviour). The accounts are largely factual but interpretative comments have sometimes been included; often the information presented is purely descriptive. When possible, the material has been prepared in consultation with ornithologists having special knowledge of the species concerned. By presenting the facts, the accounts will provide a source for use in future analyses of the behaviour of the species and taxa. When possible, the accounts have been standardized and follow the style given below but some flexibility has been maintained to accommodate details on some species. When very little is known on a species, the two sections may be amalgamated.

SOCIAL ORGANIZATION This concentrates on the relations between individuals or larger assemblages of birds, and their dispersion within their habitat. For general reviews of this topic, see Lack (1968), Wynne-Edwards (1962), Crook (1965, 1970), McKinney (1973), Wilson (1975) and Matthysen (1993). We begin by giving an impression of the social grouping typical of the species, i.e. gregarious (in family parties, flocks), occurring in pairs, or solitary. The rest of the paragraph summarizes seasonal changes from the typical pattern, particularly changes from breeding to non-breeding season, and gives details of flocks, i.e. size and composition (of different sexes and ages). The account then proceeds under three main subheadings (usually in separate paragraphs): **Bonds**, **Breeding dispersion** and **Roosting**.

Bonds The type of mating system (the social organization of the breeding unit, especially relating to copulation and breeding cycle) is presented in terms of pair-bonds between individuals, and the share of parental care taken by birds involved in breeding. Unless stated, we are reporting the SOCIAL BOND, which is defined in relation to pairing and not necessarily in relation to the biological parenting of offspring (see below). Pair-bonds are normally heterosexual; although homosexuality is common in captive birds, it is rare in the wild (but see, for example, Silver Gull *Larus novaehollandiae*, in *HANZAB* 3). In general, pair-bonds have been classified as: (1) monogamous; (2) polygamous, which itself can be further classified as (2a) polygynous or (2b) polyandrous; or, (3) when no true pair-bond is established, promiscuous. Within a species these mating systems are not always mutually exclusive. (1) MONOGAMY is the most common system in birds and often involves joint care of the young. The bond between a single male and female can be: SEASONAL, being for all or part of one breeding cycle, a new partner being obtained next cycle; SUSTAINED or LONG-TERM, where the bond is kept for a longer period, with or without breaking the association during the non-breeding period; and LIFE-LONG, where the bond is maintained until the death or disappearance of a partner. Other than in seasonal monogamy, a pair is said to DIVORCE if one member pairs with a new mate when their old mate is known to be alive (Richdale 1951). (2) The general term for pairing with two or more individuals is POLYGAMY. (2a) In POLYGYNY, during one breeding cycle a male typically bonds with two or more females, each female often caring for her own brood without any help from the male. (2b) The least common system is POLYANDRY where, during one breeding cycle, a female bonds with two or more males, each male usually caring for his own brood without help from the female. Polygyny and polyandry may be either SIMULTANEOUS or SUCCESSIVE (SERIAL). In polyandrous species, the female often plays the leading part in advertising and courtship and may also be the larger and brighter sex. Some polygamous species form HAREMS where a male and a group of females (MATE-DEFENCE POLYGYNY) or a female and group of males (MATE-DEFENCE POLYANDRY) associate together. Others form LEKS where males (MALE-DOMINANCE POLYGYNY) and occasionally females (FEMALE-ACCESS POLYANDRY) display and are visited by the opposite sex solely for copulation. (3) PROMISCUITY is when birds pair only for mating. It may be the only type of sexual relation in a species, or it may be an additional feature to one of the mating systems listed above, e.g. individuals maintain stable pair-bonds with their mates while having promiscuous matings with other individuals of the opposite sex. Promiscuity may be SPECIES-CHARACTERISTIC (frequent and widespread) or CASUAL (only occasionally seen). In the past, monogamy was accepted as the predominant mating system in birds, appearing to occur in *c.* 90% of species (Lack 1968). Genetic studies have since shown this to be often untrue. Many birds, such as the fairy-wrens *Malurus* (this volume) have a monogamous social system, where there is social pair-bond between a primary male (often called the breeding male) and a breeding female, but have a promiscuous mating system, with many extra-pair copulations taking place (Rowley & Russell 1997; see accounts this volume). For reviews on sexual selection, see Emlen & Oring (1977), Andersson (1994), Ryan (1997) and Wagner (1998). The occurrence of MATE-GUARDING is often given in this paragraph; it is the defence of a female by her mate, most likely to prevent insemination of the female by other males, though other functions have been suggested (see Samson 1976); for reviews, see Mock (1983) and Birkhead *et al.* (1987). We then present information, if any, on the stage in the annual cycle when pair-formation starts and ends. After discussing pair-bonds, we discuss SEX-RATIOS in population and any differences with age or over time; and AGE OF FIRST PAIRING and of FIRST BREEDING. Then follows a discussion of **Co-operative breeding** in those species that breed co-operatively (which may include discussions of the previous two points). Co-operative breeding species are characterized by the involvement of individuals other than the breeding pair. Typically, young adults that are old enough to disperse and breed independently delay dispersal and stay with their natal group as helpers or auxiliaries, for months or years, assisting the breeding pair in the care of young and territorial defence (Skutch 1961; Rowley 1965, 1981; Brown 1978; Woolfenden & Fitzpatrick 1984; Rowley & Russell 1997). A pair and their helpers usually form a social unit that stay together year-round on a territory (Rowley & Russell 1997). Often in co-operatively breeding groups only one female lays (SINGULAR BREEDING) but sometimes two females in a group maintain separate nests (PLURAL BREEDING) (Brown 1987). (While the term communal breeding is sometimes considered synonymous with co-operative breeding, it is sometimes restricted to groups in which two or more females lay in the same territory [plural breeding], whether in one or several nests, and assist each other to rear their broods [Skutch 1987]). Most arguments regarding the occurrence of co-operative breeding focus on the

idea that the helpers are in some way related to the offspring they help rear, or that they gain some other benefit for themselves, such as breeding experience, access to mates or territories, or improved survival through protection from predators. To analyze how helping behaviour is affected by kinship, DNA fingerprinting is now often used. For some discussions on the possible benefits of co-operative breeding, see Woolfenden & Fitzpatrick (1984), Jamieson & Craig (1987), Emlen (1991), Clarke (1995), Dunn *et al.* (1995) and Rowley & Russell (1997). There are a large number of co-operatively breeding species in Aust., with co-operative breeding recorded in at least 85 species, of which 74 are passerines (Rowley & Russell 1997). There are various ideas as to why co-operative breeding is so common in Aust. (e.g. Rowley 1968, 1976; Dow 1980; Ford *et al.* 1988; Russell 1989; Russell & Rowley 1993; Cockburn 1996; Rowley & Russell 1997). In the species accounts, a summary is given of data on co-operative breeding, including an outline of contributions by individuals of the breeding group to the breeding attempt. The details of rates of contributions by individuals are usually given in Breeding or Food. Towards the end of this paragraph we usually summarize the roles of parents in the breeding attempt, sometimes under the heading **Parental care** if there is much information that relates to social organization. However, in an attempt to reduce overlap between sections, often all details are now only presented in the Breeding section, with additional information to be found in Social Behaviour (Relations within family group). For the same reason, information on the timing of independence of young, which often indicates the breakdown in bonds between parents and offspring, is also given in Breeding. Finally, this paragraph discusses dispersal of young from, and philopatry to, natal areas, as they are often implicated in discussions on social organization, particularly co-operative breeding (e.g. Emlen 1982, 1991; Greenwood & Harvey 1982; Brown 1987; Pruett-Jones & Lewis 1990; Stacey & Ligon 1991; Koenig *et al.* 1992); dependence of young and length of times families stay together are discussed, though descriptions of behaviours between adults and young, including behaviour associated with parents losing interest in or repelling their young are usually given under Relations within family groups (in Social Behaviour). The discussion of dispersal of young here often needs to be read in conjunction with the Movements section and, occasionally, it is more appropriate to place the whole discussion in Breeding dispersion (in Social Organization) or in the Movements section. Associations outside family group, such as crèching, are also given in this paragraph.

Breeding dispersion This paragraph mainly focuses on distances between active nests or breeding birds, but information on all types of territories and dispersion is included. Species are usually classed as solitary or colonial nesters, though sometimes a species may adopt either strategy. Any details, if known, are given on distances between nests. A species may also be territorial, non-territorial or both (depending on time of year, habitat, etc.). A TERRITORY is often defined as any defended area (Noble 1939; Hinde 1956; Brown & Orians 1970; but see Emlen 1957), occupied exclusively by a single bird, pair or larger social unit. It is usually, but not always, fixed in space, has clearly defined boundaries, and ownership is proclaimed with distinctive behavioural displays and vocalizations (Davies 1980). Different types of territories have been classified (see Hinde 1956). Details of territories are given in this paragraph, including size, important characteristics of habitat, seasonal changes and activities restricted to territories. The term territories is often used loosely or uncritically by researchers (for examples, see Pyke *et al.* 1996); others use alternative terms, such as **exclusive home-ranges**, that imply that it is not known if the area is defended or not. Where practical, we use whatever term a researcher has applied. Many studies of territories relate to breeding territories, but some groups, such as the honeyeaters (Meliphagidae; see Pyke *et al.* [1996]), often form FEEDING TERRITORIES and these are also discussed here. In many species, feeding territories and HIERARCHIES are closely related and both are important to the discussion on social organization. Thus, details of hierarchies are often given here, though for some species (and in previous volumes) they were discussed in Social Behaviour under the heading Social dominance. Hierarchies noted for captive birds should be treated cautiously as they may only arise in conditions of artificial crowding. Territories and hierarchies often relate to birds within a species, but limitations in some resources can mean that other species are involved in forming INTERSPECIFIC DOMINANCE HIERARCHIES or defend species from other species. Finally, if known, data are given on home-range, which is the area in which individuals, pairs or groups of birds are active. For information on functional categories of territories, such as feeding territories, breeding territories, and for some further background, see Lack & Lack (1933), Nice (1941), Hinde (1956), Tinbergen (1957), Davies (1978), Davies & Houston (1984), Carpenter (1987) and Pyke *et al.* (1996). Size of territories may be influenced by population density (Krebs 1971; Myers *et al.* 1979), abundance of food (Franzblau & Collins 1980) and habitat structure (Smith & Shugart 1987). It should be noted that descriptions of the actual behaviours related to advertising and defending territories are usually found in Social Behaviour.

Roosting This deals with the pattern of roosting (sleeping) and loafing (comfort behaviour, e.g. resting, preening) of a species. Birds may roost or loaf solitarily or communally; and nocturnally or diurnally. We then summarize: sites (e.g. protected, unprotected, traditional, temporary), seasonal changes, times of arrival and departure from roosts, and other factors known to affect patterns (e.g. tidal regime in birds using littoral habitats for feeding). For reviews of functions of communal roosts, see Amlaner & Ball (1983), Weatherhead (1983, 1987) Ydenberg & Prins (1984) and Zahavi (1996).

SOCIAL BEHAVIOUR This section is largely confined to describing the actual behaviours that occur in interactions between individuals of a species. Causal analyses of motivational factors involved in displays have generally been considered to be beyond the scope of this work. For some general references on social signals and behaviours in birds, see Tinbergen (1964), Krebs & Dawkins (1984), Brown (1994), Johnstone (1997), and Duttmann *et al.* (1998). Usually the material has been divided into three main categories (ordinarily presented as three paragraphs): **Agonistic behaviour**, **Sexual behaviour** and **Relations within family group**. Behaviours are usually only designated as agonistic or sexual if the sources of the information have stated thus. When the function of any behaviour or display is not known and cannot be classified sensibly as either agonistic or sexual behaviour, then it is usually placed in the first paragraph of the account. In some behaviours where there is overlapping function, then the behaviour is usually placed in the category to which it seems most relevant, and a cross-reference made in the other category. Advertising displays are examples of behaviour that can be agonistic (communicating with rivals), sexual (communicating with a mate) or

both, and sometimes cannot validly be attributed to either. In general, much emphasis has been given to describing visual displays, these being loosely defined as movements that have become specialized (ritualized) signals in social communication (see, for example, Daanje 1950; Tinbergen 1952; Morris 1956; McKinney 1965; Smith 1978; Krebs & Dawkins 1984; Johnstone 1997). Because they are more easily made, many observations of displays and behaviour are made on birds in captivity. In the accounts we have tried to keep observations made in the wild and those made in captivity separate. Some attention is paid to calls and other auditory signals, particularly in the passerine volumes, but usually these are dealt with in the Voice section (the capitalized names of vocalizations in Social Behaviour indicate that some description of the sound and its use will be found in Voice). Names of displays follow those given in the major references and are customarily given initial capital letters. Use of the same or similar names for displays in different species does not imply homology. Equally, studies of related species by different researchers have often used different names for what appear to be identical displays with identical functions. The following outline for the account was adhered to when possible but sometimes it has been inappropriate to present the material in this manner.

The introductory paragraph first gives an idea of how well the species has been studied, and lists the major studies, and where they were conducted, on which the account is based. Often references are given only at this point to allow for easier reading by avoiding continual repetition. Thus, the reader can assume that all the material has been extracted from these initial references, or that material from a particular locality has been extracted from the identified source. This is followed by comments on the ease of observing, and the conspicuousness of, displays. Sometimes the heading **Flock behaviour** is used to describe behaviours that serve to integrate members of flocks, e.g. flight-intention signals or use of contact calls by feeding flocks. We then give any particular behavioural attributes that are not covered in the three main categories mentioned above. Lastly, comfort behaviour is summarized, covering mainly preening and bathing of groups or individuals, as well as thermoregulatory behaviour when not breeding.

Agonistic behaviour This section concentrates on behaviour associated with conflict, centring on displays and observations related to threat, attack and defence over food, nesting and roosting sites, and mates. This paragraph deals mainly with aggression within a species. It firstly describes behaviour related to TERRITORIAL ADVERTISING (communicating with rivals), then is followed by the escalation of aggression from threat to fighting, including any appeasement displays to avoid attack or submissive displays during attack. When **threatening**, an individual repels or intimidates an opponent without actually fighting. **Fighting** is used here to denote physical contact between birds; it is rarely used by birds as it carries risks of exhaustion, injury or death, but it is often described as it is conspicuous. **Appeasement** and **submissive displays** serve to reduce the aggressiveness of the birds to which the displays are directed. Details are then given on **escape behaviour** and **triumph ceremonies**. Ceremony is the usual term for mutual displays between paired birds, a **triumph ceremony** being one which follows a successful aggressive encounter. In the passerines, **Social dominance** is often dealt with in territories in Social Organization, though descriptions of social signals remain here. Usually, after dealing with conspecific conflict, any interesting descriptions of behaviours given during interspecific conflict are noted. The paragraph finishes with **Alarm** where descriptions are given of responses to predators, such as mobbing, which are not associated with nesting or rearing young (i.e. mainly outside breeding season). Responses during a breeding attempt are covered in the paragraph Relations within family group. For many records it is not clear whether nests or eggs are present, and these observations are usually placed under Alarm. For more background information on aggression, see Maynard Smith (1979).

Sexual behaviour Signal patterns are most explicit between mates or potential mates during pairing and breeding. This category describes interactions between birds, usually of the opposite sex, during these times. When a number of birds gather to display, it is termed communal. Many of the displays of pair-formation or pair-bond maintenance reduce aggressiveness between partners or potential partners. The term **courtship** has been used broadly to mean behaviour between the sexes at, or before, the onset of breeding, including that between established pairs or individuals attempting to form pairs. When possible, it is presented more specifically under the headings of Advertising, Pair-formation, Courtship feeding, Greeting and Allopreening, discussing where and when each of these activities occurs. **Advertising displays** are placed here if it is thought they are more sexual in function than they are advertising by rival birds. In **Pair-formation**, where there are complex behavioural features, special headings are sometimes needed. **Greeting** displays are observed when members of a pair meet after temporary separation and are often associated with change-over at the nest. Such displays are often seen in colonially nesting birds. Also mentioned is any special type of searching behaviour performed if a pair loses contact. Sometimes, displays between pairs seem unrelated to courtship and are more extensive than greeting displays, and we have used the heading **Pair-bond maintenance**. **Courtship feeding** is taken to be the feeding of one member of an adult pair by the other. It is often associated with copulation and laying but sometimes continues after this, and in some species seems to have no relationship to copulation at all (Campbell & Lack 1985; also see, for example, Lack 1940, and Krebs 1970). The degree to which this activity is ritualized can vary and in extreme cases no food is actually passed between birds. **Allopreening** (Cullen 1963) may or may not be ritualized and may be performed by the pair simultaneously, reciprocally or unilaterally. **Copulation** is usually the final topic covered and includes details on behaviour before and after copulation, and speed, frequency and conspicuousness of copulation. Any revival of sexual activity outside the breeding season is also given at this point. The term mating is often found in the literature; often it is clear that the author means copulation but at other times exactly what has taken place is not known and such observations are usually omitted.

Relations within family group This section outlines the social behaviour of young within the family, the social development of young and interactions between young and their parents. Sometimes it includes social aspects between members of a pair that are related to feeding and caring for nestlings and fledgelings that have not been covered above (in some instances overlaps with material in the Breeding section). The main intention, however, is to describe behaviour associated with feeding of young and aspects of communication between adults and young, and between siblings. Alarm responses of young have been given under the heading **Anti-predator responses of young**. Alarm responses of adults associated with nesting and rearing young have been placed under the heading **Parental anti-predator strategies**.

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VOICE There have been no changes to the scope or arrangement of this section.

For this volume, sonagrams were made, where suitable recordings were available, using an Apple Macintosh computer. Sounds were digitized at 16-bit resolution and edited using SoundEdit software (Macromedia Inc.). Irrelevant intrusions and background noises were, as far as possible, removed. Sonagrams were made using Canary 1.2.4 software (Bioacoustics Res. Prog., Cornell Lab. Orn.). The analysis used a Hamming window function, a filter bandwidth of c. 350 Hz, smooth display style, 50% overlap and 256 point FFT size. Sonagrams were sent in electronic form (as PICT files) to the publisher. Each sonagram is shown with an overlay, with time on the horizontal scale and frequency on the vertical scale. The amplitude (loudness) of a sound is shown by the darkness of the tracing.

To permit reference to the actual sound used to make a sonagram, published recordings have been used as much as possible, particularly those from the compilations attempting to cover all species in the HANZAB region (Buckingham & Jackson for Aust.; McPherson for NZ). Recordings from the sound library of the Australian National Wildlife Collection, CSIRO Division of Wildlife and Ecology, Canberra, have been used to complete the coverage; in particular we have made much use of the large collection contributed by D.A. Stewart. The caption to each sonagram lists the recordist, place and date of the recording, and the source of the recording. If the source is a number prefixed by the letter 'P' then the source is a published recording and is listed below.

Sonagrams show 2.5 s, 5 s, or 10 s of sound; there is also one sonagram that shows 198 s of the Sequential Song of the Albert Lyrebird. The vertical frequency scale does not change, regardless of the length of time shown, so that slopes of ascending and descending calls will appear steeper in sonagrams showing shorter durations of sound. Reader beware! For species with

calls of very high frequency (e.g. for the Acanthisittidae, Maluridae, and Stitchbird *Notiomystis cincta*) the vertical (frequency) scale extends to 16 kHz.

We wish to pay tribute to the completion of *A Field Guide to Australian Birdsong*, a major project on the vocalizations of Aust. birds, to which many sound recordists have contributed, and which was compiled over two decades by R. Buckingham and L. Jackson for the Bird Observers Club of Australia. Unfortunately R. Buckingham died in July 1999, a few months before publication of the last of the 12 cassettes. The series has been of great value in preparing all volumes to date, and its sounds have been the source of most of the sonagrams.

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P11 —— 1978. *Australian Bird Calls. Series 2.* Author, Balingup, WA.

P28 van Gessel, F.W. No date [c. 1984]. *Bird Calls of the Hunter Region. 1 (Tape 1). Bushbirds.* Author, Aust.

P38 —— No date [c. 1987]. *Bird Calls of the Hunter Region. 1 (Tape 2). Honeyeaters.* Author, Aust.

P48 Buckingham, R., & L. Jackson. 1991. *A Field Guide to Australian Birdsong. 6. Eastern Grass Owl to Ground Cuckoo-shrike.* Bird Obs. Club Aust., Melbourne.

P73 ——, —— 1994. *A Field Guide to Australian Birdsong. 9. Chestnut-crowned Babbler to Redthroat.* Bird Obs. Club Aust., Melbourne.

P75 ——, —— 1995. *A Field Guide to Australian Birdsong. 10. Calamanthus to Noisy Friarbird.* Bird Obs. Club Aust., Melbourne.

P90 ——, —— 1997. *A Field Guide to Australian Birdsong. 11. Little Friarbird to Scarlet Honeyeater.* Bird Obs. Club Aust., Melbourne.

P94 ——, —— 1999. *A Field Guide to Australian Birdsong. 12. Crimson Chat to Torresian Crow and supplementary calls.* Bird Obs. Club Aust., Melbourne.

P100 NZ Wildlife Service. 1980. *Birds of New Zealand: 38 Forest and Sea Birds.* Viking Music Cassette VP445C. NZ Dept Internal Affairs.

P106 McPherson, L.B. 1990. *New Zealand Birds: A Sound Guide. 6.* Author, Christchurch.

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BREEDING

Arrangement essentially follows that of previous volumes with no major changes. There are a few points we wish to reiterate.

Young In this paragraph, we use the following terms to describe the state of young at hatching (altricial, semi-altricial or precocial) and subsequent behaviour (nidicolous, semi-nidicolous or nidifugous) (from Campbell & Lack 1985):

ALTRICIAL: Hatch with little or no down, with eyes closed; young unable to leave nest and are fed by parents.

SEMI-ALTRICIAL: At hatching, covered in down and eyes are open or closed; young unable to leave nest and are fed by parents.

PRECOCIAL: Hatch covered in down and with eyes open; young leave nest on first or second day and usually follow parents but find own food.

SEMI-PRECOCIAL: Hatch covered in down and with eyes open; young unable to leave nest and are fed by parents.

NIDICOLOUS: Young remain in nest after hatching.

NIDIFUGOUS: Young leave nest immediately, or soon after, hatching.

Fledging to independence This paragraph was previously labelled Fledging to maturity but was changed from Volume 4 on because maturity is not easily defined. Independence, as we use the term, refers to the stage at which a fledgeling is no longer dependent on its parents or parent for food or protection or both and, while not always exact, is often better known than time of maturity. Age of first breeding is now given in Social Organization (in Bonds). FLEDGING and FLEDGING PERIOD: There is much confusion in the literature concerning the term 'fledging'. Some authors define it as when a birds first leaves the nest; others, when a bird leaves the nest permanently; others still, when a birds first flies. Often, what individual authors intend or mean is not at all clear. We define fledging as when a young bird first leaves the nest; a fledgeling as a young bird that has left the nest at least once; and fledging period as the time from hatching till a bird first leaves the nest. All definitions have to deal with the problem of premature fledging, such as in alarm or other circumstances or when a bird leaves the nest, often for increasing periods of time, but returns to it in between. The advantage of the definitions adopted is that it is not necessary to determine subjectively what the first flight may be, or determine what constitutes permanent departure from the nest.

Success This was calculated for nests where clutch-size, number of eggs hatched and number of young fledged was certain. Nests that failed during laying were included in calculations of egg (hatching) success. Success was not calculated for nests where young were seen in the nest close to fledging but no fledged young could be found.

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PLUMAGES AND RELATED MATTERS

These sections aim to describe the external morphology of each species, and to allocate sources of variation in morphology to sex, age, geographical variation or other sources, such as plumage morphs or wear. There are seven main sections: Plumages, Bare Parts, Moults, Measurements, Weights, Structure and Geographical Variation; three other sections, on Ageing, Sexing and Recognition, are sometimes included. All feathered parts are described in the section on Plumages; the rest of the integument is described in the section Bare Parts. Usually only one subspecies is described in Plumages, with others covered in the section Geographical Variation. However, where subspecies are very different, more than one can be described under Plumages and Bare Parts.

We have not made great changes to our approach to this section from previous volumes. However, there have been a number of changes over time and we have taken the opportunity at the start of the passerine volumes to repeat the introduction to these sections and revise the black-and-white illustrations of plumages and bare parts with examples more appropriate to the passerines.

These sections are primarily based on examination of material within the collections of museums in Aust., NZ and, less often, elsewhere. For each species, the editor or editors responsible for compiling these sections is given at the start of the Plumages section.

Nomenclature of plumages and moults Two terminologies for moults and plumages are widely used. That introduced by Dwight (1900) and slight modifications of it were used in BWP and are in general use in the Old World. The terms used in this scheme will be familiar to most readers, especially in A'asia, and are often more readily applied to bare parts, but they can often be misleading, or imply relationships between specific plumages and moults with maturity or breeding, which have not been established or, in some cases, do not exist (see below).

The scheme of moult and plumage nomenclature developed by Humphrey & Parkes (1959, 1963; also see below) has

a strong following in North America and is more precise and usually less likely to be misleading. A conceptual advantage of using the Humphrey & Parkes system of moult and plumage nomenclature is that it encourages critical thought about homologies of moults in related species and which feathers are replaced in a particular moult (or, more often, to which moult replacement of specific feathers should be assigned). This is not always easy to establish, even in species in which moults have been studied in detail; see, for example, published discussions of the correct terminology for moults of North American buntings (Rohwer *et al.* 1992; Willoughby 1992; Thompson & Leu 1994 and references therein).

In *HANZAB* we have used both systems: all plumages and moults are given names corresponding roughly with the role they play in the life-cycle, following the terminology used in BWP, followed by the Humphrey & Parkes nomenclature in brackets. Where needed, additional notes are also given.

Both schemes are broadly summarized in Table 1 and both are outlined more fully below. The conceptual differences between the two schemes are greater than the table implies; see Humphrey & Parkes (1959), Thompson & Leu (1994) and references therein for further information.

In the discussion below, we have interpreted a plumage as a single generation of feathers. A single generation of feathers may not include the entire feather covering of a bird; feathers attained by a partial moult also constitute a plumage. Wear of feathers or transitional stages from one plumage to another often affect appearance. Cases where we have felt it necessary to cover such variation under separate headings are always specified.

Under the BWP scheme, the **BREEDING PLUMAGE** is defined as that worn during part or all of the breeding season. In some species, the breeding plumage alternates regularly with a **NON-BREEDING PLUMAGE**, acquired during the post-breeding moult. In others, one plumage is worn throughout the cycle (see Glossary) and is termed **ADULT**. The first pennaceous plumage of a bird is called **JUVENILE** in all species, even in those in which it appears identical to adult plumage. In some species, juvenile plumage is followed by one or more recognizable immature plumages. These are called **FIRST IMMATURE, SECOND IMMATURE,** etc. in increasing order of age. If there are no other recognizable plumages, the juvenile plumage is said to be replaced by the first adult plumage.

The above nomenclature for plumages is easily understood, and is also popular because it 'links the various plumages with the phases in the life-cycle for which they have evolved' (BWP). However, this leads to cases in which the nomenclature is inappropriate. For example, the terms adult and immature suggest sexual maturity, or lack of it. This is clearly misleading in Procellariiformes, most of which have an 'adult' plumage for several years before they begin to breed. It is equally confusing in Golden Whistlers *Pachycephala pectoralis*, in which 'immature' males can breed in a plumage that resembles the adult female rather than the adult male. Further, in many species the above terminology implies a relation between plumages and breeding or development that has not actually been determined. Cases where BWP nomenclature seems open to misinterpretation are mentioned next to the plumage headings.

The nomenclature for moults and plumages introduced by Humphrey & Parkes (1959) has a terminology independent of other phases in the life-cycle. The scheme has also been described by Palmer (1962, 1972, 1988) and Wilds (1989). It is difficult to explain their scheme without mentioning their nomenclature for moult. They named moults by adding '-pre-' to the name of the plumage they produce.

Adult birds that have a single plumage per cycle almost invariably lose and renew their plumage in a complete moult. This is called the **BASIC PLUMAGE**; it is renewed in the **PRE-BASIC MOULT**. The pre-basic moult can also be recognized as a complete moult in adult birds that have two plumages per cycle. These birds have a separate moult, usually partial, termed the **PRE-ALTERNATE MOULT**. It results in an **ALTERNATE** plumage; birds in alternate plumage usually also have retained feathers (normally remiges and rectrices) from the basic plumage. A few

Table 1. Nomenclature of plumages and moults. Plumages are given in bold print, moults in italics. Square brackets denote moults or plumages that are absent in some species. Note that pre-supplemental moults may either follow or precede pre-alternate moults (Humphrey & Parkes 1959). Modified from Volume 1 of *HANZAB*.

CYCLE	BWP	Humphrey & Parkes	Notes
First	**Natal**	**Natal**	
	Pre-juvenile	*Pre-juvenile*	Complete
	Juvenile	**Juvenile**	Defined as first pennaceous feathering
	Post-juvenile	*First pre-basic*	Complete or partial
	First immature non-breeding	**First basic**	
	[First immature pre-breeding]	*[First pre-alternate]*	Usually partial
	[First immature breeding]	**[First alternate]**	
Second	*First immature post-breeding*	*Second pre-basic*	Complete
	Second immature non-breeding	**Second basic**	
	[Second immature pre-breeding]	*[Second pre-alternate]*	Usually partial
	[Second immature breeding]	**[Second alternate]**	
	.	.	
	.	.	
	.	.	
Definitive (Adult)	*Adult post-breeding*	*Definitive pre-basic*	Complete
	Adult non-breeding	**Definitive basic**	
	[Adult pre-breeding]	*[Definitive pre-alternate]*	Usually partial
	[Adult breeding]	**[Definitive alternate]**	
	.	.	
	.	.	
	.	.	
Other moults within a cycle	*[No standard terminology]*	*[Definitive pre-supplemental]*	Rare
	[No standard terminology]	**[Definitive supplemental]**	Rare

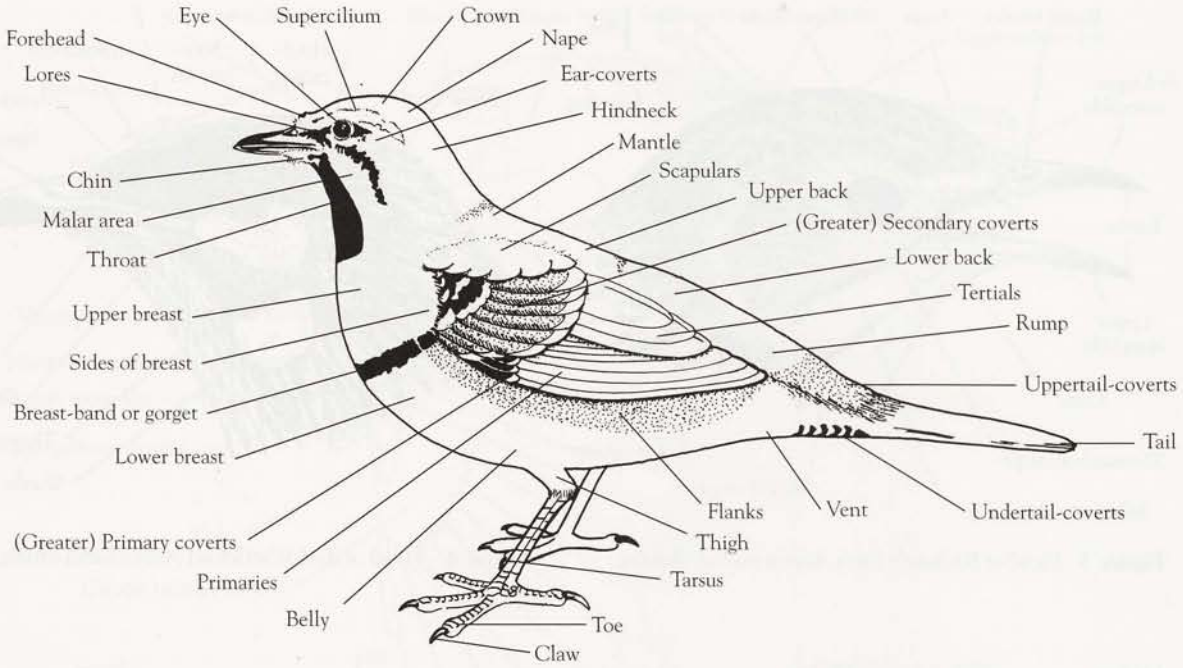

Figure 2 Cinnamon Quail-thrush *Cinclosoma cinnamomeum*

birds have more than two moults in a cycle. The plumage resulting from such an additional moult is called the SUPPLEMENTAL PLUMAGE. It may be worn before or after the alternate plumage.

As in the BWP scheme, the first pennaceous plumage is termed JUVENILE. It can be replaced in a complete moult, but more commonly there are stages of partial moult. The moult in which replacement of juvenile plumage begins must be termed pre-basic, whether it is complete or not, because it is the only moult that can be expected in the first cycle of all birds. In species which have identifiable age-classes for some time, it is convenient to qualify the names of the plumage stages with a numerical prefix. This results in such terms as FIRST BASIC PLUMAGE, FIRST PRE-BASIC MOULT, and so on. Humphrey & Parkes suggested that the term DEFINITIVE be applied to plumages that do not change appearance further with age.

Some aspects of Humphrey & Parkes' nomenclature have attracted strong criticism (Stresemann 1963; Amadon 1966), particularly the underlying assumption that the basic plumage is homologous across groups of bird. Even if this assumption is untrue, in many cases the nomenclature has advantages. Examples in which BWP terminology is misleading were mentioned above. There is no misinformation conveyed when an adult procellariform is termed definitive basic, or a breeding immature male Golden Whistler is said to be in its first basic plumage.

Humphrey & Parkes' nomenclature has not been applied to all plumages because in many cases it is difficult to use. Partial moults of body-feathers that produce no change in the appearance of a bird may be undetected in many species, yet strictly speaking the resultant plumage is alternate. Some birds (e.g. some grebes [Piersma 1988]) are in practically continuous moult of body. In large birds, moult of body is often prolonged or obscure. In such cases it can be impossible to identify plumages consisting of one generation of feathers.

Various calendar-age terminologies have been used to categorize age-classes (e.g. Anon. 1985; Rogers 1989). None seem comprehensive enough for consistent application to all birds in an area extending from the Antarctic to the Tropics. The calendar-age of a bird in a given plumage is usually made clear in the moult sections; sometimes additional information is given next to the plumage headings.

PLUMAGES This section opens with a summary paragraph that states the Handbook editor, or editors who prepared this and subsequent sections and describes the overall sequence of plumages and moults from nestling to definitive plumage as far as it is known. The descriptions that follow are based on museum skins unless otherwise stated. Unlike earlier volumes, we now state the number of skins of each sex and age that were examined in preparing the descriptions, and the museum collections from which they came. Where more than one subspecies is described separately in Plumages, the number of skins are given separately for each subspecies. If other sources of information (e.g. examination of live birds) form a major portion of the descriptions, they are also noted here; otherwise they are simply given in the text.

Plumages are normally dealt with in the sequence: adult breeding, adult non-breeding, nestling or downy young, juvenile and immatures. When plumages differ between the sexes, males are generally described first, within each of these categories. Within each age and sex described, plumages are described in the sequence head and neck, upperparts, underparts, uppertail, undertail, upperwing, and underwing. Within these topographical areas, we try and work from the front to the rear. In a few of the briefer descriptions, this sequence is modified to save space. Plumage areas are illustrated in the figures of topography. Some of the terms are defined in the glossary.

The appearance of tracts or topographical areas of the bird are described, with the appearance of individual feathers described as appropriate; individual feathers are frequently described for the wing and tail. Where individual feathers are not described, the description of the tract also applies to the

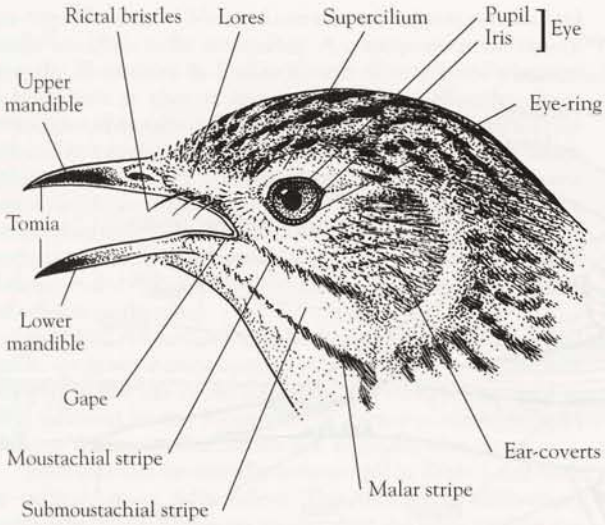

Figure 3 Head of Richard's Pipit *Anthus novaehollandiae*

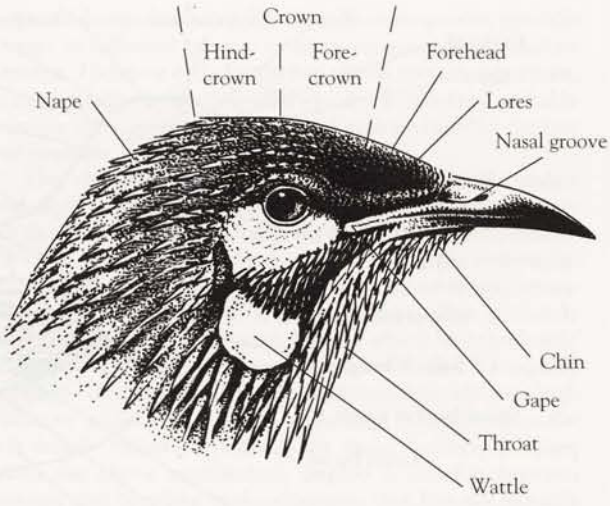

Figure 4 Head of Red Wattlebird *Anthochaera carunculata*

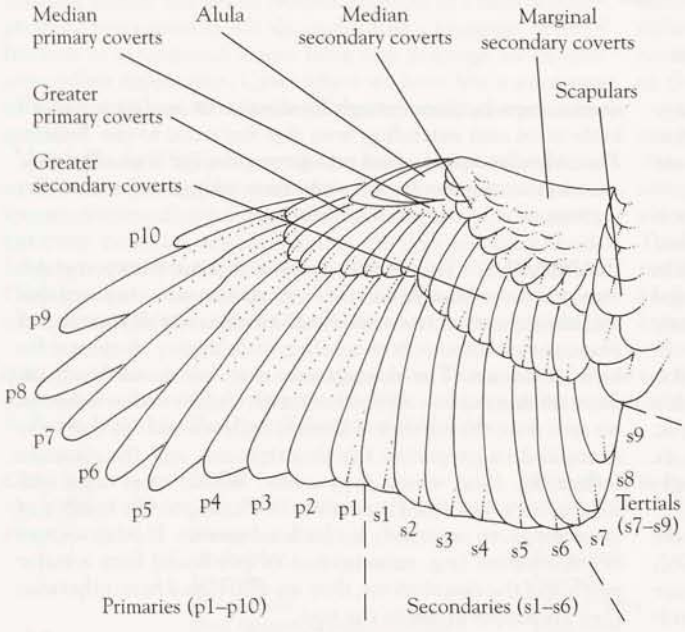

Figure 5 Upperwing of Olive-backed Oriole *Oriolus sagittatus*

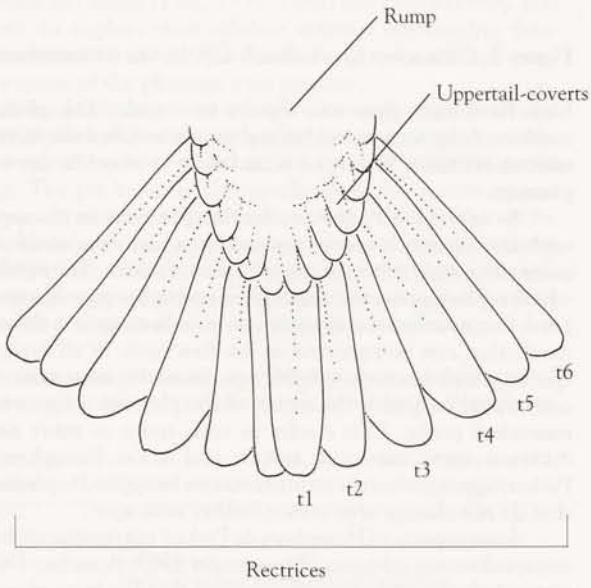

Figure 6 Uppertail of Olive-backed Oriole *Oriolus sagittatus*

feathers (e.g. if the mantle is described as black, it consists entirely of black feathers). Terms used to describe patterns of feathers are shown in the figures of topography.

The identity of colour perceived depends on the light in which it has been seen and how precisely it needs to be defined. The greatest problem is that different people perceive colours differently. We have observed all skins in diffuse natural light or under a daylight globe (Philips 60W Daylight). Colour names given are simple (e.g. dark brown) so that readers unfamiliar with more technical names (e.g. burnt umber) will not be misled. Wherever possible we have also used the F.B. Smithe *Naturalist's Color Guide* (Smithe 1975, 1981) in describing colours. The identification numbers for the closest equivalent from this guide are bracketed in the text, after the simple names of colours, e.g. dark brown (121). When the match is not particularly close the colour number is qualified, often with the abbreviation 'c', e.g. dark brown (c121). For colours that have no equivalent in the guide, we place (ne) in brackets after the colour descriptor. If we have not been able to compare colours with the guide and this is not clear from the context, we have denoted such colours (–). Where two colours are combined, the last-named colour is dominant (e.g. buff-yellow is more yellow than buff); sometimes the suffix 'ish' is added to a colour to denote a weaker tinge of that colour (e.g. buffish yellow has a weaker tinge of buff than buff-yellow). We have not used the names given to colours themselves in Smithe's

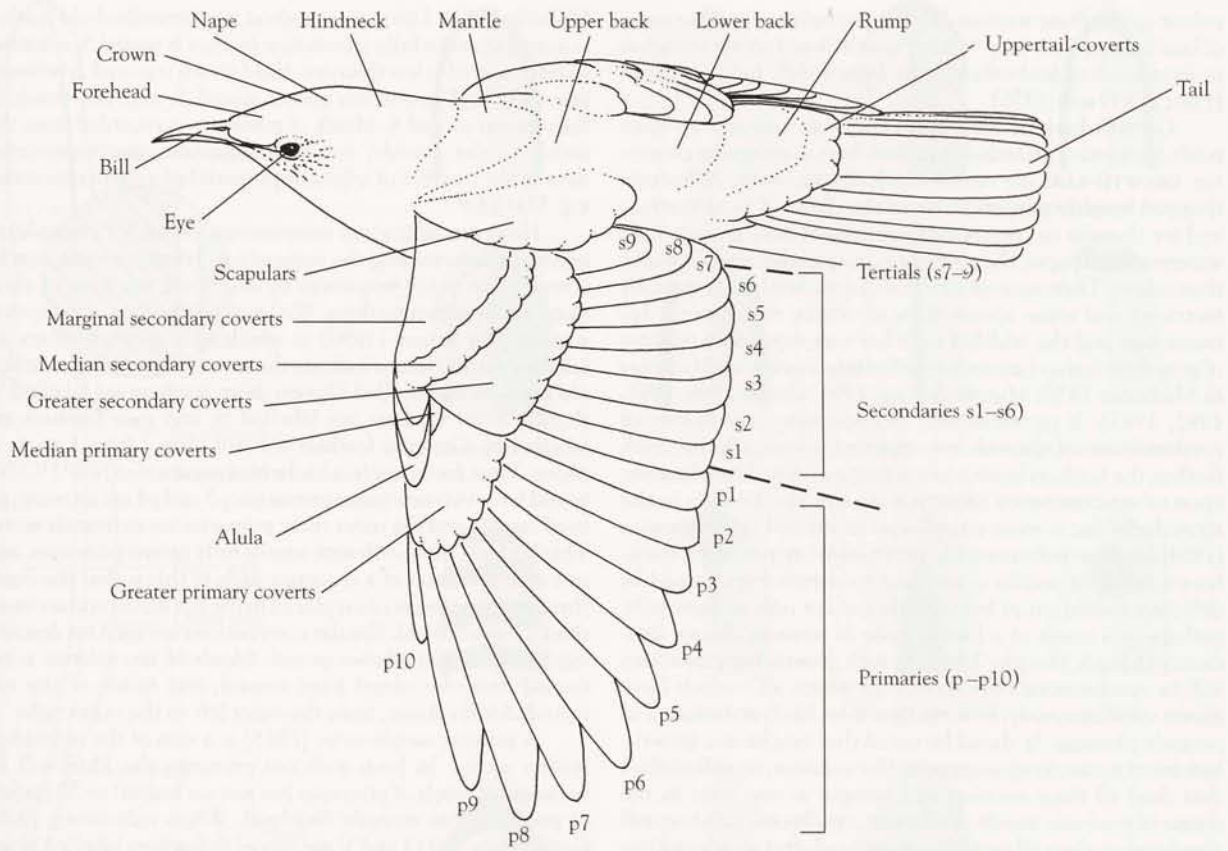

Figure 7 Dorsum of White-throated Treecreeper *Cormobates leucophaeus*

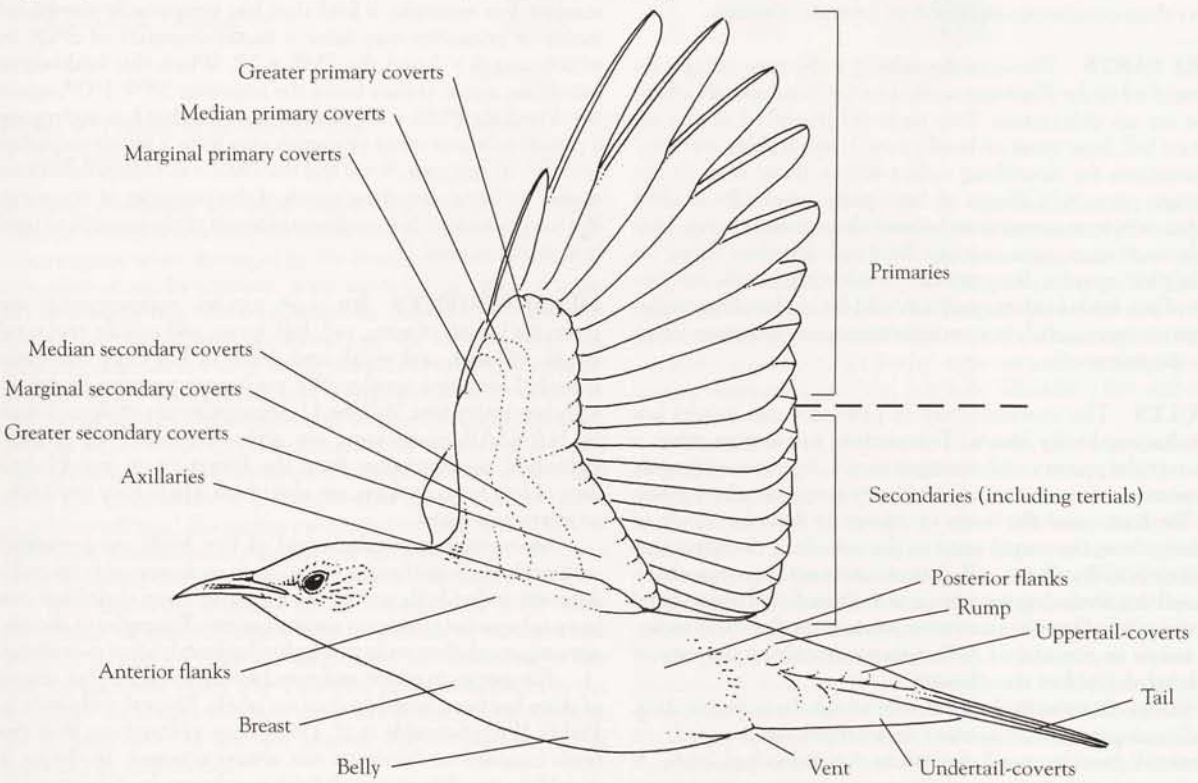

Figure 8 Underwing and underbody of White-throated Treecreeper *Cormobates leucophaeus*

colour-guide; these were used by Smithe only to convey a sense of familiarity. Many (e.g. 'Pratt's Payne's Gray') are meaningless to most readers, and others 'differ from widely held concepts' (Pratt & O'Neill 1976).

Growth-bars or fault-bars For some species, we have made mention of growth-bars or fault-bars as an ageing character. GROWTH-BARS are narrow bands of contrasting diffraction that run roughly perpendicular to the shafts of most feathers and are thought to correspond to periods of daily growth. Like watermarks in paper, they are more conspicuous at some angles than others. They are more obvious in some feathers (especially rectrices) and some species than in others; the distance between bars and the width of each bar vary depending on rates of growth and other factors (for further information see Michener & Michener 1938; Murphy & King 1991; Grubb 1989, 1991, 1992, 1995). If rectrices have characteristic growth-bars or combinations of growth-bars repeated identically on each feather, the feathers have grown simultaneously. This phenomenon of SYNCHRONOUS GROWTH-BARS can also be seen in the secondaries but is most conspicuous in the tail (see Svensson [1984] for more information). FAULT-BARS are narrower, translucent bands of similar orientation to growth-bars, caused by defective formation of barbules; they occur only occasionally, perhaps as a result of a brief episode of stress or dietary deficiency (King & Murphy 1984). As with growth-bars, fault-bars will be synchronous only in tracts in which all feathers have grown simultaneously; both are thus most likely to be found in juvenile plumage. It should be noted that synchronic growth-bars are of no use in ageing species (for instance, most Rallidae) that shed all their rectrices and remiges at one time in the course of pre-basic moult. In addition, synchronic tail-bars will also develop when all rectrices are replaced after accidental loss of the tail. Synchronic growth-bars are thus usually supportive rather than conclusive indicators of juvenile plumage.

BARE PARTS These are described for the same subspecies as described in the Plumages section, or for all subspecies where there are no differences. Bare parts are described in the sequence: bill, bare areas on head (if any), iris, and leg and foot. Conventions for describing colour follow those used in the Plumages section. Colours of bare parts cannot be studied satisfactorily in museum skins because they usually change after death, and often quite quickly. We have therefore relied on colour photographs, descriptions of freshly dead birds, descriptions of live birds (either caught in wild during banding studies or captive specimens), and on information on specimen labels or in the literature.

MOULTS The nomenclature of plumages and moults has been discussed fully above. This section summarizes what is known of the pattern and timing of moult. Sequences of moult of primaries, secondaries, tail and body are given where possible. We have used the term OUTWARD to describe moult of primaries from the carpal joint to the outside of the wing; this sequence has often been called descendant in the past; we have not used this confusing term because it is based on the out-dated practice of labelling the outermost primary the first (see discussion below in Structure). Other terms describing patterns of moult are defined in the glossary.

MOULT-SEQUENCES: In species for which there are few data, or unusual patterns of primary-moult have been noted, we sometimes provide moult-sequences for individual birds. A widespread method of recording moult-sequences is to score each feather on a scale from 0 to 5 (Ashmole 1962; Ginn & Melville 1983). Using this method, an unmoulted old feather is scored 0, and a fully grown new feather is scored 5; a feather in pin is scored 1; less than one-third grown is scored 2; between one-third and two-thirds grown scored 3; and two-thirds to fully grown scored 4. Moult of primaries is recorded from the inside to the outside; in moult-sequences, the superscripts denote the number of adjacent primaries of a particular score, e.g. $5^{4}4^{1}3^{1}O^{4}$.

However, additional information, useful, for example, in ageing or determining the sequence of primary-moult, can be conveyed in moult-sequences by describing the state of abrasion of fully grown feathers. We have adopted a scoring system suggested by Rogers (1990) in which fully grown feathers are labelled with letters to indicate the state of wear of each feather: old feathers are labelled O; very worn feathers are labelled V; slightly worn feathers are labelled S; and new feathers are labelled N. Growing feathers are still scored from 1 to 4, as above. Thus, for example, a bird with a sequence of $N^{2}4^{1}2^{1}O^{3}V^{3}$ would have two new inner primaries, p3 and p4 are growing, p5 to p7 are old and the outer three primaries are extremely worn. This bird has three different ages of fully grown primaries, and one interpretation of a sequence such as this is that the outer three primaries were not replaced in the last moult and are more than 12 months old. Similar conventions are used for describing moult of secondaries or tail. Moult of secondaries is recorded from the carpal joint inward, and moult of the tail recorded from above, from the outer left to the outer right.

A primary moult-score (PMS) is a sum of the individual feather scores. In birds with ten primaries the PMS will lie between 0 (moult of primaries has not yet begun) or 50 (moult of primaries has recently finished). When calculating PMS, feathers labelled O and V are scored 0; feathers labelled N are scored 5; and S can equal 5 or 0 depending on the circumstances. For example, a bird that has temporarily suspended moult of primaries may have a moult-sequence of $S^{4}O^{6}$ in which case S = 5 and the PMS = 20. When this bird begins moulting again it may have the sequence $S^{4}N^{1}3^{1}O^{4}$, again S = 5 and the PMS = 28. However, a bird that has undergone a partial moult of outer primaries may have a moult-sequence of $O^{7}S^{3}$. In this case, S = 0 and the PMS = 0. Unless otherwise stated, we have scored the moult of the primaries of one wing. We have not recorded condition of moult of the remicle, or used it in moult-scores.

MEASUREMENTS For most species, measurements are given for length of wing, tail, bill, tarsus and middle toe; total length of head, and width and depth of bill have also been recorded for some species. We no longer measure length of eighth primary (see Volume 1). Measurements of skins, taken by HANZAB researchers, are given for nearly all species. Published measurements from the literature or unpublished data of live birds or skins, are also given where they available, or references listed.

Measurements of skins and of live birds are presented separately because there is variation in measurements taken by different individuals and because post-mortem shrinkage can have substantial effects on measurements. Examples of shrinkage are given below under the individual methods of measuring.

For species in which males and females look similar, sexing of skins has been based on data on labels. Several authors (e.g. Parkes 1963; Schodde *et al.* 1992) have pointed out that the sexes assigned on labels are not always accurate. In theory it should be possible to sex all fresh specimens by dissection; in practice, it can be difficult, especially when birds are not in

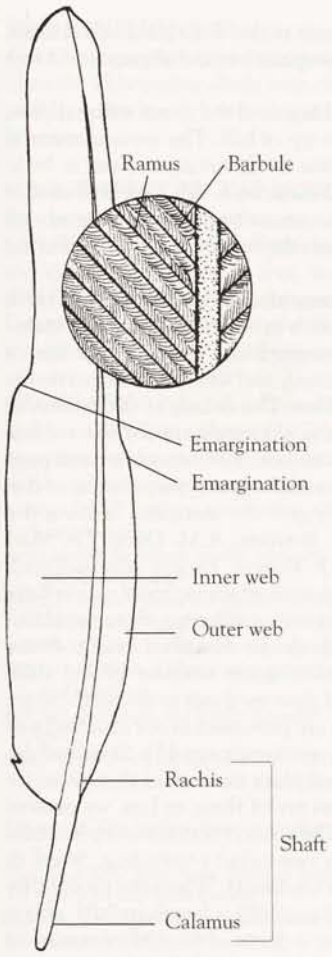

Figure 9 Primary of Brown Goshawk *Accipter fasciatus*

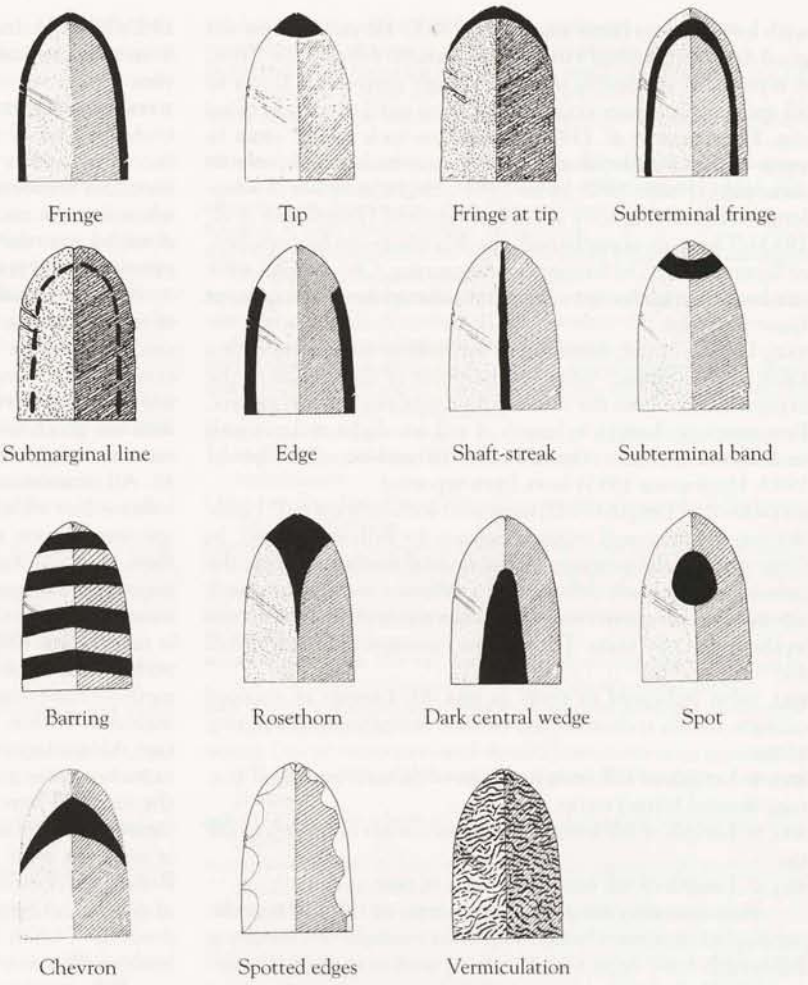

Figure 10 Feather-patterns

breeding condition. At such times their gonads are small, difficult to find and readily confused with the adrenal glands or other organs; when dissected by the inexperienced, mis-sexing can often occur. In addition, sexes recorded on labels of some old specimens (e.g. those collected by Robert Grant) appear not to have been based on dissection. We have reduced the numbers of mis-sexed birds in our samples by relying mainly on specimens for which gonads were sketched or described, and on specimens prepared by experienced workers, a process that can involve rather subjective decisions. It is likely a few mis-sexed specimens were not discarded on this basis; we have mentioned those few cases where it is thought that mis-sexed specimens may have affected the means calculated for either sex. Where published measurements contained obvious errors, we have often included the measurements, with a note of the error.

The following standard measurements have been taken for almost all species; where other methods or conventions peculiar to certain taxa are used, these are described in the species accounts. Also, when quoting measurements from the literature we always mention cases where measuring methods differ from ours, or are not known. All measurements are recorded in millimetres.

WING: Length of the wing, measured to the nearest millimetre on the folded wing, from the carpal joint to the tip of the longest primary. We measure maximum chord, flattening the wing against a butted ruler and straightening it as much as possible; maximum chord is thus the longest measurement between the carpal joint and the tip of the longest primary. We did not measure wings in which the longest primaries had severe abrasion. Measurements of maximum chord can vary somewhat between measurers, with the experienced tending to take longer measurements (e.g. Jenni & Winkler 1989 and references therein).

Natural chord, and flattened chord, other measurements of length of wing, are measured from the same points, but both give a considerably shorter reading. We have taken neither, but often quote from literature in which these techniques have been used. The former measurement involves no straightening or flattening of wing (see Baldwin *et al.* 1931; BTO 1984); the latter only involves flattening the wing (see Witherby *et al.* 1938; BTO 1984). Both measurements were more widely used in the past, but are now believed to be less easy to repeat than maximum chord (e.g. Evans 1964; Ewins 1985), partly because primaries can straighten somewhat when wet (Evans 1964).

Length of wing decreases in museum specimens. Shrinkage of between 0.39% and 3% has been reported (Herremans 1985). Most studies of shrinkage have been done on waders. In these, the amount of shrinkage is relatively larger in species

with longer wings (Engelmoer *et al.* 1983). However, there is a good deal of individual variation in amount of shrinkage. Thus, it is probably impossible to apply a single conversion factor to all species. Shrinkage continues in skins until they have dried out. Engelmoer *et al.* (1983) found this took over 2 years in some waders, but shrinkage may stop in as little as 2 months in some auks (Harris 1980; Ewins 1985). Slight increases in wing-length after drying have also been reported (Engelmoer *et al.* 1983). These are unexplained; possibly wings can be stretched, or ligaments cut, by frequent re-measuring. Our samples were not large enough for us to attempt to eliminate such sources of bias.

TAIL: Length of tail, measured to the nearest millimetre with a ruler, as the distance between the point of emergence of the central rectrix from the skin to the top of the longest rectrix. Post-mortem changes in length of tail are slight and not well understood; decreases (Greenwood 1979) and increases (Bjordal 1983; Herremans 1985) have been reported.

BILL-LENGTH: Length of bill, measured with calipers to 0.1 mm. We usually measured exposed culmen (= Bill; see below). In some groups, the junction of the frontal feathering with the culmen is not clearly defined and a different method was used; alternatives are given below and some methods are given only in the respective texts. The various measures of length of bill are:

BILL (also indicated in texts as BILL F): Length of exposed culmen, which is chord of the culmen from frontal feathering to tip.

BILL S: Length of bill from junction of culmen and skull (i.e. naso-frontal hinge) to tip.

BILL N: Length of bill from the anterior corner of nostril to the tip.

BILL C: Length of bill from front edge of cere to tip.

Post-mortem changes in dimensions of the bill may depend on its structure (Fjeldså 1980); for example no changes in bill-length have been found in most waders studied (Greenwood 1979; Engelmoer *et al.* 1983), but significant decreases and increases as great as 2.9% have been reported in some species (Summers 1976; Engelmoer *et al.* 1983).

BILL-DEPTH (BILL D): Depth of bill measured (except where stated within text) at junction of frontal feathering with the exposed culmen, to the lower edge of the ramus below; it is the minimum depth possible at this point.

BILL-WIDTH (BILL W): Width of bill (distance between tomia) measured (except where stated within text) at junction of frontal feathering with the exposed culmen; it is the minimum width possible at this point.

Width and depth of bill are subject to a great deal of shrinkage (Kinsky & Harper 1968; Fjeldså 1980).

TARSUS: Length of tarsus measured with calipers to 0.1 mm, from the midpoint of the hindside of the tibiotarsal joint, to the midpoint of the joint between tarsus and middle toe in front.

TARSUS A: A measure 2–3 scales shorter than Tarsus (above), measured from tibiotarsal joint to last smooth scute on front of tarsus, slightly above level where hindtoe emerges.

Shrinkage of tarsus is generally insignificant; Bjordal (1983) attributed the few reported post-mortem changes to difficulty in applying the measurement to exactly the same points in fresh and dried legs.

TOE C: Length of middle toe measured with calipers to 0.1 mm from the joint at the base of the middle toe (in front of the leg) to the tip of the middle claw.

TOE: As Toe C, but excluding the middle claw.

Length of toe decreases by *c.* 2% after skinning (Fjeldså 1980; BWP 5). Its measurement is also difficult to standardize from museum skins because preparation and alignment of feet vary.

TOTAL HEAD-LENGTH (THL): Measured to 0.1 mm with calipers, from the back of the skull to tip of bill. The measurement is becoming widely used for live birds because there is little variation between individual measurers. We have included it when data are available. THL cannot be taken consistently on skins, because the backs of their skulls are removed to differing extents during preparation.

Presentation of measurements At the head of each table of measurements, information is given on the samples measured. Subspecies (if any), geographical location and age of sample (where known) are stated, and whether measurements were taken on live birds or skins. The details of the sources of data are given in brackets; the abbreviations for the various museums are given in Abbreviations and Conventions on page 46. All measurements of skins made during preparation of this volume (for which we simply give the institutes holding the specimens) were taken by K. Bartram, A.M. Dunn, J.S. Matthew, S.A. McKenzie or D.I. Rogers. Except where stated, measurements were taken as described above; in all cases where measuring methods are not known or different, this crucial fact is mentioned. Different methods are described briefly. Some authors who published measurements without giving their methods have since described their methods to us and these are included. Within tables, data are presented in our standard way (see Abbreviations and Conventions, page 45). Standard deviation is given to one decimal place more than that given for the mean. Where sample sizes are of three or less, we present measurements of individuals. Differences between sample means of each sex were tested with two-tailed t-tests (e.g. Sokal & Rohlf 1981; Fowler & Cohen Undated). When the probability of differences being due to chance (P) is less than 0.05, this is denoted *; when $P<0.01$, this is denoted **. Other statistical analyses that may be done are discussed in the accounts.

Where values differ markedly from those given elsewhere, this is discussed.

WEIGHTS Weights are taken from specimen labels, from published or unpublished data on birds captured for banding, and from other sources in the literature. Except where stated, weights are given in grams. They are presented in the same way as measurements. Information on temporal variation in weight is summarized if available.

STRUCTURE The following points are treated: shape of wing; number of primaries, secondaries, tertials and humerals (if present); wing-formula; shape of tail, bill, and leg; and other structural peculiarities. Primaries are numbered from the carpal joint outward. Individual primaries are indicated by a 'p' and a number, p1 being the innermost, and p10 the outermost functional primary in most species. The secondaries (including tertials) are numbered from the carpal joint inward, abbreviated as s1, s2 and so on. The rectrices are numbered from the central pair outward: t1, t2 and so on. All wing-formulae were taken on skins; wing-formulae can be affected by post-mortem shrinkage (Mead 1977; Knox 1980) but no other source of data was available.

AGEING, SEXING Characters that can be used for ageing and sexing and that are not covered in other sections (such as Plumages, Bare Parts or Structure) are described here, as are combinations of characters that distinguish ages or sexes.

RECOGNITION This section is sometimes included to describe characters that distinguish species that are difficult to identify. This section deals with characters that are only usually visible in the hand; other characters are given in Field Identification.

GEOGRAPHICAL VARIATION The general nature of the geographical variation is summarized (even where no formal subspecies are recognized) and differences between recognized subspecies, if any, are given, in reference to the detailed descriptions already given in the Plumages and Bare Parts sections. An outline of differing taxonomic opinions on treatments of taxa is usually given.

GLOSSARY Based chiefly on BWP, Campbell & Lack (1985) and Lucas & Stettenheim (1972). Terms in italics are defined elsewhere in the glossary, or shown in the topographic illustrations, or both, as are many of the main terms defined.

ALULA: Small feathers attached to the first digit of wing; also called bastard-wing.

AXILLARIES: Feathers in the 'armpit', attached to the body (and not feathers of wing).

BARB: A branch from the feather-shaft; collective term for a *ramus* and the *barbules* attached to it.

BARBULES: Lateral branches of a *ramus* that interlink *barbs*.

BODY-FEATHERS: All *pennaceous* feathers of a bird except the remiges and rectrices.

BRISTLE: Stiff hair-like feather, usually with a few *barbs* at the base of the shaft.

BROOD-PATCH: A region of bare, vascular and oedematous skin on the abdomen that increases transfer of heat from incubating bird to eggs.

CALAMUS: The hollow base of the feather-shaft; no *barbs* are attached to it.

CARPAL JOINT: The wrist joint, forming the forward pointing prominence of the folded wing.

CASQUE: Enlargement or adornment on dorsal surface of bill (e.g. in friarbirds *Philemon*).

CENTRIFUGAL: Moult that begins in the middle of a row of feathers and progresses in both directions.

CENTRIPETAL: Moult that begins simultaneously at the two extremes of a row of feathers, and progresses towards the centre.

CHEEKS: In passerine volumes, sometimes used to describe feathers just below the eye that are, technically, anterior *ear-coverts*. When 'cheeks' was used with the term 'ear-coverts', ear-coverts then referred only to those behind the eye.

CLINE: Gradation in one or more characters in populations of a species across its geographical range or part of it.

CLOACAL RING: Feathers circling the rim of the cloaca.

CONTOUR-FEATHER: Feather with *pennaceous* webs forming part of visible external surface of body.

COVERTS: One or more rows of feathers that overlie, dorsally or ventrally, the bases of *remiges* (*wing-coverts*) or *rectrices* (*tail-coverts*) or over the aural opening (*ear-coverts*). See illustrations of topography (Figs 2–8).

CRURAL TRACT: The tract of feathers running along the thigh (tibiotarsus).

CULMEN: Dorsal ridge of upper *mandible*.

CYCLE: Shortened version of plumage cycle, which runs from a given plumage or moult to the next occurrence of the same *plumage* or *moult*. Cycles do not always last for a year, e.g. Andean Sparrow *Zonotrichia capensis* (Miller 1961), King Penguin *Aptenodytes forsteri* (Stonehouse 1960).

DIASTATAXIS: Arrangement of feathers in wing in which the fifth upper *secondary covert* has no corresponding *secondary*.

DISTAL: Pertaining to part of feather, wing, tail, etc. farthest from the body.

DORSUM: Uppersurface of body.

DOWN-FEATHER: Feather with fluffy *webs* formed by *plumulaceous* barbules.

EUTAXIS: Arrangement of wing-feathers in which fifth upper secondary covert has a corresponding *secondary*.

EYE-RING: A ring of feathers froming a marking round the eye.

FAULT-BAR: See discussion in Plumages introduction (above).

FILOPLUME: Fine hair-like feather with a small tuft of *barbs* at the tip (occasionally there are a few barbs elsewhere).

FORM: Neutral term indicating an individual variant or a taxonomic unit.

FRINGE AT TIP: A narrow area of contrasting colour at the tip of a feather and that does not extend onto the sides of the feather (see Fig. 10).

GROWTH-BAR: See discussion in Plumages introduction (above).

HACKLE: A long slender feather on the neck.

HALF-BAR: An incomplete bar across the *web* of a feather, which meets the edge but does not reach the shaft.

HUMERAL COVERTS: *Upperwing-coverts* covering the base of the *humerals*.

HUMERALS: Remiges attached to the humerus, the innermost wing-bone (also see *subhumerals*, *tertials*, *humeral coverts*).

INTEGUMENT: External covering of a bird, including skin and feathers.

INWARD: Moult of a row of feathers proceeding from the outside to the inside. Common in *secondaries*.

IRREGULAR: Pattern of moult in a row of feathers that cannot be described as *simultaneous*, *outward*, *inward*, *centrifugal*, *centripetal*, or *staffelmauser*.

LAMELLAE: Fine hair-like or plate-like structures lining the bill of some filter-feeding birds.

LAMINIPLANTAR: Descriptive term for *tarsus* with divided scutes along the front surface and a smooth hindsurface; also termed bilaminiplantar.

MANDIBLE: Used here as a term applying to either jaw, including the horny covering.

MANDIBULAR RAMI: The two halves of the lower *mandible*, separated by the soft tissue at the base but uniting distally at the gonys.

MANTLE: Area of *upperparts* between the lower *hindneck* and the anterior base of the wings.

MORPH: One of two or more well-defined *forms* in the same populations of a species that, within individuals, does not change over time or *plumages*.

MOULT: Process by which all birds periodically shed and replace their *plumage*.

NASO-FRONTAL HINGE: Junction between the *culmen* and the skull; it is flexible in some birds.

ORBITAL RING: A bare fleshy ring immediately surrounding the eye, present in all birds but often thin, dark and practically invisible.

OUTWARD: Moult in a feather-row from the inside to the outside. Seen in the *primaries* of most birds.

PAPILLA: Small conical protuberance.

PENNACEOUS: Compact, closely knit texture forming coherent *webs* in *contour-feathers*.

PLUMAGE: A single generation of feathers brought about by a single *moult*. Sometimes applied to the aggregate of feathers covering a bird.

PLUME: Type of ornamental feather.

PLUMULACEOUS: Pertaining to long flexible *barbs* that are not close-knit, and give a fluffy texture to feather or part of a feather, instead of forming a coherent *web*.

POST-ORBITAL PATCH: A patch of contrasting colour (plumage or skin) immediately behind the eye.

POWDER-DOWN: Soft friable *down-feathers*, that produce fine dust particles used in care of plumage.

PRIMARIES: Flight-feathers borne on the manus, outside the *carpal joint*.

PROXIMAL: Pertaining to part of feather, wing, tail, etc. closest to the body.

PTERYLOSIS: The way in which *contour-feathers* are arranged on the skin. Contour-feathers occur in orderly tracts called pterylae; the intervening spaces are called apteria.

RACHIS: The long distal portion of a feather-shaft, bearing the *webs* (vanes).

RAMUS: A branch projecting from the *rachis*. *Barbules* are attached to, but are not part of, the ramus.

RECTRICES (singular, rectrix): Feathers of the tail.

REMICLE: Vestigial outermost *primary*.

REMIGES (singular, remex): A cumulative term for the *primaries*, *secondaries*, *tertials* and *humerals*, the flight-feathers forming the rear margin of the wing.

RICTUS: Skin at the junction of the *mandibles*.

ROSETHORN: See illustrations of topography (Fig. 10).

RUMP: The area between the *uppertail-coverts* and the *back*; its upper

boundary is generally the line between the tips of the secondaries in birds with outstretched wings.

SCAPULARS: A group of feathers on the *upperparts*, situated at the base of the wing.

SECONDARIES: Flight-feathers attached to the ulna, including the *tertials*.

SIGNIFICANT: Shown by statistical test as unlikely to be due to chance (said of difference between means of two or more samples).

SIMULTANEOUS: A type of *moult* in which a group of feathers is shed more or less at the same time, inducing a period of flightlessness.

SKIN: A stuffed, unmounted study specimen.

SPECULUM: A patch of distinctive colour on the wing; usually applied to the metallic patch seen in dabbling ducks.

STAFFELMAUSER: A pattern of *moult* in a row of feathers in which a wave of moult begins before the preceding wave is complete. This produces two or more active moult-centres in a row of feathers.

STANDARD DEVIATION: A statistical term describing the scatter around the mean in a sample of data. In a normal distribution, 99% of a sample lies within 2.58 standard deviations of the mean, 95% within 1.96 standard deviations.

STREAK: Pattern of colour oriented longitudinally on feather.

SUBHUMERALS: *Underwing-coverts* covering the base of the *humerals*; they are continuous with *axillaries*, which differ in being attached to the body.

SUBHUMERAL COVERTS: All small *coverts* at the base of the underside of the wing, between the *subhumerals* and the *marginal coverts*.

SUBMARGINAL: Describes markings of feathers that lie near and parallel to the fringes of the feather (see Fig. 10).

SUBORBITAL PATCH: A patch of contrasting colour (plumage or skin) immediately below the eye.

TAIL-COVERTS: *Coverts* that overlie the bases of the *rectrices*, both dorsally (*uppertail-coverts*) and ventrally (*undertail-coverts*) and that flex with the tail. *Uppertail-coverts* generally lie between the preen gland and the rectrices, covering the base of the rectrices; *undertail-coverts* lie between vent and rectrices. See illustrations of topography (Figs 2–8).

TARSUS: Strictly, shortened form of tarsometatarsus; osteologically, the upper foot of birds. Also used as a general term for this area of the leg, which is the part between the toes and the tibia.

TEGMEN: Term coined by Gladstone (1918) for broad translucent film bordering the *ramus* on the underside of the *remiges* of some birds.

TERTIALS: The innermost *secondaries*; on the outstretched wing their tips do not line up with the line formed by the tips of the outer *secondaries*. The term has also been applied to *humerals*; we have not used it in this sense.

TERTIARIES: Synonym for *tertials* and apparently preferred choice in Campbell & Lack (1985). Not used in *HANZAB*.

THIGH: The feathered portion of the *tibia*.

TIBIA: Strictly, shortened form of tibiotarsus, the osteological equivalent of the shin in birds. Also used as a general term for this area of the leg, which is the uppermost part visible in the field in most species.

UNDERPARTS: In the Plumages texts, cumulative term for the ventral side of the body, excluding the wings, tail and chin, throat and foreneck (cf. use in Field Identification section).

UPPERPARTS: In the Plumages texts, cumulative term for the dorsal side of the body, excluding the wings, tail and dorsal surface of head and neck (cf. use in Field Identification section).

VARIATION: Differences in any character between animals of the same species. The following broad types of variation may be recognized: individual (between individuals of the same population, sex, age, and studied at the same season), seasonal, sexual, age and geographical.

VENT: Area round the cloaca and anterior *undertail-coverts*. Sometimes applied to the cloaca alone, though we have not used it in this sense.

VENTER: Undersurface of body.

WEB: A rather flat structure attached to the side of the *rachis* of *pennaceous* feathers, formed by a coherent series of *barbs*. Also called a vane.

WING-BAR: Transverse band of contrasting colour in any part of the wing.

WING-COVERTS: *Coverts* that overlie the bases of *primaries* (*primary coverts*) or *secondaries* (*secondary coverts*), both dorsally (*upperwing-coverts*) or ventrally (*underwing-coverts*). Both primary and secondary coverts can be further subdivided to *marginal*, *lesser*, *median* and *greater coverts* (see illustrations of topography, Figs 2–8).

WING-FORMULA: Configuration of tips of *primaries* relative to each other, expressed as distances from tip of each primary to the longest primary on the folded wing.

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