Commentary

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A CALL FOR FEATHER SAMPLING

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Feathers collected from birds captured at banding stations, on breeding and wintering grounds, and from museum specimens are beginning to yield important insights into life history, ecology, and evolution of birds. For example, stable isotope analyses of feathers have allowed insights into feeding ecology of marine and terrestrial birds (Thompson and Furness 1995, Thompson et al. 1995, Bearhop et al. 1999, Hobson 1999, Cherel et al. 2000), locations and strategies of molt (Hobson 1999, Cherel et al. 2000, Hobson et al. 2000, Hebert and Wassenaar 2001), allocation of nutrients to reproduction (Klaassen et al. 2001), dispersal (Hobson et al. 2001a, Graves et al. 2002), and connections between breeding and winter habitats of migratory songbirds (Marra et al. 1998; Wassenaar and Hobson 2000; Hobson et al. 2001a, b; Rubenstein et al. 2002). Molecular genetic analyses of feather material similarly holds considerable promise for studies of migratory connectivity and population structure (Milá et al. 2000, Milot et al. 2000, Kimura et al. 2002, Ruegg and Smith 2002), and the prospect of combining genetic with isotopic markers is likely to be particularly informative (Webster et al. 2002, Clegg et al. 2003). With increasing concerns over declining migratory songbird populations and the need to understand demographic units and patterns of connectivity between breeding as well as wintering populations, maximizing availability and utility of requisite samples is a pressing issue.

In addition to studies of migratory connectivity, feather material can yield data relevant to a broad ornithological constituency. First, feathers are a source of DNA for genetic studies of phylogeography and population structure of both migratory and resident species. Such studies can yield important insights into the recent evolutionary history of a species as well as on-going processes (e.g. natural selection and gene flow). Second, feathers offer a ready source of material for assessing levels of some contaminants (Furness et al. 1986, Furness 1993, Thompson et al. 1995, Burger et al. 2001), and thus can be extremely useful for understanding consequences of human activities and, in some cases, causes of population declines. Finally, archived feather material can be informative to future studies examining temporal changes in breeding as well as wintering ranges of species. Such data could be important to evolutionary biologists interested in microevolutionary processes, population biologists investigating causes of population declines, and conservation

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biologists concerned about effects of climate change.

Such broad applications of feather material have been fostered by technological advances now allowing multifaceted information to be obtained from a single feather. For example, vane and rachis can be used to obtain isotopic ratios and to assess levels of contaminants; and the proximal tip of the rachis contains skin cells with sufficient DNA to permit PCR-based genetic studies of phylogeography, population structure, and connectivity.

With those advances in analytical techniques, the research bottleneck has shifted from lab to field: although isotopic and genetic tools are available, it remains difficult for a single researcher (or team) to collect samples from many hundreds or thousands of individual birds from across the range of a particular species. Hence the primary rationale for an organized and systematic feather-collection initiative is fostering studies at scales of sampling intensity that are otherwise impossible to achieve. In North America alone, ~1.2 million songbirds are banded each year (M. Gustafson pers. comm.). Yet in only a few instances are feathers being collected, with no systematic effort within the ornithological community being made to collect and archive such samples, clearly representing a lost opportunity for gaining valuable material.

Systematic collection of feathers from migratory bird populations would seem to hold large research potential, but such an effort also would entail significant logistical and financial hurdles and require clear thinking about appropriate and inappropriate uses of feather material. Outlined and discussed herein are some of the scientific, logistical, and financial issues involved in a systematic effort to collect feathers.

Collecting feathers will require significant regulatory coordination and oversight. Most importantly, banders (the most likely group to engage in feather collecting) might be granted permission for collecting feathers from taxa not on federal or state endangered species lists as a routine part of their master banding permit. Would banders be willing to pull feathers while processing birds? It is assumed in general that the answer would be yes. Currently, some of us have been collaborating successfully with organizations that band large numbers of birds. In our experience, banders are quite willing to collect feathers as long as adequate scientific justification is provided and permits are forthcoming.

An important drawback of feather collection is that this material does not provide breadth of information associated with traditionally vouchered avian museum specimens. We recognize the importance and desirability of vouchers; however, it remains true that many advances in behavior, ecology, and evolution do not depend on vouchered specimens. Furthermore, it would be logistically and politically unfeasible to develop vouchered collections sufficiently comprehensive to serve the sort of large-scale seasonal and geographic analyses of connectivity and population structure that these new feather collections would address. Nonetheless, lack of voucher specimens has several implications users of feather collections must recognize. First, collected feathers must be associated with important data, such as sampling date and locality. Second, taxon identifications and determinations of age and sex must be made as accurately as possible. In this regard, data associated with feather-based analyses would be analogous to data associated with on-going national banding initiatives yielding many important discoveries while relying on expertise of licensed banders to correctly identify taxa. Third, it will be important for users of feather collections to recognize the limitations of such resources. For example, we would not recommend use of feather material for phylogenetic studies even of readily identifiable taxa if vouchered tissue samples were available or could be readily obtained. Fourth, increasing feasibility of using feather material for a variety of applications must not become a rationale among researchers or permitting authorities for limiting traditional voucher-oriented collecting activities. Vouchered specimens provide a wide array of information and potential benefits for present and future generations of researchers that cannot be replicated by collections of feathers alone. In general, users of feather collections should carefully weigh the costs and benefits of feathers versus vouchered material on a case by case basis, but there are clearly situations where broad-scale feather sampling can provide valuable material that is otherwise unobtainable. Such situations include projects where large numbers of conspecific samples are needed across seasons or geography, exactly the kind of materials that are largely lacking from vouchered tissue collections.

Such a feather collection would require considerable curatorial expertise and would be housed in an existing museum. Without doubt there would be frequent need to consult traditional specimens to resolve questions of identity and, possibly, to assign sex and age. We anticipate banders contributing to such a facility would consult with its personnel on criteria for age determination, and responding to those questions would be facilitated by access to collections of skins and extended wings.

Preservation of feather material would require different facilities and protocols than preservation of traditional museum specimens. We have found that feathers being used for PCR-based analyses of DNA can simply be placed in individual envelopes and stored in a dry place for the short term (days to weeks), and in a freezer for long-term storage (weeks to years). Long-term storage at –80°C is likely to be optimal for genetic samples, but a complete understanding of long-term storage requirements for non-PCR-based applications should be investigated. Stable isotope assays simply require feathers be stored dry.

Consistent field sampling protocols need to be adopted. This is a complex issue, and collection protocols should be made to minimize the time and effort required of banders while maximizing the utility of new samples. For example, collection protocols would need to be developed carefully to differentiate samples from birds captured at migratory stopover points versus birds sampled on known breeding territories. At breeding sites, one might wish to collect material from both migratory and breeding individuals. At stopover sites, the seasonal period for collecting material would be less critical, but, for many species, knowing whether the bird was in juvenal or adult plumage would be critical for knowing where sampled feathers were grown. Similarly, we recommend pulling (symmetrically) two tail feathers, and two to three breast feathers from each individual bird. Tail and breast feathers can provide different isotopic signatures of origin, depending upon where those feathers were grown. Although pulling feathers may cause momentary discomfort for a bird, the associated fitness costs appear to be too trivial to be measurable, as has been found to be the case for blood sample collection (Hoysak and Weatherhead 1991). This trivial cost to individual birds can, more importantly, generate new knowledge of great potential importance to the conservation of populations.

A feather collection would require significant additional costs for museums. Who would bear the cost of curation? Clearly, dealing with the influx of thousands of feathers from banding labs and independent banders would require significant input in terms of funding for the handling and shipping of samples, as well as curation. Also the question of whether proposed irradiation of mail parcels by the U.S. Postal Service would result in loss of DNA from feather samples.

Despite financial, logistical, and scientific issues surrounding application and utility of feather collections, we believe the advantages far outweigh the disadvantages. As ecologists and evolutionary and conservation biologists, we need to convince institutions and governments the value of collecting this material and making it a priority.

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