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# WHAT IT MEANS TO BE A NATURALIST AND THE FUTURE OF NATURAL HISTORY AT AMERICAN UNIVERSITIES

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This commentary originally was presented to recognize receipt of the Joseph Grinnell Award for Excellence in Education at the 85th Annual Meeting of the American Society of Mammalogists in Arcata, California, in June 2004. Natural history is the multidisciplinary description of nature, and naturalists are those who study nature. In its own right, natural history is a relevant discipline, despite varying degrees of focus by professional biologists and academic institutions over the past 100 years, and it is a critical contemporary discipline relative to global crises in the conservation of biodiversity. Many scholars have written that natural history has fallen out of favor at American universities. I review this perspective within the context of 20th century developments in society and trends in American higher education. My conclusion is that a narrowing of the context of natural history in the 20th century has diminished its significance. However, there is compelling evidence that, if we broaden our approach and horizons, natural history scholarship can play a pivotal role in American science and education in the 21st century. Institutions of higher education that emphasize natural history in their curriculum will enhance not only their academic profile but also students' appreciation of the importance of natural history throughout their lives.

Key words: academic programs, higher education, natural history, naturalist

This is a good time to think about what it means to be a naturalist because we are in a new millennium that provides an opportunity to take stock of ourselves and think about where science and society in general are heading. Although about one-half of my career has been spent in academic administration, including leadership as department head, dean, vice president, and president at 2 large public institutions, I have remained active as a naturalist, and I have a great deal of interest in the future of my profession.

Recently, an article appeared in the *Chronicle of Higher Education*, which is read by many academics in the United States, entitled ''The Impending Extinction of Natural History'' (Wilcove and Eisner 2000). The authors conclude that natural history is disappearing at many American universities. Naturally, it is not very comforting to read that everything you are and worked so hard to become might simply disappear.

So, I decided to write this essay from the perspective of a mammalogist and college president to explore more deeply the plight of natural history and the role of naturalists within the context of 20th century developments in society and trends in American higher education, and more importantly what might be done about it as we enter the 21st century with more need than ever for a robust science of natural history with a return to prominence and respect for the work of naturalists.

## THE DILEMMA OF THE NATURALIST AND NATURAL HISTORY

If we begin with a definition of natural history, right away we will encounter a problem. It turns out that the history in natural history has little or nothing to do with history as we commonly conceive and use the term, that is, something to do with the past (Herman 2002). When the term was coined, ''history'' meant ''description'' (i.e., systematic account). Viewed in this context, natural history is a description of nature, and naturalists are those who study nature. That is exactly how it was viewed in historical times—essentially a descriptive and analytical science. Although natural history has evolved far beyond its historical roots, many in public and scientific communities who do not work in the area are unaware of the advancements, and in modern biology the terms ''naturalist'' and ''natural history'' have lost their precise meanings. There have been many explanations for this, and it is amazing how variable they are (Dobzhansky 1966; Grant 2000; Schmidt 1946). The dictionary does not help, implying that what we do is more popular than scientific and that we are mere amateurs. Some modern writers, while expressing appreciation for the work of naturalists, have referred to natural history as ''old-fashioned'' and associated it with the term ''nature lover'' and of an era long passed (Nichols 1992). On a more encouraging note, new literature has appeared that articulates who we are and

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where we are headed, even though some of it is not that reassuring (Futuyma 1998; Grant 2000).

As early as the beginning of the 20th century, important scientists began talking about scientific as opposed to amateur natural history. David Starr Jordan, an ichthyologist and the founding President of Stanford University, defined natural history this way in 1916: ''By old-fashioned natural history, I mean the recognition or study of animals and plants as completed organisms, each greater than the sum of all the parts. It involves knowledge of names and of some degree of classification. It leads up to the problem of the origin of species, the affinities of forms, of the complex relations we call habits, the problems of geological and geographical distribution, the details of evolution and a balanced knowledge of things as they are, as actual through temporary stages in a university of change. It is at once the beginning and the end of biological study'' (Jordan 1916, quoted by Magnus 1993:3) I believe that this definition fits closely with the perspective of natural history practiced by most mammalogists in the 20th century. This is not surprising given that Jordan was an early mentor of Joseph Grinnell, who most people acknowledge was the founder of academic mammalian natural history (Jones 1991).

Mayr (1946) spoke of the ''new systematics,'' of the new ''natural history,'' and of the naturalist–taxonomist. He described the taxonomist of the mid-20th century as a naturalist in the broadest and best sense of the word—a student of nature in all of its aspects. In addition to being a morphologist, he or she must be a zoogeographer, an ecologist, and a student of animal behavior. He or she must combine this with knowledge of supporting fields, such as genetics, geology, and statistics. Dobzhansky (1966:544), in addressing the question of whether or not naturalists are old-fashioned, described a naturalist as ''... a biologist interested chiefly in the Darwinian, or compositionist, aspects of the phenomena of life ...'' in contrast to the reductionist approach that seeks to describe biological phenomena in terms of chemistry and physics.

Grant (2000:4) described the modern naturalist as ''basically an explorer and tester of evolutionary and ecological ideas that are developed to reveal and explain regularities in nature.'' Naturalists encounter a variety of organisms in nature and attempt to explain what they find. To be a naturalist is to ask questions directly about organisms in nature and to seek answers wherever they are to be found (macroecology, population genetics, and so on), by whatever means are available (field experimentation, analysis of DNA, and so on).

Herman (2002:934), a wildlife biologist, offered a more traditional definition of natural history as ''the scientific study of plants and animals in their natural environments. It is concerned with levels of organization from individual organism to the ecosystem, and stresses identification, life history, distribution, abundance, and inter-relationships. It often and appropriately includes an aesthetic component.'' With regard to the latter statement, Schmidt (1946:62) suggested that ''naturalists, in becoming more scientific in attitude, need not and should not lose their essential quality of an emotional enthusiasm toward natural phenomena. It is this that distinguishes the naturalist among scientists, and it is this quality of enthusiastic interest that makes naturalists the best of teachers and enables them to bridge the gap from the sciences of biology and the sciences in general to the non-scientific public.''

To me, the descriptive definition of Jordan combined with the more theoretical explanation of Grant offers the most precise concept of what natural history is and what a naturalist does. Good natural history is a source of timeless, priceless information for the biological sciences. It inspires theory as well as provides crucial data for answers to comprehensive, synthetic problems in ecology, ethology, evolution, and conservation biology (Greene 1986). I also agree with Herman and Schmidt that the aesthetic and emotional interests of naturalists give them credibility with the public on important issues of conservation and environmental policy.

## Historical Context: It's Déjà Vu All Over Again

In my historical research on this topic, I found out that things have a funny way of happening again, even if it takes a while—it's déjà vu all over again, to borrow a phrase from Yogi Berra. So it is not surprising that in reviewing the history of biology, I learned that the current situation is not the 1st predicted extinction and funeral for natural history and the naturalist. At the end of the 19th century and beginning of the 20th century, a similar prediction was made at the time of the so-called ''dichotomy'' between the experimentalists and the naturalists (Allen 1979). In my opinion, this split has continued even into modern times.

High-handed and sometimes arrogant statements came from both sides. Our own C. Hart Merriam became embroiled in the battle (Merriam 1893). He severely attacked the experimentalists and complained about university curricula in biology. According to Merriam (1893:355), ''The pendulum has swung too far in the direction of exclusive microscopic and physiologic work. When it swings back (and I believe the time is not far distant) the equilibrium will be restored—the perverted meaning of the term 'biology' will be forgotten, and the present one-sided study of animals and plants will give place to a rational biology and to the advancement of a school of naturalists far in advance of those who have passed away.''

The progress of biology was being stifled by such infighting and narrowness. Leaders began to call for a synthesis of methods and aims. Perhaps the most successful attempt to create unity in biology was the rise of neo-Darwinian evolutionary theory, termed by Julian Huxley as the ''Modern Synthesis'' or the ''Evolutionary Synthesis'' (Mayr 2004). It has been hailed by biologists and historians alike as the primary integrative event in 20th century biology. The Evolutionary Synthesis was chiefly the union of 3 groups of biologists: geneticists, paleontologists, and naturalists. This ended the rift with the experimentalists, and it resulted from the efforts of a few ''bridge builders,'' including such renowned scientists as Theodosius Dobzhansky, George Gaylord Simpson, and Ernst Mayr (Futuyma 1998).

## Why and How Did This Happen?

During our nation's first 2 centuries, naturalists sat as presidents (Thomas Jefferson and Theodore Roosevelt) and

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were admired for it. Charles Darwin, who contributed many of the concepts on which the paradigm of modern biology rests, was first and foremost a naturalist (see Mayr [2004] for a thorough discussion about Darwin's influence). Now, the attrition of academic naturalists has progressed over the past half-century throughout the country. We have experienced an extinction of experience.

So what happened? Greene (1986:100) argued ''the reasons for recent disinterest in and condescension toward natural history include: strict adherence to Popperian concepts of what constitutes science, without regard for the origins of theory; widespread appeal of reductionism and a certain 'technophilia' that have accompanied the rise of molecular biology; and powerful, institutionalized pressures to deliver fast results'' and garner large research grants. According to Greene (1986:100), ''natural history has not sustained a comparable aura among evolutionary biologists, and much of it has been done anecdotally, seemingly as an afterthought and under the naïve assumption that no special training, perspective, or effort was necessary.''

In another essay on this topic in *Orion*, Pyle (2001) postulated that the demise of natural history had to do with 3 main developments: rise of highly quantitative, experimental, and specialized scholarship—the so-called ''hard sciences''; depopulation of the countryside and rise of the cities and suburbs; and World War II and the subsequent Cold War.

Mathematics had traditionally separated biology from the physical sciences. As mathematics penetrated deeper into every province of science, the descriptive and empirical nature of natural history began to seem subjective to its critics. The naturalist's methods were seen as oriented to the field and the museum, as descriptive and qualitative in form, and as resting largely on inference and speculation (Allen 1979). Natural history became not only unfashionable, but derogatory; naturalist came to be a pejorative, or at best a quaint condescension, connoting a lack of conceptualization, intellectuality, or scientific vigor (Futuyma 1998).

When World War II started, resources shifted to support a kind of science that delivered specific results; bombs capable of precise mayhem seemed a higher priority than classifying beetles (Pyle 2001). And then came Sputnik. After 1956, advanced academic programs in mathematics arose around the country. Biology classes shifted toward the microscope and away from the field. Meanwhile, urban flight left a much depleted population of rural residents in close daily contact with the countryside. More recently, emphasis on medicine and genetics helped to drive research away from the whole organism and into the cell and molecule—out of the field and into the laboratory.

Peters (1980:192) portrayed a particularly negative view of natural history, describing it as more of an art than science, a ''contemplative and reflective activity,'' sometimes deeply satisfying but always of value solely to the individual observer. To quote Peters (1980:202): ''Natural history can convince us that the earth is worth salvation but it is too intricate, too personal, and too impractical to provide us with the tools necessary to save it. This is the work of science.'' Thus, his justification was that natural history is art and not science.

Bartholomew (1986:328) provided a strong response to this narrow-minded understanding of biology, noting: ''Observations of the natural history of the biological world, where organisms are the principal integrative units and the vehicles through which natural selection operates, tell us unequivocally that although the philosophers of science are particularly on target for chemistry, physics, and perhaps molecular biology, they are probably misoriented with regard to higher levels of biological integration. The approaches of classical chemistry and physics become progressively less appropriate as one ascends the hierarchy of integrated levels in biology.'' Mayr (2004:5) argues, conclusively in my opinion, that biology is a bonafide autonomous science, even though it has some properties that are not found in the physical sciences, and he speaks forcefully about the dangers of reductionism, which he believes ''should be removed from the vocabulary of science.''

## What Has Happened at American Universities?

After 1945, American universities underwent profound changes that over time would influence naturalists and programs in natural history (see Graham and Diamond [1997] and Rhodes [2001] for discussions of the major trends in higher education). New federal science policy and increased investment in science by the government combined to increase campus research efforts. An arms race ensued that escalated yearly, as institutions of every stripe competed ever more aggressively for better students, better faculty, government grants, private gifts, prestige, winning athletic programs, and commercial market dominance. Institutions, particularly the large elite public ones, developed a growing dependence on outside support to cover indirect costs to fund internal research infrastructure. Research universities then began focusing increasingly on for-profit ventures intended to provide the sponsoring institution with robust and stable sources of revenue. This pursuit of profits proved to be both infectious and diverting, but necessary in light of diminishing public appropriations.

Young faculty who demonstrated research progress through scholarly publications won increased upward mobility as the American academic market matured. Then, department heads and university administrators valued faculty who could secure large grants that would pay their salaries and cover full indirect costs. Faculty in these areas gained further advantage, especially if their work had a strong likelihood of being commercialized.

At the same time, a certain ''faddist'' or ''bandwagon'' aspect developed in science and biology. Certain approaches and disciplines became in vogue and others lagged behind, declined, or disappeared altogether. Most significantly, and also most regrettably in my opinion, the biology bandwagon shifted from outdoor to indoor studies. Arrogance also set in, with disdain often being expressed by people working in one discipline toward those in another (e.g., classical or old-fashioned biology versus modern or molecular biology). Field studies and natural history lost out in most of these battles. New people entering the profession tended to gravitate to the popular fields without taking stock to see if the older fields, whether descriptive or experimental, needed further work, and with no provision

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for the continuance of work in them (Schmidt 1946). These dichotomies of outdoors versus indoors, or field versus laboratory, have little theoretical or methodological meaning in biology. The prime consideration should be for them not to advance separately or in isolation, but rather together in cooperation to increase unification and integration of biology (Dobzhansky 1966).

Long-term field studies, so critical to development of theory in natural history, virtually disappeared at universities because they did not lend themselves to the temporal requirements of dissertation research, timely tenure reviews, and rapid production of solid publications (Tinkle 1979). Granting agencies became reluctant to support long-term studies, particularly by beginning investigators who might do their best, but for the same reasons are reluctant to initiate such studies (Tinkle 1979). Likewise, taxonomy and descriptive systematics suffered similar downturns (Isely 1972; Kruckeberg 1997; Lammers 1999; Landrum 2001).

Thus, the various economic factors, such as research grants and social forces associated with career advancement and disciplinary norms, encouraged specialization and fragmentation of biology. Following the shift in attitude came institutional changes that impacted natural history programs and naturalists. Universities disposed of their research collections (Dalton 2003; Gropp 2003, 2004); departments of zoology, entomology, and (except by vigorous resistance) botany were dismantled and replaced by departments of biochemistry, ecology, and evolutionary biology, and the like. Naturalists did not fare well under these circumstances and a gradual attrition, particularly at the large research-intensive institutions, began to occur. As budgets tightened and reductions became necessary, it was often the naturalist–curator whose position was eliminated (Kaiser 2005).

Now, field natural history and descriptive systematics are discouraged in many academic biological programs. Regular positions held by prominent field biologists with an active student program have been discontinued when the professor involved retires. The naturalist has been replaced by a specialist in some laboratory area. We have watched course offerings in organismal biology dwindle at many universities. And, we have seen vastly more grant money become available for laboratory biology than for field investigations.

## So Is Natural History Really Dead?

No, certainly not, but it appears to be at a serious crossroads. Although at one time the terms natural history and naturalist developed the pejorative connotation of a lack of conceptualization, intellectuality, or scientific rigor, now there is some indication that these terms are reemerging. This is good news, and much of the comeback is due to the hard work, the reputation, and the respectability of 1 man, E. O. Wilson of Harvard University (Wilson 1995).

Now we are beginning to realize there is such a thing as a scientific naturalist, and many distinguished evolutionary, ecological, and organismal biologists justly bear that title. A scientific naturalist is a person with a deep and broad familiarity with 1 or more groups of organisms or ecological communities, who can draw on his or her knowledge of systematics, distribution, life histories, behavior, and perhaps physiology and morphology to inspire ideas, evaluate hypotheses, and intelligently design research with an awareness of organisms' special peculiarities (Futuyma 1998). A naturalist is the person who is inexhaustibly fascinated by biological diversity and who does not view organisms merely as models, or vehicles for theory, but rather as the thing itself that excites our admiration and our desire for knowledge, understanding, and preservation. Knowledge of natural history allows an investigator to phrase questions with precision and to facilitate synthesis from lower to higher levels of integration from organismal to ecosystem levels (Bartholomew 1986).

Although there may not yet be a crisis, there is certainly cause for concern that the store of living knowledge of organismal diversity could dwindle, specifically the disappearance of descriptive natural historians and systematists. Wilcove and Eisner (2000:B24) put it far more eloquently when they said, ''the deinstitutionalization of natural history looms as one of the biggest scientific mistakes of our time, perpetrated by the very scientists and institutions that depend upon natural history for their well-being. What's at stake is the continued vibrancy of ecology, of animal behavior and botany, of much of molecular biology, and even of medicine and biotechnology.''

Mares (2002:232) put it this way: ''If you do not know the taxonomy and systematics of the organisms you study—if you cannot identify them correctly and understand how they are related—then you cannot study them in any meaningful manner.'' Mares goes on to say, ''Unfortunately, [young biologists] no longer learn to identify species. They do not learn about taxonomy or systematics. Most do not take the classic courses that provide a strong background in species identification, natural history, field methods, and zoogeography, courses such as mammalogy. They concentrate on synthetic courses, or on working with a few species, becoming specialists before they are generalists. . . . They are sublimely ignorant of the diversity and complexity of nature.''

It may appear as if I am preaching to the converted because most readers surely agree that natural history is important. However, it seems that many of us, in teaching and training students, do not substantially act on our conviction. It seems clear that many students of ecology and evolutionary biology—and not just those dedicated to modeling, molecular evolution, or laboratory population genetics—are emerging from graduate school with little knowledge of organisms beyond the species they did their research on, often a system suggested by their adviser (Futuyma 1998). All of us have met and heard students who, in explaining their work on some aspect of the biology of mammals, birds, or insects, say that they are not interested in mammals, birds, or insects as such but, instead, as models for studying principles. They do not view themselves as mammalogists or herpetologists but as ecologists or evolutionary biologists—as if being a mammalogist were a badge of shame.

Natural history is too important to disappear, and there are signs that biologists in related fields are beginning to appreciate this dilemma and the growing importance of natural history. The field of wildlife management started as applied natural history, and according to Herman (2002), it would do well to

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regraft itself to those natural history roots, especially in view of the changing roles that will be manifest as this century comes of age. Disciplines such as field physiology require an understanding of an organism's natural history to develop hypotheses about physiological mechanisms (Costa and Sinervo 2004). Powerful experiments in community ecology must take into account knowledge of autecology and natural history of species' particulars and idiosyncrasies because only with this knowledge can experiments in community ecology reflect the actual influences of interactions among species (Abele et al. 1984). Furthermore, it has become apparent that the products of the work of naturalists, such as the information base associated with specimens collected by naturalists and deposited in natural history collections, are crucial to providing the data required to understand important problems such as the impact of climate change on the living world (Jensen 2004).

The real question is how and where natural history will survive and who will practice it. It is becoming popular again with the public, and many amateurs are taking a real interest. But it must have more than amateur interest to survive. In this regard, natural history is very much like the field of astronomy, which has both an amateur and academic following. If we achieve the same outcome, that is, a robust academic underpinning with strong public interest and support, then natural history will become even more important in the new century.

Natural history has a chance to thrive in the international arena, especially in megadiversity and developing countries that are only beginning to appreciate the value of their biological resources. For example, a cadre of young naturalists at Latin American institutions of higher education have developed strong education and research programs in mammalian natural history with considerable promise for both conservation and biological theory (Mares 1991).

It is more problematic to speculate on what will happen to programs in natural history at American universities. Natural history certainly has a chance to grow in importance in evolutionary biology and ecology programs. It also should continue to survive at state universities with wildlife biology programs. It needs to remain part of wildlife curricula, and those who teach it need to be educated as well as trained in the fundamental importance of natural history to wildlife management, biology, and research. And they need to be proud that they are teaching natural history, a topic linking their students so clearly, and so appropriately, to giants like Charles Darwin, David Starr Jordan and Joseph Grinnell, Aldo and Starker Leopold, and E. O. Wilson and Ernst Mayr (Herman 2002).

There are universities around the country that continue to successfully offer natural history academic programs. For example, the Department of Wildlife and Fisheries Sciences at Texas A&M University was founded by William B. Davis on the grounds of a strong natural history emphasis encompassing the ''ologies'' and built around the development of a natural history collection. (Davis was a student of Grinnell and followed his approach in establishing the Department of Wildlife and Fisheries Sciences, which he headed for 3 decades—Schmidly and Dixon 1998). A few liberal arts colleges, such as Evergreen State University in Washington state, have academic majors in natural history. The University of Vermont has a masters program in field natural history, and Texas Tech University has just created an undergraduate natural history and humanities major in its honors program.

Natural history research could thrive at those research universities looking for competitive niches to develop strong national reputations because it costs relatively little compared to the resultant benefits. There is no better example of this than Texas Tech University, where I was a student, faculty member, administrator, and president for many years. Texas Tech University initiated a major program in mammalian natural history in 1962 (ironically the same year that I enrolled there as an undergraduate student in zoology). This program includes undergraduate and graduate education, a large collection, a major publication series, and multiple faculty positions. The Texas Tech University program incorporates synergistic interaction between modern advances in science and the museum concept of archiving the biodiversity of life. It is unique in that opportunities are available for graduate research in collection management, traditional mammalogy, fieldwork, and molecular biology and systematics (Bradley et al., in press).

Natural history museums at research universities offer one of the best opportunities to reverse the decline in natural history and continue the education of naturalists (Schmidly 2001). By their very nature they are interdisciplinary and focused on issues more than disciplines. Their legacy is to connect with the public, and they have a history of engaging both undergraduate and graduate students in research education. They also are networked into a worldwide community of scholars committed to research in natural history, systematics, conservation biology, and bioinformatics. A superb example of this approach is at the University of Oklahoma, which recently opened the new and totally modern Sam Noble Oklahoma Museum of Natural History (Mares 2001). A similar example at a smaller, regional institution is the new Sternberg Museum of Natural History at Fort Hays State University in Kansas. Under the leadership of former American Society of Mammalogists C. Hart Merriam Award winner Jerry Choate, the Sternberg Museum, in association with the Biology Department, has developed a strong focus and reputation for scholarship in natural history.

Survival at the large, powerful research universities is more uncertain. They typically support big science and engineering programs with expensive facilities and faculty who are expected to bring in large grants and commercialize their work. At these types of places, natural history programs likely will be gobbled up, unless enlightened administrators understand their value and keep them alive. Notable exceptions to this trend would include institutions like the University of New Mexico and the University of California at Berkeley, where active programs remain in place.

## Strengthening Natural History and Stimulating Students To Study It

We can strengthen natural history by erasing the dichotomy between ''naturalists'' and ''scientists''—the supposition that one must be either an old-fashioned ''ologist'' or a builder of

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conceptual frameworks, but not both. Many students would like to pursue both the conceptual growth of our field and add to the store of knowledge of the biology and systematics of the organisms that most intrigue them—if they were encouraged to do so and if their teachers served as role models. Many evolutionary biologists and ecologists could teach not only about those subjects but also about the organisms they know. Think of how easy it should be, in filling an ecological or evolutionary faculty line, to hire someone who could not only introduce students to the thrilling developments in our conceptual subject matter but who also could inspire students with the diversity of organisms that, as Darwin said, excite our admiration (Futuyma 1998).

At universities, the key to reversing the situation lies in hiring (and eventually granting tenure to) scientists with an abiding affection for natural history. Administrators and senior professors who are not interested in natural history are not likely to value it when judging candidates for junior faculty positions. Without access to entry-level positions, a new generation of natural historians will never emerge to become tomorrow's administrators and senior faculty members. The institutions that pay for research, however, could assume a leadership role in rescuing natural history. If more money were available for basic natural history studies, more graduate students and faculty members would incorporate natural history into their research and teaching.

For natural history to persist and grow, there also will need to be a job market to provide professional positions for those students who pursue this as a career field. Unlike the situation in the academy, the news here is beginning to look better. Nongovernmental organizations, such as The Nature Conservancy, are employing graduates with natural history and field biology training and experience. State and federal agencies are expecting a substantial number of natural resource specialists to retire over the next decade (Colker and Day 2004). This will open career opportunities for people with natural history training, but it will be necessary to make changes in how they are educated. In addition to knowing something about natural history and organisms, they will need to be broadly trained and capable of working across disciplines (Packard and Schmidly 1991), with the ability to address broad issues at the ecosystem or watershed level; to process, filter, and distill copious quantities of information; to be familiar with advanced technologies; and to have communication, dispute resolution, and social skills.

Finally, we must address the perception that we have of ourselves and that others have of us. If we consider descriptive natural history and systematics to be ''old-fashioned'' and of little significance, there is not much hope that others will support it. We should stop worrying about ''physics envy'' or that molecular biologists will take us over. We should not apologize for continuing to accumulate the basic information upon which all other branches of biological science depend. Yet, we have seen scientists working in natural history (especially taxonomists and ecologists) criticized for their failure '' . . . to dispel the notion that their work—which involves dirty boots rather than gleaming lab machinery—is somehow less scientific'' (Anonymous 2004:385). It is time to regain our swagger. What we do is important and we do it with pride!

## Conclusions

I am actually optimistic and excited about the future of natural history in the broader context. There is greater need for our work than ever before. Much of it is done out-of-doors in moderately wild places that have been and are continuing to be degraded and destroyed at an unprecedented rate (Lubchenko et al. 1991). I coined the term ''archival natural history'' to describe efforts that document landscape change over periods of time longer than the life span of a generation of field biologists. I used that approach in my own work on the natural history of mammals in Texas (Schmidly 2002, 2004). It was clear from that research that we are losing parts of life's history that would seem unrecoverable, and we also are reducing our ability to interpret that history. Remnants of natural environments and their occupants color our view of natural processes, and such views may be distorted. Natural history is becoming increasingly unnatural history. But now scientists from around the world are calling for a renewed interest in natural history and supporting fields such as taxonomy (Wheeler et al. 2004). It is becoming evident that society's investment in natural history over the centuries can be repaid through a more powerful appreciation of biodiversity supported by researchers, educators, and decision-makers.

If we as a community of naturalists have one overriding ethical responsibility, it is to contribute what we can to preserve the biological diversity that is our subject—to fight the looming extinctions by political action, by education, and by applying our knowledge and expertise. Ironically, Grinnell (1925) was way ahead of his time in this regard and published a conservationist's creed for naturalists that preceded the work of Aldo Leopold.

Our job is to protect beauty, whether or not we admit it (Herman 2002). Barry Lopez (2001), a writer and essayist, said it this way, ''Write and speak with appreciation for all you have been gifted. Recognize that politics with no biology, or politics without field biology, or a political platform in which human biological requirements form but one plank, is a vision of the gates of hell.''

Ultimately, conservation efforts absolutely require individuals who really know mammals and plants (or birds, mollusks, and so on)—their taxonomy, habitat requirements, biogeography, and patterns of endemism. Wilson (2000:2) stated it very eloquently in an editorial in *Conservation Biology*: ''If conservation biology is to mature into an effective science, pure systematics must be accompanied by a massive growth of natural history . . . . So let us resume old-fashioned expeditions at a quickened pace, solicit money for permanent field stations, and expand the support of young scientists—call them 'naturalists' with pride.''

Another important step would be to reinstate natural history studies in elementary and secondary schools. Many children are fascinated by plants and animals, and, if nurtured by adults, this can become a lifelong joy or even a career path. Untended, it

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usually atrophies as a child grows older. Meanwhile, the demise of natural history goes unnoticed, increasing the likelihood that future generations of schoolchildren will spend even more time indoors, clicking away on their plastic mice, happily viewing images of the very plants and animals they could be finding in the woods, streams, and meadows they no longer visit.

There also is a need to refocus college curricula to include a better understanding of humankind's place within the natural world and the larger society. The responsible citizen, as well as the competent professional, needs increasingly to draw on an appreciation of the natural world if he or she is to make sense of the societal issues that are most important to us today (Rhodes 2001). Where better to gain an appreciation of the natural world than through natural history courses and the fascination of firsthand fieldwork and observatory experience.

A major opportunity exists for naturalists to work with faculty in the humanities to develop interdisciplinary approaches that transcend departmental boundaries around the issue of ''place'' and the need to educate people about the need to live more sustainably. Many scholars are beginning to write about what it means to belong to a place and the power of landscape and place in the human experience (Simpson 2002). The University of Utah has initiated such a program in ''environmental humanities'' within its College of Humanities (Scully 2004). There is no group of scientists better equipped to work interactively with scholars in the humanities than naturalists who appreciate the perspective of consilience and the aesthetic nature of their work.

A critical factor to success in academia that is often under appreciated, or even maligned, is the university administration. It can be a powerful and positive force, as it has been at Texas Tech (Bradley et al., in press) and the University of Oklahoma (Mares 2001), or it can literally destroy or harm a program if uninformed or uninterested. We have too few administrators with backgrounds in biology, generally, and natural history specifically. If natural history is to survive and even thrive at universities, we will have to encourage more naturalists and field biologists with the appropriate skill set to pursue career opportunities in administration. Institutional leaders who understand and practice natural history will understand its fundamental importance and place in higher education. I have always encouraged my students to consider administration and a few of them have been successful (e.g., Steve Smith and Ken Wilkins are deans at Humboldt State University and Baylor University, respectively; and Terry Yates is a Vice President at the University of New Mexico). I am very proud of the fact that natural history research and education are thriving at their institutions.

I want to close this essay with a final observation. In 2002, while President of Texas Tech University, I had the opportunity to participate in a discussion about the past, present, and future of mammalian natural history in what has become known as the ''old farts'' symposium (Phillips and Jones 2005). The experience of the ''old farts'' stretched from the 1930s when the Modern Synthesis was underway to natural history's peak in the 1950s and 1960s, through the end of the century and the beginning of a new millennium. Today, the ''young turks'' in mammalogy are armed with their knowledge of modern ecology, systematics, and a plethora of mathematical and laboratory technology. At the beginning of the 21st century, we confront a natural history of genome structure and function that needs to be known in conjunction with a natural history of whole organisms for a full understanding of diversity at the level of populations in nature. This will require the ''old farts'' and ''young turks'' to work together using a broader, integrated evolution-centered approach that will involve both field naturalists and theorists. I once heard a colleague and imminent naturalist–mammalogist, Dr. James S. Findley, say: ''If you want something done right, then ask a mammalogist to do it.'' Well this opportunity is now before us, and I am confident that mammalogists will step up and lead the way in strengthening natural history as a science crucial to the needs of the 21st century, thus ensuring that the legacy of Joseph Grinnell will continue to thrive.

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