

Ecoliteracy for ecology and ecologists: eroded underpinnings



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While most of us are comfortable thinking about ecological literacy as the ability to read, understand, write, and think critically about chemistry, biogeochemistry, geology, calculus, physics, meteorology, and so on, we probably overlook one critical area a bit closer to home – natural history. We, as do so many, take natural history for granted. There aren't too many academic courses entitled "Natural History", yet courses dependent on an understanding of natural history (ecology, mammalogy, ichthyology, entomology, ornithology, herpetology, mycology, animal and plant physiology, taxonomy, and the other organismal courses) form the foundation for much of what we, as ecologists, do. Unfortunately, there has been a notable and dramatic decrease in natural history offerings at US colleges and universities (Figure 1; Futuyma 1998; Greene 2005; Grant 2009). While our observations in the US may not yet hold for all countries, we anticipate similar trends elsewhere in the world over time. This is largely the result of an academic zero-sum situation where gains in cell and molecular biology (CMB) and environmental science translate into losses in organismal biology. While growth in biology has been extraordinarily beneficial, we are only now beginning to recognize the evisceration of biology's conceptual middle ground and its detrimental effect on our own field. The demise of natural history courses has severely reduced our ability to address complex research and applied problems such as climate change, environmental health, emerging disease, and renewable energy demands and impacts (Burton 2003). On the basis of recent National Research Council (NRC) and National Science Foundation (NSF) reports (*A New Biology for the 21st Century* and *Transitions and Tipping Points in Complex Environmental Systems*, respectively), Gropp (2009) noted the importance of organismal biology and evolution for solving environmental, food, energy, and health problems, suggesting not only the need for training in biology's middle ground but also literacy training to bridge to disciplinary areas, including ecology.

The demand for a working knowledge of natural history is not new. EO Wilson has repeatedly pointed to the value of knowing species in ecological studies. Even as the "old

guard" of classical alpha taxonomists and broadly trained ecologists dwindles, the demand for their expertise is rising (Kim and Byrne 2006). Biologists with a broad knowledge of taxonomic diversity are becoming as imperiled as some of the species of study. Ironically, even as their numbers diminish, the requirement for more detailed knowledge of the biological diversity and ecology of organisms and species is becoming increasingly critical to understand and address present and future environmental problems. The NRC's *A New Biology for the 21st Century* emphasizes the necessity to "understand and sustain ecosystem function and biodiversity in the face of rapid change". To ensure a source of trained professionals to fill future needs, we argue that research, teaching, and training in areas such as plant and animal physiology, life history studies, animal behavior, and taxonomy must be re-established.

We cannot "do" biodiversity if we cannot recognize species. We cannot understand biogeochemical cycles without being able to identify the organisms that obtain, use, and cycle nutrients. We cannot fathom, let alone predict, the impact of global climate change without a clear conception of how species adapt, adjust, and evolve to change. In fact, there isn't a single subdiscipline of ecology that does not fundamentally depend on information grounded in natural history.

The erosion of natural history and organismal courses has manifested itself in several ways – through changes in departmental focus, in course offerings, in faculty research, in textbook coverage, in experiential learning opportunities, in shifts in funding and faculty hires, and even in the maintenance of support facilities (eg collections). Over the past few decades we have participated in the profound transition from traditional programs in botany and zoology to programs in molecular biology, anatomy and physiology, and evolution and ecology (E&E). At some of our larger institutions, these areas have been maintained as stand-alone units. Unfortunately, this has not been the case at many others, where biology increasingly tilts toward either the CMB or E&E ends of the spectrum. The middle ground, largely composed of organismal courses, has often been dropped or combined into multidisciplinary classes, with the subsequent loss of opportunities for students to focus on organismal biology and taxonomy. "Traditional" courses, perceived as optional in an evolving discipline, suffer when the emphasis for hiring new faculty shifts to other areas. As coverage of CMB topics increased in popular introductory texts, information on natural history and organismal biology decreased. Budgets, along with funding opportunities, have often been the driving forces leading to these curricular changes. For instance, experiential learning opportunities, a critical component of ecology and related courses, are

lost or reduced as a result of funding cuts for field trips. Moreover, programs increasingly grapple with the costs of fuel, liability insurance, and availability of vehicles appropriate to transport classes safely. New faculty members are often unwilling or in some cases unable to drive their own vehicles for field trips, and hiring drivers can be prohibitively costly. Recurring expenses for field trips draw greater attention at budget cutting times than smaller supply requests or maintenance associated with larger equipment purchased via grants. The increasing disparity of the research budgets for the National Institutes of Health as compared with other agencies (eg NSF, National Oceanic and Atmospheric Administration, Environmental Protection Agency, etc) indirectly drives hires and curricula as institutions seek to supplement tuition with grant overhead benefits by “following the money”. The inability to provide support for basic maintenance and staffing of biological collections has affected our capacity to teach and train, and in all too many cases has culminated in the reduction of or de-accessioning (removal and selling of items) within museum collections. Accessibility to current biological collections may be improved through NSF efforts to support digitizing archived data and specimen images for web access. Although this will not solve issues regarding the maintenance and enhancement of contemporary collections, greater accessibility may result in increased funding as gaps in collections become more obvious. However, an exaggerated focus on digitization may unfortunately also lead to a decline in maintenance for preserved specimens.

There are a variety of ways to approach this situation. Traditional efforts could re-emphasize organismal biology by noting career opportunities, promoting hiring, and working with policy makers to increase funding opportunities. Of course, at colleges and universities, faculty can add, reinstate, and build organismal courses that have strong field experience components. These might capitalize on rising numbers of students coming into college with nature-based experiences. To do this, however, we must also address some other, less obvious issues such as the cost and liability of field and organismal courses. Departmental budgets must include funding for field experiences including transportation and insurance costs. Graduate training programs for future faculty must build a “comfort level” for engaging with students in the field. Research stations must be revitalized, facilitated, and incorporated as viable options for undergraduate curricula, courses, and internships. Stipends would facilitate participation in short courses at field stations. Nontraditional approaches could focus educational efforts on increasing exposure to biodiversity by, for instance, addressing the “nature deficit disorder” through implementation of pre-college environmental literacy requirements like those of Maryland’s 2011 “No Child Left Inside Act”. Ecologists can collaborate with teachers and schools to lead schoolyard ecology programs, even where testing requirements restrict student outdoor activity. At the community level, “BioBlitz” programs – where individuals come together to identify all the organisms in small areas – could lead to increasing recog-

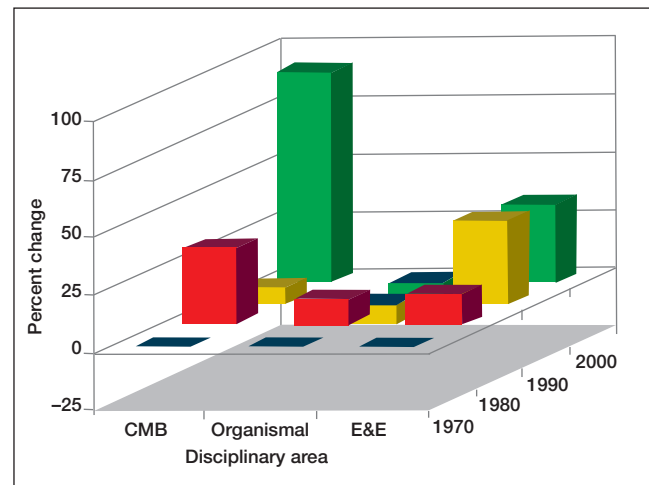


Figure 1. Changes in courses in three areas (CMB, E&E, and organismal biology) between 1970–2000 in Biology programs at American University, Catholic University, George Washington University, Georgetown University, Howard University, Johns Hopkins University, and the University of Maryland.

nition of the value of organismal courses and an elevated interest in organismal biology. In addition, we must explore and encourage other nontraditional approaches such as internet-based generation and dissemination of taxonomic knowledge.

We must again emphasize the discovery, description, and inventory of global species diversity and employ new technologies to assist in this effort. It is encouraging to see networks such as the National Ecological Observatory Network, the Long Term Ecological Research Station Network, the USA National Phenology Network, Project BudBurst, the Ecological Research as Education Network, the Global Learning and Observations to Benefit the Environment (GLOBE) program, and others highlighting natural history study with ecological research by faculty, students, and citizen scientists. The recent “Natural History Initiative Workshops” and the formation of both the “Natural History Network” and the online *Journal of Natural History Education and Experience* indicate a growing interest and possible resurgence in natural history study. Kolan and Poleman (2009) and Pearson *et al.* (2011) both provide examples for the revitalization or “recovery” of natural history and taxonomy.

No single method is sufficient unto itself. We must coordinate efforts to provide adequate organismal biology training for students who want to pursue careers in organismal areas and make students aware of their opportunities. Most of all, as ecologists, we must recognize that we cannot perform ecology without a strong foundation in natural history and organismal biology. It is not enough to save all the pieces; we must be able to identify them before we can understand how they fit together.

References

Please see WebReferences