What I Do: Notes from the Frontiers of Academic Curating in Biology

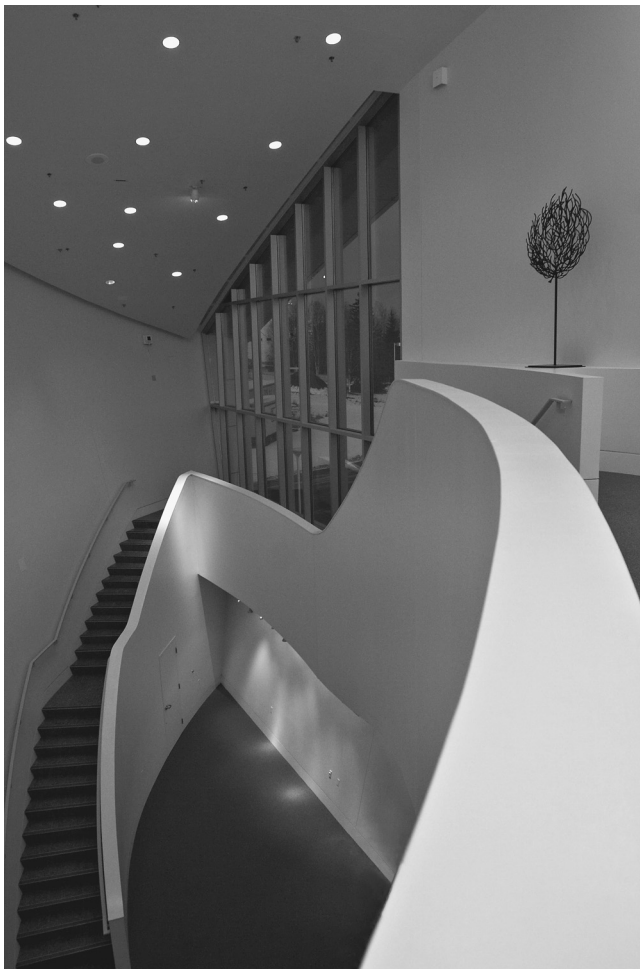
Kevin Winker

Abstract In an era in which genomes are being sequenced and support for traditional biological collections is diminishing, it's a dynamic time to be an academic curator in biology. Pressures arise from factors such as bureaucracy, from the need to document productivity in terms that largely neglect collections, from the seeming discord between taxonomic orientation and hypothesis testing, reliance on soft money, teaching and research, and the need to build collections. Some of us prefer to continue building collections nonetheless. These factors combine to produce unprecedented levels of stress on academic curators. However, these seas can be navigated, and doing so brings both traditional and nontraditional rewards. This article presents a personal working study in navigating this increasingly complex career choice.

First, Some Perspective

I am Curator of Birds at the University of Alaska Museum (of the North). I am also a professor in the Department of Biology and Wildlife at the University of Alaska Fairbanks. Additionally, I hold an unsalaried appointment in the Institute of Arctic Biology. Being a successful curator in academia is quite challenging these days. But as with most jobs, there are good and bad days. My job does provide a degree of fun work and excitement in field, collection, and laboratory. As a faculty curator at a research university, I have

Kevin Winker (ffksw@uaf.edu) is Curator of Birds and a professor at the University of Alaska Museum (of the North), the Department of Biology and Wildlife, and the Institute of Arctic Biology at the University of Alaska Fairbanks. He serves as chair of the Committee on Bird Collections of the American Ornithologists' Union.



responsibilities that are unusual among my faculty peers. My nine-month appointment is 25 percent teaching, 25 percent research, and 50 percent curating.

It is the curating component—responsibility for the growth, maintenance, and use of the State Bird Collection—that few understand. I have given considerable thought and effort toward "living the dream," if you will—attempting to define and achieve an example of modern academic curating that encompasses local to international scales. Like anyone, I have encountered bumps on the road. On a personal level, 16 years into my post-Ph.D. career, I am excited about my job and the future successes it will bring in teaching, research, and curating during the next 20-plus years.

In this article I will discuss what I do as a faculty curator, and the philosophy behind the approach I have taken to meld the disparate responsibilities of a modern academic curator so that the collections might continue to be engines of science and education. In an era when museum collections are demonstrating remarkable relevance to many questions of burning importance to science and society, we have nevertheless seen a decline in active university collections. If these important repositories are to remain helpful, it is imperative to revitalize their role in our institutions of higher education. The University of Alaska is among the world's foremost universities in coupling strong biological collections with the institution's mission. We must remind ourselves both of the essential mission of these collections and of the role these resources play if we are to ensure that the long-term strengths of these rather large investments are developed and realized.

Philosophy and Vision of a Modern Academic Curator

A museum collection gives daily contact with the stable aspects of the institution housing it. Those of us who routinely handle natural history specimens know intimately their lasting scientific strengths. Moreover, when you work with the specimens collected by scientists who preceded you (both in scientific and in human generations), you are tapped into the core of society's scientific enterprise.

When I use the term "specimen" I am thinking primarily of preserved whole-organism samples: dead animals preserved for scientific study. Few people see such specimens; they are not preserved for exhibiting or aesthetics, but rather for functionality. In the research context, sub-samples of animals—a few drops of blood or a few feathers, for example—have far less utility. Scientists focused on doing their studies and writing their papers tend not to understand the fundamental difference between the attributes of samples versus those of specimens. When you use a sample for a specific purpose, you tend to be blind to the specimen's many other uses, either now or in the future. And the future is where more attention needs to be paid. Too many decisions regarding specimens are made in the shortsighted present.

Natural history collections have taught us that we cannot anticipate the scientific questions of the future that will be addressed by today's specimens. Moreover, the future questions are probably more important to society than the question(s) for which the specimen was preserved in the first place. Because a specimen is available, and is used again and again for continued studies of many different kinds, whole-organism sampling has no peer in terms of economics and long-term scientific utility.

In my experience, you get more bang for your science buck, or scientific return from your time investment, when preserving specimens for long-term scientific use. I am sure many would debate this point, but they would have an uphill battle. Progressive changes like the elimination of DDT from our environment owe a huge debt to natural history collections. I have called this the "biological filter paper" aspect. A specimen documents the environmental conditions of its time and place, enabling it to serve an invaluable role for future studies (Winker 2004). As the biological world continues to change at an increasing rate (because humans have an increasing presence), it's vital to understand how earth's web of life is affected—not only for us humans but also for other species along for the ride. Clarity relies on preserved specimens, which are increasingly being used for studying contaminants, diseases, resiliency, genetic diversity, organism distributions in relation to development and environmental disturbance, food web changes, biological responses to climate change, and other aspects of the biological world that are in a state of flux. The studies generated by curators—as important as they seem to those of us having that title—are but a small part of the scientific insight that society gains from its collections investments.

Part of the challenge and opportunity of curating a scientific collection is to continue to bring its strengths to bear on current scientific issues. A big part of the curator's job, then, is to keep the collection active and growing—and in a very real sense anticipating the future needs that tomorrow's scientists will have for specimens from today. Couple this slower, long-term temporal beat with the need for product in the present (papers, students, and grants), and you have a complicated dance.

Despite institutional longevity (how often do universities fold?), there is a degree of dynamism in the component parts: Principle Investigators (or PIs), students, and research. Dynamic continuity is a good way to think of it. Because the enterprise runs on soft money—grants and donations, with no internal budget allocations of any consequence—the actions of individual curators can be the equivalent (in dietary terms) of a diet of sugar and caffeine. In one's moment-to-moment frenetic existence, while riding the sugar and caffeine high, time seems to pass rapidly.

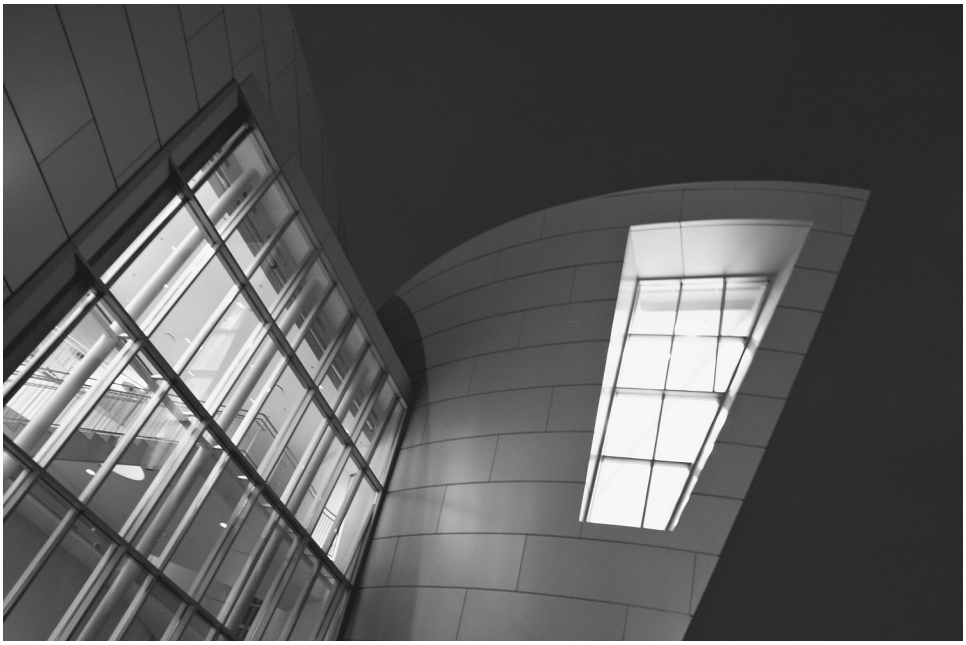
From the collections perspective, time passes more slowly. Even an institution's buildings are ephemeral when compared to the longevity of the traditional scientific natural history collection. Going home at the end of a day after preparing bird specimens, I feel a deep sense of having accomplished something that will survive me and those around me (bird skins will last literally for centuries). At that moment, it doesn't matter that many of my non-curatorial colleagues do not understand this type of product.

Over the long term, however, a lack of understanding does matter. Building the scientific infrastructure of the present and future by growing natural history collections does not usually have a large impact on personnel assessments, nor does it often receive priority at institutional levels. My institution is an exception to this generalization and is among the leading universities of its type in properly recognizing the importance both of biological collections and of its curators' continued commitment to increasing those collections. That institutional backing comes, for example, through formally apportioning half of the curatorial positions to curating itself and including the details of such duties in the Unit Criteria for evaluations approved by our academic departments and the faculty senate. It is common at other institutions to find a terrible oversight on the part of administrators, who do not consider the human effort required to keep collections active and growing as being equal to the academic processes of producing publications, students, and grants. Such an oversight is hard to understand, because collections will almost certainly outlast all of the latter, enabling continued productivity, supporting important scientific progress, and bringing long-term recognition to the institution.

The problem for all of us not intimately tuned into the subject of biological collections at the academy lies in the difficulty of grasping the very different temporal beats of scientific progress versus the addictions to the sugar and caffeine highs of research cash and rapid gratification. Scientists are trained to consider published research products (peer-reviewed papers) as the sterling measure of productivity. But part of that game is as artificial as the rabbit that greyhounds chase around the racetrack. In reality, the papers we publish today will be noticed and cited by other scientists for a few decades at most. Although they may contribute gravel to the path of scientific progress, these papers, over time, are largely forgotten. In contrast, preserved specimens increase in scientific value over time.

Curating and Science

Curating a taxonomic collection is a scientific conundrum, because in our era science is expected to be question-oriented rather than taxon-oriented. This can create a horizontal-versus-vertical friction in one's approach to science. Much anguish arises here. It can disrupt colleagues and supervisors, as well as authorities who think they have a better understanding of how science should be conducted. At issue is whether one conducts experiments and tests hypotheses, or uses what Mayr termed the observational-comparative method, based on observation (1982). Not all learning is (or can be) advanced through experimentation or hypothesis testing. The view that this is the only approach to "real" science is thankfully (albeit slowly) declining. Mayr vividly emphasized the observational-



comparative method's important role in the history of biology: "Observation in biology has probably produced more insights than all experiments combined" (1982, 32).

Some of our greatest advances—sequencing the human genome, for instance—are made through exploratory (rather than hypothesis-testing) motives. We always want to see what's over the hill or around the bend. Sometimes we can predict what we'll find; at other times we'll just take a look, with few or no expectations. To me, what is important is the scientific process, in which observations give rise to questions, which in turn generate hypotheses (tentative answers), which can be tested through experimentation (Mayr 1982). Personally, I enjoy all parts of this process, and don't feel the need to be involved exclusively at one end or the other. Collections foster all these stages. Exploratory methods have been a long-term strength, and they should continue to thrive together with hypothesis testing in specimen- and collections-based science.

Making It Work

Over the past several decades, the average growth rate of the world's bird collections has slowed or declined. University natural history museums and their collections have not fared well. When money and space get tight at an institution and something has to go, the less productive curators and collections often get the axe (whether actively or by not filling vacant curatorial positions).

Part of the challenge is to successfully match organismal biology with modern research and education, which increasingly emphasize experimentation and reductionism. A successful curator must be able to describe the relevance of organismal biology to modern science, and must demonstrate those values through results (papers, students,

grants). Institutions have problems finding new curators who can meet these challenges. And in a climate oriented toward short-term rewards, curators find it difficult to know the breadth of their situation and the responsibility of such positions to science and society. No central authority exists to make the job clear in this modern age. A crucial part of the role lies outside the experience of most non-curatorial colleagues and administrators.

When the attentions of curators, administrators, and colleagues are focused almost exclusively on short-term productivity, the long-term strengths of a collection are not well developed or served. I have gradually come to understand this, and it helps me determine how to think of my job and how to focus my energies. First, I wear three hats: I am an educator, a researcher, and a curator. From an institutional perspective this is a very reasonable division of responsibilities. The University of Alaska Museum houses the state's natural history collections, and Alaska has never had a formal biological survey. Curating thus comes first. Also, nobody else in Alaska has this responsibility in the class Aves (birds), so the importance of its getting done falls upon me. The global distribution of my colleagues is sufficiently thin that similar reasoning could apply quite broadly.

How shall I most effectively go about being a curator? Well, the quality of science generated from a collection is directly related to the quality of that collection. Over the long term I'll be one of many contributors to that scientific outflow. Thus, the collection's value to science and society will be greatly enhanced by increasing the resource's value to other researchers. (At the institutional level, it is important to have internally-funded research curator leadership; the collection's strengths should not be left to chance in either development or use.)

Quality growth is one element. But another involves a major decision: Am I going to be a curator, or just a researcher who uses collections? Many curators in name are predominantly the latter. Researchers using a collection, even if they are collecting and depositing their own material into it, typically do not have the vision required to develop the collection as a research resource for the broad user community. Collection development under such a curator would likely be focused on his or her narrow research interests and aimed at other similar researchers. If research criteria alone are used to fill positions and evaluate curators, then curating and collections development will languish behind the short-term and demonstrably ephemeral scientific fads of the present. When this results in squandering the long-term value of a collection, it's too great a cost.

Personnel evaluations at most universities, at least for now, prioritize an overly narrow set of short-sighted measures of productivity. Administrators and colleagues want to see returns for the investments being made in these programs. They are not wrong in looking for returns—although we collectively need to expand the vision of what constitutes return or "product." Long-term outlooks cannot be neglected, but neither can the collection afford to go dead or comatose by neglecting short-term productivity. Given the unacceptability of having a collection's short- or long-term productivity dwindle to near zero, a main goal of curating is to strike a balance between these two seemingly disparate types of contributions. Ideally, the long-term strengths should be planned and not accidental (as they too often are because so much attention is paid to short-term gains).

As a curator, I need to manage my research time so that I generate new information on the rapidly moving edges of science. The most effective way to do this (because it is the

most efficient and retains curating as a priority) is to couple at least some of my research to curating and the long-term strengths I am trying to develop in the collection. Although curating the collections often has no overlap with my research (which may not involve specimens), I find it possible to exploit research opportunities that come on the coat tails of strong collections development. Research questions begin to appear in the specimen trays as collection gaps are filled. And when collections development comes before research (as it must in my job), the overall scientific gains tend to be much greater. As a consequence, I have adopted an approach that is potentially costly to short-term research productivity because it gives priority to curating rather than research. But this approach is less selfish, more altruistic, and—I would argue—better scientifically.

Imagine that I need one or more specimens of a particular species for a study I have planned. The cost and field effort involved in getting these specimens would likely be similar to the cost and field effort of going to the same place and making a broad, institutional-scale collection. The former involves a little less work in specimen preparation and permits, and the sharp focus might generate a published paper more rapidly. In contrast, when a study is focused on an area and the diversity of its birds (or other organisms), single questions are not driving the outcome, and long-term gains in specimens are assured. This latter style of work has become less popular, but overall it yields greater gains. Ultimately, this increases bang for buck and enables more science to be done. Specimen collections are usually spotty in taxonomic, geographic, and temporal coverage. Large gaps remain to be filled by institutional collecting efforts.

When going into the field without focusing rigidly on a single question, I often find other things of equal or greater interest. Many years ago I attempted the other approach—field work with a focused question—but quickly learned that I was neglecting data (and specimens as potential data) that were probably more important. Pasteur's phrase, "Chance favors the prepared mind," is absolutely true. If you are in the field with too precise a focus, your contribution to science will probably not be as great as it might have been had you had more long-term thoughts. This reasoning has proven valid in my case, and I have learned to enjoy the broader scientific issues with which I am involved and the diverse and interesting work being done on specimens that I had a role in bringing into collections.

One example to illustrate the benefits of a broader approach is in our enhancement of the seabird component of the University of Alaska Museum's bird collection. I have little research interest in seabirds, but this is a large and important segment of Alaska's avifauna. Most of our specimen additions to this diverse group of birds have come through salvage of birds found dead or killed (on purpose or inadvertently). Important sources have been the longline fishery by-catch (birds taking bait on hooks from commercial vessels before the hooks sink to the bottom of the sea, dragging the birds with them to drown) and airport runway safety measures (shooting pest birds before they cause air strikes and airplane crashes). We have added thousands of birds to the collection from these sources. But we have also actively collected many seabirds, because in many areas no fresh dead birds are being recovered, and many species are rarely if ever found dead.

In working to fill our collection's seabird gap, we determined that one important geographic and taxonomic area consisted of cormorants from the Aleutian Islands. We were

aware of the need to boost sample sizes of Aleutian cormorants and had planned to do so. The state's bird collection is seriously deficient if we do not have the definitive material on these birds from our own back yard (nobody else does, either). Documenting biodiversity at the species level is one of the most important functions of a bird collection, and this was a gap that existed in collections the world over. We were already active throughout the Aleutians—we just had not yet made the special effort to get cormorants.

In processing larger birds for scientific specimens we throw away a lot of muscle and internal organs; with regard to soft tissues we save only a few cubic centimeters for genetic samples. Cormorants are large, common birds, not caught as by-catch. As piscivores (fish-eaters) they are near the top of the food chain. Coupled with this there was recent evidence for contaminants being a problem in the Aleutians. Deborah Rocque, on board with us as a graduate student, had experience in contaminants and research desires in this area for her Ph.D.

While filling an important taxonomic and geographic gap in the collection, and by using parts of the birds we usually throw away, Rocque developed a good study and we wrote an interesting paper showing that the remote Aleutian Islands have point sources of pollution (probably from World War II-era military bases). The Aleutians also receive contaminants from Asia through long-distance air transport (Rocque and Winker 2004). Such synergy between collections growth and research is stimulating and satisfying in a collections sense because it goes to the heart of efficiency by simultaneously generating product in both areas.

These cormorants are a good example of how short- and long-term productivity can be melded effectively, although we cannot always attain such efficiencies. In fact, we have no research interests in the vast majority of the thousands of seabirds we've recently added to the collection, although they are attracting many new users. I routinely collect and prepare specimens that don't interest me personally but are important for filling taxonomic or geographic gaps. The alternative would be to prioritize my own research. If I did that, my productivity would probably double. However, I get much satisfaction from making the long-term investments that will enable future science to blossom.

Teaching from and in Collections

So far, I have left out of consideration the educational role of collections. Institutions, curators, and the National Science Foundation (NSF) make a proper distinction between teaching and research collections. Teaching collections are used almost exclusively for that purpose, and they suffer considerable degradation as a consequence because the specimens are handled too much for long-term preservation. Teaching collections are investments in science education. A research collection should serve a role in education, particularly at university museums and especially in graduate education. However, a natural history research collection cannot be sustained by its role in education or its derivative, public entertainment.

One of my most important responsibilities as a faculty curator is to couple the core strength of the museum—its collections—with education. In the U.S. and globally, there

are relatively few opportunities for graduate students in active university museums. A faculty curator develops such opportunities and finds students seeking curatorial assistantships that will provide them with a background not only in specimen-based research, but also in the complicated details of curating and collections growth and management. Research assistantships are common, in comparison; by the formula of my appointment, they must come second to whatever curatorially based support I can develop. (There are no internal funds for either).

I also teach undergraduates. My teaching responsibility is to provide one course per year. This has mostly involved teaching Ornithology to juniors and seniors, and I've also done classes in advanced topics in evolution for graduate students. In addition, we offer an informal weeknight skinning class in scientific bird preparation. The focus is on specimen preparation, but time is also spent in the collection, examining dissections, and discussing birds and ornithology. Undergraduate and graduate students, volunteers, interested members of the public, and agency personnel attend these sessions. Graduate students have come to play a strong role in this program. It remains a valuable teaching and mentoring exercise.

Informal teaching is a frequent component of our museum existence, because visiting students, colleagues, dignitaries, and members of the public drop by our labs for scheduled tours. During our Halloween event for children and our annual Open House, many hundreds of visitors come through our labs in just a few hours. The opportunity to share something we are passionate about with others, even briefly, is mutually stimulating.

With some support from Alaska EPSCoR (NSF-funded Experimental Program to Stimulate Competitive Research), I worked with Terry Dickey, head of Museum Education, and Cyndie Beale, West Valley High School biology teacher, to help an undergraduate student interested in high school teaching to create a hands-on specimen collection to use in high school classrooms to teach adaptation and natural selection. This effort was very successful. The collection is now part of the West Valley teaching infrastructure and is used in many classes.

There are fewer and fewer opportunities for students to gain experience with specimens and natural history collections. Ultimately this is causing a gap in the professional training of people who often do not know the importance of bringing back specimens they find dead—or if they do bring them back, too often they don't follow through and record proper data or get them preserved and into a collection. Too few professional wildlife managers know how to preserve a scientific specimen. It is, unfortunately, no longer surprising when we learn of agency personnel making decisions that demonstrate a lack of understanding of museum collections and the important role specimens play in science-based resource management. There are noteworthy exceptions—some terrific agency employees who know how important it is for two groups who have broadly shared goals to work closely together—but each year their numbers seem to dwindle.

We need a stronger working relationship between museums and resource management agencies. It is cost-effective to collect and archive samples of the biological systems we're monitoring and managing. That way, when something begins to change, we can go back and figure out what correlates with those changes and may have had a causative

role. It worked beautifully with DDT—and in a human health context, with Lyme disease. (See Winker 2004 for more on this type of retrospective collections-based science). Instead, however, much of today's monitoring and management focuses on counting things and using number changes to stimulate investigation into causes. This is overly reactive, and probably costs more in the long run, because there is little or no baseline evidence other than numbers to begin to probe for causation when system changes bring urgent questions. A substantial part of my job has become an attempt to inform and educate agency personnel about these possibilities.

In sum, the teaching component of my job is far broader than I could ever have guessed, even in my first years as a curator. It is fun, interesting, and amazingly diverse.

Juggling Anvils

It's an exciting time to be a biologist. In my job I get to practice the best of nineteenth-century biology—exploration and discovery in the field—and the best of twenty-first-century biology, such as bringing samples into the laboratory and generating DNA sequences, then applying powerful computers and sophisticated algorithms to analyze complex new data. The scientific products can range from distributional and taxonomic notes to papers on genetics, evolution, ecology, and interdisciplinary topics. Engaging in such a broad scope of scientific enterprise can be quite stimulating. It can be a mind bender, too.

When your job has stringent funding limitations, but no overt barriers, you can go hog-wild. The plank across the stream can be improved. The air castles of proposals can be built. Exciting questions can be developed and addressed. You can succeed as a dream builder. You can begin to think in short- and long-term scales. However, in university terms, you are unlikely to find ways to make your enterprise permanent. You run it on soft money, which inevitably runs out. Flush one year; poor the next. This is a tough cycle. It keeps you on your toes and keeps the knife blade of competitiveness always sharp. Running an enterprise on soft money—just keeping your students' stipend money coming in, and maybe paying yourself a summer salary—is only one of the accepted pressures of the job.

Teaching, curating, graduate students, committees, correspondence, professional meetings, seminars, visiting colleagues, speakers, researchers, job candidates—there are plenty of duties and diversions to fill one's calendar. Sometimes in my escapes to the field I feel as though I am juggling anvils to free up just a little space for research. Keeping those anvils in the air and preventing them from crashing to the ground is one of many skills we didn't learn in graduate school.

Academia presents so many good opportunities that it is easy to become overengaged—to become spread so thin that days are far too short, and even easy things don't get finished without delay. You can get good at being efficient and productive. If you pay attention, however, you may realize that you're at the edge of what you can accomplish and the load requires you to neglect other important things, like sleep.

This is all part of exploring personal space, and everyone will do this differently. I

try to learn lessons from others. For example, Peter Medawar, a biologist and Nobel laureate, viewed his stroke as a direct consequence of obsessive overwork. A few lines in his autobiography leapt out at me: "Any sufferer from hypomanic busy-ness tends to create the very pressures from which he or she struggles to be free. The condition is self-exacerbating because one tends to be blown up with the feeling of being equal to any demand through having become expert in the allocation and fruitful use of time" (Medawar 1988, 151). Another sentence rings so true it's frightening: "A danger sign that fellow-obsessionals will at once recognize is the tendency to regard the happiest moments of your life as those that occur when someone who has an appointment to see you is prevented from coming" (1988, 150). The noted scientist, curator, and historian G. Brown Goode (1851-1896) "was regularly chided by colleagues who warned him not to be overwhelmed by the 'ceaseless grind of museum work,'" and he died at 46 "from what contemporaries called overwork" (Kohlstedt 1991, 6). There is a lot of exciting work to be done, but one does not need to go about it like a hummingbird.

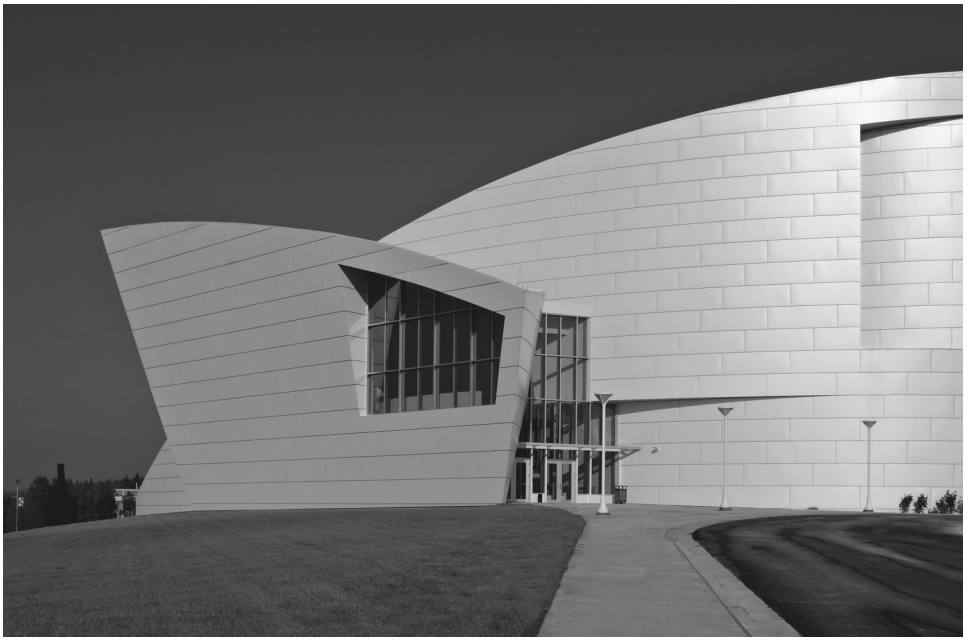
As I look back on the decade past, I am happy to have achieved a balance that is productive in our standard metrics: the bird collection is three times larger (averaging 1,500 specimens added per year); I have been principle investigator on $1.25 million and co-investigator on another $4.97 million in grant funding; author or coauthor of over 50 publications; and successful supervisor of eight graduate students (6 M.S., 2 Ph.D.).

Collecting Birds

Killing birds for science seems to many to be an incongruous approach to conservation. In fact, scientific bird collectors have been among the staunchest conservation advocates for over a century. I am proud to continue this tradition. I love birds and work hard to learn more about them so that we will continue to have these wonderful creatures along with us for thousands of years. The world is a poorer place for every species of bird lost, but they are not at risk of being lost due to scientific collecting; in fact, specimens have helped immensely in our efforts to manage and conserve birds successfully.

The number of birds collected for science is miniscule in relation to the numbers of birds that die each year from other causes. The birds killed annually by housecats and collisions with windows, communications towers, and vehicles far outnumber those killed for science. The number of mallards (*Anas platyrhynchos*) or mourning doves (*Zenaida macroura*) killed each year by hunters is higher than the number of birds of all species collected for scientific collections in North America during the past century. Sacrificing a few birds for science provides broad benefits to humans and to the biota we manage, by enabling us to learn more about them and to use that knowledge in management and conservation.

I've identified five reasons that seem to stimulate an opposition to bird collecting (Winker 1996); most are erroneous, and all are needless obstacles to this type of science. These reasons are: 1) Focusing conservation at the level of the individual; 2) unfamiliarity with population biology; 3) misunderstanding scientific research; 4) typological thinking; and 5) misplaced morality. I will address each briefly:



1) We cannot afford to confuse the welfare of the individual with the welfare of the populations we manage lest we quickly go broke. All individuals die, and there is no preventing that. Conservation is properly focused on populations and species.

2) The basic principles of population biology give us the ability to harvest animal populations sustainably, whether for science or for other uses (such as wild fisheries or hunted game). Annual mortality is not higher because of collecting; all agents of mortality generally act together at the population level, and populations tend to achieve a "carrying capacity." Annual mortality pushes them back down to this level (numbers usually go higher during the seasonal resource boom when reproduction occurs). This principle is still in operation even in declining populations, and in such cases (when populations are still relatively large) scientific sampling can help determine the cause of decline.

3) The highly productive observational-comparative method in collections-based science thrives on the long-term value of preserved specimens. They are not throwaway objects that lie around uselessly after today's study is done, but instead represent an investment in future research.

4) Typological thinking—in which one clings to the idea that one or two examples of an animal define that species or subspecies—ignores natural variation (in both biology and statistics). It has led some permit-granting agencies to allow the collection of only one or a few animals per species or population. In studying healthy populations, these quantitative limits compromise scientific quality by stopping an effort before natural variation can be documented. The population itself is not affected by having a tiny and essentially insignificant source of mortality thwarted.

5) Finally, opposing collecting on moral grounds should be treated as a religious view, one to be respected, but not imposed on others. There are many better and more effective ways to stop avian deaths—for example, from cats, window kills, communications

towers, vehicle strikes, and, most important, habitat loss. None of these other sources of avian mortality provides scientific benefits for humans and birds.

Scientists are not out slaughtering large numbers of birds. The numbers are, in fact, quite small. I have banded far more birds than I will ever collect, but the scientific value of the lower number of birds collected far outweighs the larger number banded. This is due to a simple fact that I learned as a graduate student: When I release a banded bird I am literally releasing most of the data that might be gained from a field effort. Bird banding can answer some important questions, and I still band birds. However, I never band birds without a collecting component, and I often collect birds without a banding component. Some of the most productive work I've done has combined the two. The datasets gained from such combinations are astoundingly rich and have a lasting value. I am confident that the scientific yield per dollar spent is very high.

Future scientists will look back on our time as one of the last in which we could obtain specimens of animals that are now common, but which in the future will become uncommon, rare, and even extinct. Collecting a few individuals now will not influence this trajectory. Humans are steadily eroding the habitats and ecosystems these populations and species need to survive. What is dooming them over the long haul is the unchecked advance of human development and the whole-scale conversion of animal habitats to fields, pastures, parking lots, shopping malls, and aquaculture farms. Stopping the construction of one rural shopping mall would do more for bird conservation than stopping ten bird collectors for the duration of their careers. This is like an immanent storm. I feel the pressure to document the avifauna of this era so that we can retain as much of it as possible—as thriving natural populations—through and past the worst of the human tempest.

Conclusions

When you add all this up, being an academic curator becomes quite a challenge. I do not mean to suggest that curating is nearly impossible to accomplish. Much of curating is simply helping others to be involved in the business. Creating new partnerships, fostering and increasing collection use, and increasing contributions to the collection bring about the collective effort needed to grow a strong resource. There is a joint responsibility to build and maintain a community resource; a broad group needs to participate if a collection is to realize its great scientific potential.

Partnerships, collaborations, and the integration of specimen-based work into more ongoing research can enable the collection to grow as it should from the contributions of many different people—and from many places and institutions and agencies. Above all, specimen-based researchers should recognize the value of working with curators to build long-term resources and put specimens into collections, if only to archive their own work for the benefit of future workers. Resource managers, too, should be routinely archiving specimens from the populations they oversee. Even non-professionals such as amateur naturalists and artists can make important contributions. In fact, ornithology, like many other disciplines, has a strong history of amateur contributions to collections and pub-

lished literature, and there is no reason why this cannot continue. Establishing relationships with curators and collections can easily enable anyone to contribute.

These views might be summed up as follows: Institutions, this is your scientific endowment. Manage it well. Curators, you are the front-line contracted managers of this endowment. Manage it well. Demonstrate investment gains at both short- and long-term scales. Find a workable balance in the disparate obligations and opportunities that enable the collection to achieve its great scientific potential. Non-curatorial colleagues, you too can use this endowment to address your research questions. You should also find ways to contribute to its growth and maintenance. Resource managers and agencies—get involved. From collections, we learn so much of great importance to the resources you manage that this learning should not be allowed to happen by accident. Programs to monitor populations should routinely include specimen archiving. Salvage programs should also be established and funded.

As I write this, I have a strong urge to prepare a bird specimen. It is a product guaranteed to escape rapid recognition (unless a visitor drops by). However, it adds another brick to a complex and beautiful assemblage that is part of the infrastructure of science. And people will still be using it long after I'm gone.

Acknowledgments

I thank past and present administrators at the University of Alaska Fairbanks (UAF) for their support and understanding of people and collections, especially Aldona Jonaitis (director of the museum), Paul Reichardt (provost, UAF), and Joan Braddock (dean, College of Natural Science and Mathematics).

References

Kohlstedt, S. G. 1991. *The Origins of Natural Science in America: The Essays of George Brown Goode.* Washington DC: Smithsonian Institution Press.

Mayr, E. 1982. *The Growth of Biological Thought*. Cambridge: Belknap Press.

Medawar, P. 1988. *Memoir of a Thinking Radish: An Autobiography*. New York: Oxford University Press.

Rocque, D. A., and K. Winker. 2004. Biomonitoring of contaminants in birds from two trophic levels in the north Pacific. *Environmental Toxicology and Chemistry* 23: 759-766.

Winker, K. 1996. The crumbling infrastructure of biodiversity: The avian example. *Conservation Biology* 10: 703-707.

_____. 2004. Natural history museums in a post-biodiversity era. *BioScience* 54: 455-459.

WHAT I DO; KEVIN WINKER: In Fairbanks, Alaska, the University of Alaska Museum of the North commands a ridge overlooking the Tanana River and the Alaska Range. *Photos courtesy of University of Alaska Museum.*