



Use of herbarium supplies to make simple feather-sheets for ornithology collections

Brian J. Gill

*Auckland War Memorial Museum, Private Bag 92018, Auckland, New Zealand;
e-mail: bgill@aucklandmuseum.com*

Summary. Feather-sheets, each displaying selected feathers plucked from an individual bird and mounted so that each feather can be viewed in its entirety, are useful references to aid identification of isolated unidentified feathers. A method is described whereby simple feather-sheets can be relatively easily and quickly prepared by museum staff and volunteers using the same materials that herbaria use to mount dried botanical specimens. Feather-sheets are yet another way in which ornithological collections can facilitate biological identification and recording.

Key-words. Specimen preparation; bird collections; techniques; identification

INTRODUCTION

There is often a need or desire to identify individual bird feathers to species level. The circumstances inviting feather identification may range from the trivial (e.g. an attractive feather found by a nature-lover on a local walk) to the forensic (e.g. feathers intercepted in luggage at an international border). Unfortunately, identification of isolated feathers is no easy matter because of their immense morphological diversity (Cieslak & Dul 2006). First there is the variability of feathers within an individual bird's plumage, each principal feather in the wing and tail, for example, being slightly different from its neighbour in size, shape, pattern and coloration. The diversity of feather form between species, and individual variability within species, multiplies this into a very large and complex identification problem.

Only recently have ambitious attempts been made to facilitate feather identification, encouraged, no doubt, by advances in colour photography and scanning. Books have been published that are designed to aid identification of feathers, for example the compendium by Cieslak & Dul (2006) of selected feathers of 60 European species, mainly birds-of-prey and owls. Web-sites have also been developed to provide access to images of feathers. For example, web-pages of the United States Fish and Wildlife Service aim to facilitate identifications by providing high-quality scans of the flight feathers of the

major groups of North American birds (National Fish & Wildlife Forensics Laboratory 2013).

Photographic guides are extremely useful, and both books and web-pages give great flexibility of access. However, it is often preferable to be able to compare unknown feathers, or fragments of feathers, with *real* reference examples. Natural history museums are in the unique position of being able to provide access to real feathers for identification purposes. The feathered parts of birds are typically preserved in museums as mounts and study-skins (Cato 1986, Winker 2000). Some museums also have collections of spread wings. All these preparations give a good idea of the colour of birds' plumage and a rough idea of the general size and shape of some of the feathers. However, the traditional preparations are limited in their utility for individual feather identification by the feathers being densely overlapping, as in living birds.

It is obviously unsatisfactory to expect to pluck feathers out of selected study-skins every time a need arises for identification of an individual feather! Instead, special feather-sheets prepared by museums so that representative individual feathers are mounted in isolation, and may be viewed in their entirety, are a means by which museums can provide a useful resource for feather identification. Being able to see entire isolated reference feathers can give surprisingly quick and immediate guidance in narrowing down the possible species for a particular identification problem. Feather-sheets reveal clues to the nature of individual feathers that may not be immediately obvious. For example, in life and as a study-skin the New Zealand kingfisher *Todiramphus sanctus* presents as being bright blue-green on its dorsal surfaces (and buff-coloured ventrally). However, a feather-sheet for this species shows mainly grey (dorsal) and buff (ventral) feathers with little blue evident. The blue effect is due largely to the overlapping of thousands of grey dorsal feathers that each have a little blue only at their edges.

Töpfer (2010) reviewed the importance and management of feather collections. It seems that few bird collections outside Central Europe have feather-sheets, and such feather-sheet collections as exist have mostly been prepared and donated by laypersons and amateur ornithologists. Most museums have not developed feather-sheet collections, being unmindful of their usefulness, rating them as a low priority or being unable to divert staff resources to what is imagined to be an excessively time-consuming preparation.

Soon after I began my curatorial career in the early 1980s I received the first of many requests for feather identification—a small drab brown feather that had been found in a bag of processed sugar. I remember pulling out a few feathers from study-skins of a starling (*Sturnus vulgaris*) and house sparrow (*Passer domesticus*) to act as reference samples, which impressed on me the need for a better solution. Several years later I received from an amateur plumologist in Germany a written request for feathers of New Zealand birds. He included photocopies of feather-sheets, which gave me the idea that selected feathers from an individual bird could be removed, arranged and mounted for use as a reference. In 1999, in collaboration with Maree Johnston (Auckland Museum's land vertebrates technician at the time), we made a tentative start on a collection of feather-sheets for Auckland Museum using materials from the museum's herbarium.

Since then, encouraged by the usefulness of the museum's feather-sheet collection, a succession of technical staff and volunteers has added to it, experiencing no difficulty in mastering the simple techniques involved. Our intent has been to have all the locally-common bird species (and the sexes and ages where radically different in plumage) represented by feather-sheets for identification purposes. Auckland Museum now has 86 specimens (single or multiple sheets) representing 68 species. Specimens illustrated in this paper are all from the Auckland Museum collection.

The aim of this article is to encourage other museums to consider developing collections of feather-sheets (if they do not already have them) to provide yet one more way in which natural history museums can facilitate biological identification and recording.

PREPARATION OF FEATHER-SHEETS

Material

To obtain supplies for the preparation of feather-sheets, a simple option is to adopt the same materials (Fig. 1) that the nearest herbarium employs for mounting dried botanical specimens. From the Auckland Museum herbarium we sourced:

- White sheets, 420 x 265 mm (a standard size), in thick or thin archival-quality card, onto which feathers could be arranged.
- Archival-quality translucent adhesive tape with which the feathers could be attached to the sheets ("Filmoplast® P" acid-free library mending tape; 2 cm wide, supplied in 50-m rolls; Neschen AG, 31675 Bückeberg, Germany).
- Paper "flimsies" to enclose the sheet (or group of sheets) back and front to protect against abrasion.
- Standard cardboard storage boxes (external dimensions: 450 x 300 x 100 mm) in which the sheets and their enclosing "flimsies" could be stored.

Methods

At Auckland Museum we have mostly made feather-sheets from whole birds that have been found dead by members of the public and stored temporarily in deep-freezers. The selected feathers from a small bird (up to the size of a blackbird *Turdus merula*) may fit on a single feather-sheet. Feathers from larger birds will need multiple sheets (Fig. 2)—we have used up to eight sheets for the feathers of a light-mantled sooty albatross *Phoebastria palpebrata*.

At the bottom right-hand corner of the sheet (or first sheet where multiples are needed) we glue on our own departmental blank paper label using archival-quality PVA glue. To keep it from curling while drying, the label is inter-leaved with absorbent paper under pressure (e.g., inter-leaved in a large telephone directory with a weight on it). Collecting details for the bird are written on the label. Any second or subsequent sheets for the same bird need only a registration number, Latin name and sheet number (e.g. 2/4, 3/4 etc.).

Before plucking begins, the bird is weighed, and several standard measurements are recorded (Eck et al. 2011). It is also important before plucking to make relevant notes on

the plumage, particularly the general outward appearance for birds where the species exhibits plumage polymorphism relating to sex, age or season. The age or sex as indicated by the plumage may be difficult to discern retrospectively from the isolated feathers in a feather-sheet. When plucking is finished the body can be opened and the sex determined or confirmed from examination of the gonads.

Selected feathers are plucked from the bird one-by-one, with care taken to avoid damage. Depending on the species or condition of the bird, some flight-feathers may be difficult to detach. Needle-nosed pliers may then be helpful to give a better grip on the feather shaft as close as possible to its base (Fig. 3). Plucked feathers are placed (in a correct order, if relevant) onto the feather sheet (Fig. 4). Thick card is used for birds the size of an Australian magpie (*Gymnorhina tibicen*; c. 350 g) or larger; thin card is used for smaller birds. To keep feathers in place on the sheet, weights can be laid over them—e.g. steel or plastic rulers laid over rows of feathers, or small lead fishing weights placed on single feathers. In Auckland Museum's feather-sheets all feathers are non-overlapping.

Once the feathers are in position they may be taped in place. The library mending tape that we have used has a detachable backing paper to facilitate handling. It may be cut to any length, and the width may be reduced by cutting the tape length-wise. A long continuous strip of tape may be placed over a row of related feathers, rather than taping each feather individually. For flight feathers, one strip of tape across the shafts and a second strip across the webbed ends of the feathers, should suffice to keep them permanently in place. The width of the strip can be adjusted depending on the size of the feathers, the result being a balance between the need for more tape to guarantee adhesion and less tape to minimise the area of feathering that the tape obscures. Feathers in a row should have sufficient space between them that the tape is able to adhere to an appropriate area of card; if the feathers are too close together the entire row may lift.

For a continuous strip of tape run across a row of large feather shafts, the tape should be attached at one end of the row and advanced progressively across the feather shafts and pressed into contact using a rod (e.g. knitting needle, or smooth surface of closed forceps) so that the tape follows the contours of the shafts. This allows a maximum amount of tape to adhere to both the paper and the feathers. Tape stretched directly across a row of thick feather shafts will make contact only on the uppermost surfaces of the shafts, and on part of the paper between shafts, giving a weak result. For small feathers, whether singly or in a row, a single strip of tape catching the ends of the shafts may suffice.

Once all feathers on the sheet are stuck down they can be labelled by writing directly onto the sheet beside the feathers. Labelling (see Guiding Standards below) may include the region or side of the body from which the feathers came, and the dorso-ventral orientation in which the feathers have been mounted. Time required to produce a finished feather-sheet (including measurement and sexing of the bird) has varied from 4–6 hours for a small bird to 8 hours or more for a large bird requiring multiple sheets.

Figs 5 and 6 show two examples of completed feather-sheets of small birds. Fig. 7 shows part of a feather-sheet to give more detail on how the translucent adhesive tape looks when fixed across rows of feathers. The finished feather-sheet or group of sheets

is placed in a paper “flimsy” for protection and then into a standard storage box (Fig. 8). At present the small collection at Auckland Museum is arranged in the storage boxes taxonomically (passerines separated from non-passerines) and alphabetically (A–D, E–H, etc.) by Latin name.

Guiding standards

It is desirable to have a minimum standard governing which feathers to attempt to include on a feather-sheet—at least a complete set of flight feathers (Töpfer 2010)—and consistency in labelling is also helpful.

For the Auckland Museum collection we now aim to include the following feathers on each new feather-sheet:

- primary remiges: a full set from one wing; displayed dorsally or ventrally; plus selected feathers from the other wing displayed the other way.
- secondary remiges: all or most of the set from one wing; displayed dorsally or ventrally; plus a selection from the other wing displayed the other way.
- rectrices: all; those from one side displayed dorsally; the other side displayed ventrally.
- body feathers: samples from selected regions of the head and body; as many as required to sample a good variety of feather sizes, patterns and colours.

In labelling feather-groups on the sheet, we use P1, P2 etc. for the primary remiges; S1, S2 etc. for the secondary remiges; and T1, T2 etc. for the rectrices. For a row of primaries from the left wing mounted with the dorsal surface uppermost, we would add the label “Wing, L side, primaries, dorsal surface”. Similarly: “Tail, R side, ventral surface”. “Ventral wing, greater 2° coverts” would indicate coverts from the underside of the wing. Similarly: “Dorsal wing, marginal coverts”. Groups of body-feathers are simply annotated with the region of origin e.g. “Back”, “Nape”, “Crown”, “Chin”, “Breast”.

DISCUSSION

The principal purpose of museum collections of feather-sheets is to provide comparative material for identification of isolated feathers, but they also have potential for studies of moult, as sample-sources for molecular analyses and as voucher specimens (Töpfer 2010). The feather-sheets at Auckland Museum have been used mainly as aids to the identification of unknown feathers found by members of the public or under investigation by agencies (e.g. field officers of the Department of Conservation). Museum ethnographic objects may incorporate feathers, e.g. feathers of both native and introduced New Zealand birds in Maori feather cloaks (Harwood 2011), and feather-sheets have potential to assist with identification of these. It may also be mentioned that feather-sheets often look attractive, and may occasionally find a role in temporary or special exhibitions. Images of museum feather-sheets may be useful as eye-catching items in museum publications and web-pages, and perhaps even as elements reproduced in merchandising. One important and pleasing attribute of feather-sheets is that they take up very little storage space in museums.

Natural history museums are uniquely able to provide access to specially prepared feather-sheets and thereby allow real feathers to be seen for comparative purposes, but the need to arrange a visit to a museum collection makes feather-sheets less accessible than feather images in books and web-pages. However, the potential exists for museums, as an additional step, to obtain high-resolution scans of their own feather-sheets, and to make these scanned images available for publications and web-pages. In this way, museum collections can facilitate the identification of feathers by all available avenues—on-site and off-site; real and electronic/virtual.

All forms of preparation of specimens for ornithological collections require a good deal of time, effort, care and expense. Feather-sheets are no exception, but they are not excessively difficult to produce. In fact they can be a perfect task for museum staff and volunteers—easier to master than study-skin preparation, yet still offering both challenge and satisfaction. A convenient short-cut to sourcing materials for feather-sheet preparation may be to adopt and adapt whatever materials are used by the local herbarium for preparing dried botanical specimens.

ACKNOWLEDGEMENTS

I wish to acknowledge the staff and volunteers who have prepared feather-sheets for the land vertebrates collection at Auckland Museum during the past 15 years: Jason Froggatt, Mimi Huang, Maree Johnston, Shannon Loney, Ramola Prasad and Dhahara Ranatunga. I also thank Paul Sweet for useful advice, the herbarium staff at Auckland Museum for their support, and Jason Froggatt for helpful comments on a draft of this paper.

REFERENCES

- Cato P.S., 1986: Guidelines for managing bird collections. – *Museology* 7: 1-78.
- Cieslak M. & Dul B., 2006: Feathers. Identification for bird conservation. – Warsaw: Natura Publishing House.
- Eck S., Fiebig J., Fiedler W., Heynen I., Nicolai B., Töpfer T., van den Elzen R., Winkler R. & Woog F., 2011: Measuring birds. – Wilhelmshaven: Deutsche Ornithologen Gesellschaft.
- Harwood H.P., 2011: Identification and description of feathers in Te Papa's Maori cloaks. – *Tuhinga: Records of the Museum of New Zealand Te Papa Tongarewa* 22: 125-147.
- National Fish & Wildlife Forensics Laboratory, 2013: The feather atlas. Flight feathers of North American birds. – <http://www.lab.fws.gov/featheratlas/> [Accessed on 16 August 2013.]
- Töpfer T., 2010: Scientific importance and management of feather collections in natural history museums. – *Journal of Afrotropical Zoology, Special Issue*: 93-99.
- Winker K., 2000: Obtaining, preserving, and preparing bird specimens. – *Journal of Field Ornithology* 71: 250-297.

Note added in press:

Till Topfer (pers. comm. to B. Gill, Sep. 2014) has pointed out that placing adhesive tape across the webbed ends of flight feathers on a feather-sheet prevents individual feathers from being straightened for length measurements. To avoid this problem it may be satisfactory in many cases to instead place extra tape across the shaft-ends of the feathers.



Fig. 1. Materials for feather-sheet preparation: herbarium sheets, label, PVA glue (for label), adhesive tape (for feathers), lead weights, rulers. Photo: B. Gill.



Fig. 2. Selected feathers of a Swamp Harrier *Circus approximans* (LB13296) mounted on six feather-sheets. Photo: B. Gill.



Fig. 3. Needle-nosed pliers may assist when flight feathers are difficult to remove (Cook's Petrel *Pterodroma cookii*, LB14697). Photo: B. Gill.



Fig. 4. Collection manager Jason Froggatt mounting primaries and secondaries of a Cook's Petrel *Pterodroma cookii* (LB14697). Note plastic rulers used to hold the feathers flat and in sequence while adhesive tape is applied. Photo: B. Gill.



Fig. 5. Feather-sheet of Shining Cuckoo *Chrysococcyx lucidus* (LB14706, adult female). All feathers fit on one sheet. Photo: R. Kho.



Fig. 6. Feather-sheet of Welcome Swallow *Hirundo neoxena* (LB12311, unsexed adult). All feathers fit on one sheet. Photo: R. Kho.



Fig. 7. Section of feather-sheet of Song Thrush *Turdus philomelos* (LB12219, unsexed juvenile) to show tape fixed over feathers. Photo: R. Kho.



Fig. 8. Feather-sheets at Auckland Museum are stored in standard herbarium boxes. Note the “flimsy” (paper cover) opened up to reveal the multiple feather-sheets (of Swamp Harrier *Circus approximans*, LB13296) that it protectively encloses. Note also the cardboard insert that enables the entire group of feather-sheets (enclosed in their “flimsies”) to be lifted out of the box. Photo: B. Gill.

