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NATURAL HISTORY, FIELD ECOLOGY, CONSERVATION BIOLOGY AND WILDLIFE MANAGEMENT: TIME TO CONNECT THE DOTS

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***Abstract*.—Natural history and field ecology are essential building blocks for successful conservation and management of herpetofauna. Thus, natural history and field ecology merit major infusions of funding and increased recognition of their importance in science and management. Others have stated matters well: (1) Academic training in natural history should receive high priority; (2) we need to integrate our work across disciplines (from molecules to communities), and use all of our knowledge toward common goals; (3) natural history is not dead but today is a flourishing enterprise; and (4) mutual respect and collaboration between disciplines best serve our own mental health as well as the future of natural history. We need to merge the best natural history, field ecological data, and biological questions with the latest advances in other fields of inquiry if we are to advance science and solve key environmental issues. It takes a scientific community and many concerned parties to save a species, let alone an ecosystem. We must connect these dots to see the big picture.**

Key words.—conservation, field biology, herpetology, natural history, wildlife management

INTRODUCTION

During the development of this inaugural issue of *Herpetological Conservation and Biology*, I wondered about several questions. Why start a new journal when some in our profession view collecting and reporting natural history or field biology information as unnecessary? What can we do collectively to organize our common goals to better understand the lives of amphibians and reptiles? Why are conservation efforts sometimes considered separate from scientific studies on the biology of amphibians and reptiles? How can we better protect and manage our dwindling herpetofauna? These questions are addressed here.

Recently, several authors expressed the importance and role of natural history and field biology in science (see Arnold 2003; Greene 2005; McCallum and McCallum 2006; Trauth 2006). Using their key points as a springboard, my specific objectives are to: (1) examine the general state of our thinking about the role of natural history and field biology in herpetology; (2) suggest ways to elevate these skills and tools to a more deserved level; (3) encourage studies from many disciplines and approaches to provide the best biology; and (4) recommend ways to link our common interests for improved conservation and management for our herpetofauna.

WORDS OF THE MASTERS

Most of the great biologists of our past and recent times were or are still "naturalists". A few outstanding examples are as follows:

***Charles Darwin*.**—Instead of entering the seminary, Darwin went on worldly travels in his formative years. He collected animals and data in the wilds of South America and the Galapagos Islands, observed patterns in nature and thought about how all these happened. His naturalist start led him to be a proponent of evolutionary biology. Decades later these initial impressions resulted in his book, "*The Origin of Species…*" (Darwin 1859), where he stated at the outset:

"*WHEN on board H.M.S. Beagle, as naturalist, I was much struck with certain facts in the distribution of the inhabitants of South America, and in the geological relations of the present to the past inhabitants of that continent. These facts seemed to me to throw some light on the origin of species—that mystery of mysteries… On my return home, it occurred to me… that something might perhaps be made out on this question…*"

***Aldo Leopold*.**—He wrote the first widely used book on wildlife biology (Leopold 1933), which made him the "father" of wildlife biology and management. As a professor at the University of Wisconsin, he spent breaks at a small cabin on land that served as a retreat. During this time, he was a naturalist (i.e., observer) and he became a deep thinker that led to his book "*A Sand County Almanac*" (Leopold 1949). This now serves as a major work of literature as well as inspiration to a generation of environmentalists (Flanders 1974, Meine 1988, Meine and Knight 1999).

***Robert C. Stebbins*.**—He is often considered the dean of western herpetology and may be best known for his well-illustrated field guides (e.g., Stebbins 2003). These were based on detailed species accounts in earlier books (e.g., Stebbins 1962) and his years of field work. More recently, he co-authored a major book (Stebbins and Cohen 1995), where the authors state:

"*Our selection of the title of the book, A Natural History of Amphibians, reflects our interest in individual animals and their populations, how and where they live and reproduce, how they interact with one another and their environment, and the evolutionary processes that have made them what they are and that continue to shape their future.*"

Further, they pointed out the decrease in teaching and research in natural history, but suggested it is equally important to other disciplines that we study life at the level of whole organisms and their interactions in nature.

Besides his fame as a natural historian, he conducted intensive scientific studies on a wide variety of topics: one of the first implants of a radio transmitter into a large Australian lizard (Stebbins and Barwick 1968), experimental removal of the parietal eye in Galapagos Islands lava lizards (Stebbins et al. 1967), function of the parietal eye (e.g., Eakin and Stebbins 1959), and speciation in the Ensatina, *Ensatina eschscholtzii* (Stebbins 1949, Brown and Stebbins 1964). He is a great educator and scientist with many interests and skills (e.g., he is an accomplished painter of African wildlife).

Eric Pianka.—When speaking as an invited lecturer to the International Congress of Zoology, Pianka (2002) stated that, "I fear that I must begin with some bad news for all zoologists: Zoology is rapidly becoming obsolete!" He compared a number of disciplines and noted that studies in areas like molecular biology deal with microscopic levels and data can be gathered relatively quickly, whereas fields like community ecology require lots of space and time to complete.

Further, he recognized that many scientists have been neglecting higher levels of organization (e.g., community ecology), which is worse than simple benign neglect because people working at each level (e.g., molecular, physiological) express disdain for those struggling to work at higher levels. He also pointed out that not only are "ology" courses (e.g., herpetology) disappearing from curricula everywhere, but also study of fields like molecular biology seldom provide great insights into the evolutionary forces that mold adaptations. He then stated that this thinking is perilous because all levels of approach are necessary to truly understand any biological phenomenon.

NATURAL HISTORY AND HERPETOLOGY: WHERE ART THOU TODAY?

Recently, I was talking with a professor in California and an undergraduate student (attending a nearby college). On her own, this student had started a field study to determine the occurrence of snakes at the San Joaquin Experimental Station (SJES) in central California. However, she was dismayed that her advisor said that "natural history was dead" and her time should be spent on a more fruitful line of inquiry. This attitude was insensitive for a professor to state as it discourages a student's interest in biology. Even in its narrowest definition (a descriptive study), a natural history study can be the impetus to interest students in biology or environmental issues. Interests in nature and wildlife may lead to employment focusing on conservation, applied ecology and wildlife management or to a rewarding career as a research scientist in academia or government.

Also, she selected an intriguing area and topic. Although Block et al. (1994) set 144 pitfall traps (18,780 trap days) at the SJES, they excluded snakes from all comparisons because they were not sampled adequately. Besides a SJES checklist (Newman and Duncan 1973), the student's study appears to be the first re-assessment of SJES snakes since Henry Fitch studies there six decades earlier (Fitch 1949, Fitch and Twining 1946). This is a valuable study because changes in species diversity, relative abundance, and community structure over time have intrinsic scientific value and conservation implications.

Far from its demise, natural history and field biology are alive and well (see Arnold 2003). There are many strong arguments in favor of field and natural history studies by many renowned biologists (Greene and Losos 1988; Noss 1996; Futuyma 1998). Also, natural history and field ecology do not have to be exclusive endeavors. Today, most biologists are engaged in varied multidisciplinary studies and conservation efforts. Natural history and field biology are part of our repertoire that we employ to solve questions (Fig. 1), particularly when dealing with conservation and management issues.

Further, it is myopic and erroneous to consider training as a naturalist as easy or some sort of outdoor play. Although field biologists know it, many other scientists would be aghast at the time, energy and endurance necessary to conduct field work (Pianka 2002). It is among the most demanding tasks mentally and physically. Studies in nature often appear 'messy' because there are many confounding environmental factors. Still, many of these complex questions require field-based approaches and demand our best minds to unravel their mysteries.

It is challenging to become an accomplished naturalist, field ecologist or wildlife biologist as one needs to learn not just the names and systematic status of plants and animals, but how to merge these data with distributional constraints, habitat associations, physiological constraints, and behavior of animals. Investigators in applied fields also must develop skills of persuasion to convince fellow humans to change their actions or work on coordinated efforts. Often, it is the naturalists or field ecologists who possess the broadest and deepest understanding of species in landscapes and ecosystems. They usually are the first to see the big picture.

This knowledge helps us to ask better experimental or theoretical questions. Experimental designs and tests usually focus on a few factors, and results can yield illuminating results and interpretations. Still, these studies are usually intensive and expensive to perform, which may limit their geographic scale or result in few replications. Further, modeling employs many factors with the latest technological prowess (computers), geographical information systems, and mathematical concepts. Many of these "data" or inputs, however, are suppositions or generalizations that have yet to be verified in the field. Modeling can summarize, display and interpret vast amounts of information, which is useful to answering many questions. However, sometimes models or computer simulations develop lives of their own not related to the field situation.

We need a balance or mutual respect for the contribution of all these fields and approaches to improve our understanding of species biology and community interactions. Each discipline may provide different interpretations, but multidisciplinary approaches can provide insights beyond that obtained via single endeavors. We need to use all of our knowledge to formulate the critical questions and employ collaboration from all quarters to best solve problems.

WHERE'S THE INFORMATION TO PROTECT SPECIES AND THEIR HABITATS?

Natural history or field ecological data are essential for effective protection and management of threatened and endangered species. For example, reliable information on many criteria (Table 1) is required for consideration on the International Union for Conservation of Nature's (IUCN) Red List of threatened species (http://www.iucnredlist.org/info/categories_criteria2001) (Mace and Lande 1991; Mace et al. 2002). The IUCN prefers a population viability analysis, which is a model that estimates the extinction probability of a taxon based on known life history, habitat requirements, threats and any specified management options. Few such analyses, however, exist for amphibians and reptiles.

The recent Global Amphibian Assessment (http://www.globalamphibians.org) (Stuart et al. 2004) included data on each of the 5,918 known amphibian species. Although up to 40% of the world's amphibians may be declining, the percentage of "Data Deficient" species (23.4%) is very high for amphibians compared to mammals (5.3%) and birds (0.8%). This category has inadequate information to make an assessment of its

TABLE 1. Abbreviated version (minimum set of information) required for non-marine taxa in the IUCN Red List of Threatened Species (IUCN 2001).

Scientific name including authority details
English common name/s and any other widely used common Red List Category and Criteria
Countries of occurrence (including country subdivisions for large nations)
A map showing the geographic distribution (extent of occurrence)
A rationale for the listing (including any numerical data, inferences or uncertainty that relate to the criteria and their thresholds)
Current population trends (increasing, decreasing, stable or unknown)
Habitat preferences (using a modified version of the Global Land Cover Characterization (GLCC) classification
Major threats (indicating past, current and future threats using a standard classification which is available from the SSC)
Conservation measures (indicating both current and proposed measures using a standard classification which is available from the SSC)
Information on any changes in the Red List status of the taxon, and why the status has changed
Data sources (cited in full; including unpublished sources and personal communications)
Name/s and contact details of the assessor/s

risk of extinction based on its distribution, abundance and population status (Hilton-Taylor 2000).

Status reviews are often the first step in a listing process in the U.S. (Henifin et al. 1981; USDI and NOAA 1996). These activities are funded or conducted by one of the federal agencies or others to determine the status of a species and include field surveys, museum research, and literature searches to compile complete information. Status reviews are required by the Endangered Species Act and are suppose to include all of the available information on a species. A status review should also use the knowledge and external consensus of experts on the species.

Most of the information needed is based on natural history or field ecology studies. I completed one of these status reports in the mid-1980s on the Black Legless Lizard (*Anniella pulchra nigra*)—a dark color morph living near Monterey Bay of coastal California. We conducted field surveys prior to completing the set of required questions (see Table 2). Most of our prior knowledge was based on a major field study about 40 yrs earlier (Miller 1944). Clearly, a solid report should have wide scope to document the range of variation in habits and habitat requirements across the geographic distribution of a species as well as several intensive studies at representative sites to determine key population features (e.g., demography, population estimates, and fecundity). Such assessments, however, are often inadequate because we lack even the basic information on most of our herpetofauna.

It is difficult to undertake effective conservation of species if we have spotty, outdated and minimal data on life history features. We have knowledge of natural history or ecology for only a few common or widespread species, such as the Slider Turtle (Gibbons 1990), Desert Tortoise in the Sonoran Desert (Van Devender 2002), and Gila Monster (Bogert and del Campo 1956; Beck 2005). There are efforts on some species groups, including: box turtles (Dodd 2001), North American tortoises (Bury and Germano 1994), garter snakes (Rossman et al. 1996), and U.S. amphibians (Lannoo 2005). Species that have much known about them are often those that are hunted (e.g., American Bullfrogs; see Bury and Whelan 1984) or listed as threatened or endangered.

For most other species, I think that today we know less proportionally—compared to the increase in overall knowledge in biology—about their distribution, habits, abundance and trends than we did in the past. In large part, this is due to prior research and studies in landscapes with few human perturbations (roads to pesticide use). What we knew about a species in a pristine area decades ago may have little relation to what the populations face today because our imprint has grown rapidly across the landscape.

Thus, studies of life history and natural history are essential for the survival of our biota. One cannot make intelligent management decisions without range-wide data on species. Now, we must focus studies on the ecology of populations and species where human perturbations occur (i.e., do not just study a species in a pristine habitat).

There is a glaring need to have recent information on species'

TABLE 2. Outline used for a listing of U.S. Federal threatened or endangered species. Categories based on Henifin et al. (1981) and the U.S. Endangered Species Act. Not shown are parts for information sources and authorship.

Species information

1. Classification and nomenclature
2. Present state status
3. Description
4. Geographical distribution.—Includes populations currently or recently known extant; those known or assumed extirpated, with explanation; historically known populations.
5. Environment and habitat.—Summary of the most important aspects of these criteria, particularly those factors thought crucial to the taxon's survival, distribution, and abundance.
6. Population biology.—General summary; demography with number and geographical spacing of known populations (estimated if necessary), with estimates of currently known number of individuals per population, if available. Describe census methods used.
7. Current ownership and management responsibility.
8. Evidence of threats to survival.
    a. Present or threatened destruction, modification, or curtailment of habitat or range.
    b. Over-utilization for commercial, sporting, scientific, or educational purposes.
    c. Disease or predation.
    d. Inadequacy of existing regulatory mechanisms.
    e. Other natural or manmade factors.

Assessment and Recommendations

9. Priority of listing or status change
10. Recommended critical habitat
11. Interested parties

distributions, ecology and population trends. Developing quantitative information on responses of biodiversity and ecosystem processes to perturbations is of priority (Noss 1999; Dayton 2003). Experimental tests of concepts are needed, yet they are far from comprehensive because, among other reasons, many species are yet unknown or difficult to measure (Schulte et al. 2006). There are several national programs now underway such as the Partners in Amphibian and Reptile Conservation (PARC) (http://www.parcplace.org) (Gibbons 2000) and the Amphibian Research Monitoring Initiative (Corn et al. 2005; Muths et al. 2005). Still, the task ahead is onerous, and we need more effective means to gather information and communicate the results of research and conservation efforts.

CONCLUSION AND RECOMMENDATIONS

Natural history and field ecology are essential building blocks for a comprehensive education about not just herpetofauna but for key biological questions and collaborative work (Fig. 1). Learning how to observe animals and their lives in the wild will improve one's ability to pose key ecological questions. Natural history and life history studies are mandatory elements for conservation and management purposes (Fig. 1), and merit major infusions of funding.

To be a "naturalist" one needs to develop critical thinking skills, test hypotheses, have intellectual curiosity and maintain competence in several disciplines or endeavors. Thus, being a naturalist may be a skill set embedded in more modern labels such as conservation biologist, evolutionary ecologist or restoration ecologist. These all are part of a larger process (Fig. 1). I support the guidelines and advice of other scientists who have commented on the topic:

- Given the rapid loss of species now occurring as the result of human actions, academic training in natural history should receive high priority (Stebbins and Cohen 1995).
- Natural history is far from dead, but today is a flourishing enterprise (Arnold 2003). Further, he stated that the future of the naturalist's tradition lies in concept development and, of utmost importance, that mutual respect and collaboration among disciplines best serve our own mental health as well as the future of natural history.
- Remove the impediments to natural history, including excessive technophilia, little funding, elitism on the part of some biologists and a shortage of journals that publish organismally focused studies (Greene 2005).

Studies of natural history, life history and field ecology provide the factual information to address critical environmental issues, particularly the gathering and interpretation of the best biological data for the listing of species as threatened or endangered as well as the factors leading to their declines. The importance of field data and thorough status reviews cannot be underestimated because once a species is listed, it often triggers a multi-million dollar recovery effort for the species. Moreover, the timeliness of information becomes apparent when we admit that all too often the most detailed field studies and data sets were ones conducted decades ago, and recent data are scant.

Thus, we have several needs: (1) accurate and timely information on populations; (2) more intensive studies of life history features as well as current distributional limits and population trends; and (3) merger of the best natural history and field ecological data with the latest advances in genetic analyses, landscape ecology and other fields of inquiry. Communication between varied disciplines and fields of study and management is important to advance science and to address our key environmental issues. It takes a scientific community and many concerned parties to save a species, let alone an ecosystem. We must connect these dots to see the big picture.

Toward these goals, we hope that the new journal *Herpetological Conservation and Biology* will provide a forum and home for research and discussion on conservation and management issues. We should recognize the importance of natural history and not shy away from its role in science. In particular, we require more published material (peer reviewed) to better conserve and manage our amphibians and reptiles.

It is time to rekindle the spirit of inquiry, passion and excitement of field research and study of natural history. Thus, I suggest that

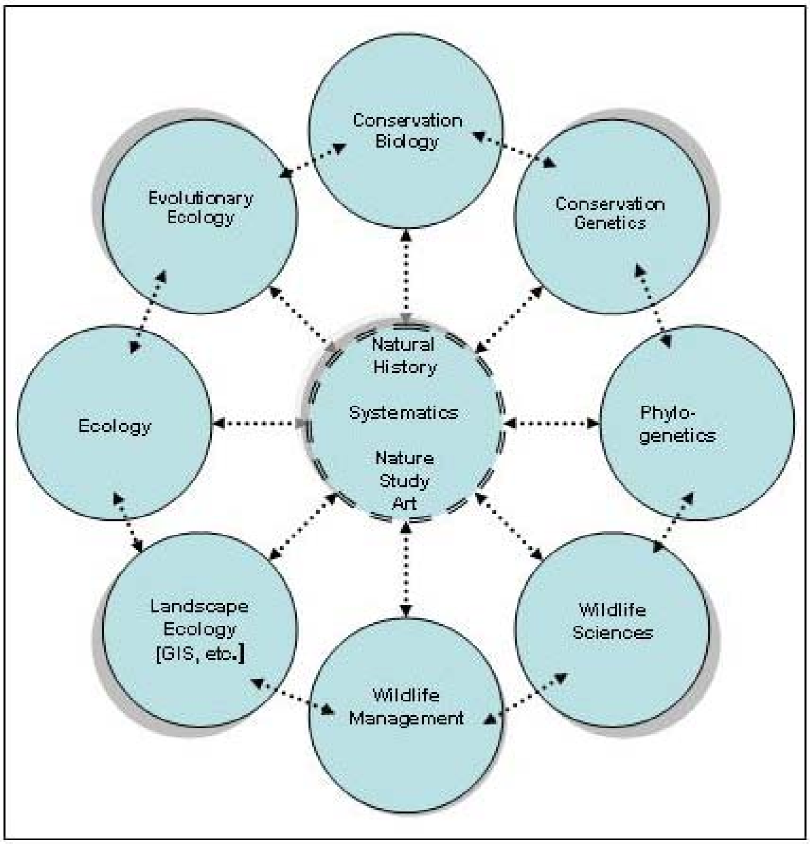

FIGURE 1. Representation of interrelationships of biological disciplines.

we do not lose sight of why most of us study animals and try to protect natural resources. This is best said by two of our distinguished colleagues:

"*I regard inquiry as the greatest pursuit of man…. One of the richest sources of subject matter is to be found in undisturbed portions of the biosphere…*

As wild animals disappear, our own lives are endangered, for their well-being is intimately tied to our own. Their plight warns us of imminent ecological danger to man himself. It is the nature of the web of life that this should be so. We must not allow this priceless heritage to be degraded."

Robert C. Stebbins (1971)

"*It seems to me that the natural world is the greatest source of excitement; the greatest source of visual beauty; the greatest source of intellectual interest. It is the greatest source of so much in life that makes life worth living.*"

Sir David Attenborough (2006)
http://www.bbc.co.uk/nature/programmes/tv/lifeonair/faq.shtml

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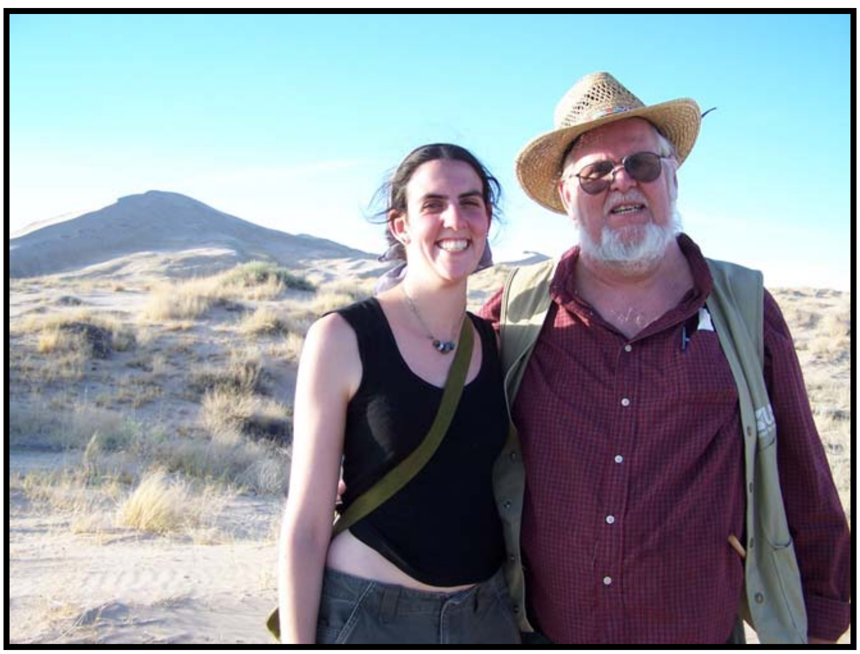

R. BRUCE BURY is a Research Zoologist with the USGS Forest and Rangeland Ecosystem Science Center, Corvallis, Oregon. He is pictured here with his daughter, Gwendolynn, at the Kelso Dunes, Mojave National Reserve, California. This was in early June 2006 just after the first organizational meeting of *HCB* in Henderson, Nevada. He was born in southern Oregon and grew up in northern California, where he attended Humboldt State University (A.B.), Calif. State University - Sacramento (M.Sc.) and the University of California at Berkeley (PhD). He has authored 150 publications, mostly on forest amphibians and desert reptiles in the western United States. (Photographed by Roger A. Luckenbach)