2008

# Water Quality, Stream Habitat and Macroinvertebrates of Sage Creek, Badlands National Park

Nels H. Troelstrup Jr.
*South Dakota State University*, nels.troelstrup@sdstate.edu

Jill D. Rust
*South Dakota State University*

# PRESIDENTIAL ADDRESS

## The Need for Field Biologists in a Technophilic World

Address to the South Dakota Academy of Science
Cedar Shore Resort, Chamberlain, SD
April 5, 2008

Nels H. Troelstrup, Jr.
South Dakota State University
Brookings, SD

Advances in technology have brought many changes to science, and the field of biology is no exception. We are now in the information age with access to entire libraries at the click of a mouse button. We are rapidly mapping genetic codes and have even cloned vertebrate animals. We have used biotechnology to engineer desirable characteristics into our domesticated plants and animals. Computing power has doubled approximately every 24 months since the mid-1960's (Moore 1965, Moravec 1998). The Internet has expanded opportunities for collaboration and communication to nearly everyone on the planet and educational opportunities for people in remote locations (SCUP 2007, Valentino and Jones 2004). This increase in accessibility to information has been said to level the playing field and greatly enhance opportunities for people around the globe (Friedman 2005).

However, technology has also brought its disappointments. Interaction has become increasingly digital. Many of our campus committees and research groups now meet only through e-mail, and decisions are often made without face-to-face interaction and discussion. Internet courses and degree programs are now widely available, eliminating face-to-face interaction between student and teacher (SCUP 2007, Valentino and Jones 2004). Often, the hands-on components of courses (lab and field exercises) are also eliminated to refocus faculty time and limited teaching resources. Field and lab experiences are thought to be too time consuming and expensive (Wilcove and Eisner 2000). Specimen collections take-up too much space and commit personnel and funding to long-term maintenance (Gropp 2003). Field stations require commitments of personnel and operating funds which might otherwise be used on campus.

Perhaps nowhere has this trend toward technophilia been felt more than in the natural sciences. Much of the traditional training in the organismal areas of biology (e.g., zoology, botany) has been eliminated to make room for high-profile areas in biological technology (e.g., genomics, GIS, modeling, bioinformatics, biotechnology) (Schmidly 2005, Wilcove and Eisner 2000). Limited laboratory space and start-up funds to support new faculty have been directed away from natural history collections, field biology courses and field stations to support these new programs. This has occurred not only due to the great advances

that these new areas bring in their own right but also due to simple economics. Reductions in state support for higher education have placed increasing burden on institutions and their administrators to focus on income from indirect costs generated from large grants (Gropp 2003, Schmidly 2005). Those professional areas generating greater dollar returns to the institution are favored over those who generate less.

When I interviewed for my position with South Dakota State University, I was pleased to see remnants of traditional zoology and botany programs still in existence. Like my own undergraduate experience, students still had opportunities to take field oriented biology courses and learn field methodology prior to graduation. In addition to our Agriculture Experiment Stations, the university had committed to the Oak Lake Field Station. This 570 acre facility provides opportunities for students and faculty to study eastern tall grass prairie and prairie pothole ecosystems. New NSF supported laboratory facilities have further enhanced capabilities of the station and attracted research faculty and graduate students from other universities. This facility, together with the South Dakota School of Mines & Technology Geology Museum, University of South Dakota Missouri River Institute, several state institutional collections and the Washington Pavillion of Arts and Science all provide opportunities for students, faculty and the public to study natural history and field biology.

The relevance of traditional organismal biology programs and facilities which accompany them stems from our need to understand natural history. Global biological diversity has received much attention in the scientific and popular literature over the past 30 years. In addition to its aesthetic value, biodiversity contributes in many practical ways to human existence. Many species have been domesticated to provide food and fiber. Others have contributed greatly to medicine while still others contribute in major ways to natural biogeochemical cycling, flood control, erosion control, energy fixation and a number of other ecosystem services. E.O. Wilson (1988) estimated that we had described approximately 1.4M species on Earth but that from 5M to 30M species had yet to be described. Who can say what great discoveries helpful to society may be held by those yet to be discovered? Who will discover and describe them? These tasks generally fall under the purview of the organismal biologist. Natural history collections exist in support of the naturalist, serving as repositories of described specimens. Information regarding the environments where specimens were collected and hidden qualities of the specimens themselves (e.g., size, age, growth rates, chemical composition, morphology) resides on the shelves and in the vials of the natural history collection (Beidleman 2004, Brown 2001, Dosch 2007, Gamauf and Haring 2004, Ponder et al. 2001). Field stations provide strategically located sites where long-term studies of natural history and ecology of these species can be studied. Data collected from these stations are also used to examine long-term changes in our environment.

Many of those undiscovered species and their habitats sit on the brink of extinction (at least locally). Native tall grass prairie, a major ecosystem of South Dakota, has been cited as one of the most endangered ecosystems in the United States (Noss et al. 2001, Samson and Knopf 1996). Wetland habitats have also

suffered tremendous losses in the face of human development and provide one of the greatest natural resources of eastern South Dakota (Sieg et al. 1999). The United Nations Environmental Program (2006) recently reported that 15 of 24 ecosystem services were on the decline worldwide. South Dakota lists several species of fish, herptiles, birds and mammals at risk (SD GF&P 2008). Many smaller species of invertebrates, nonvascular plants, protists and microbes are not yet sufficiently inventoried to allow assessment, yet comprise the bulk of biodiversity on Earth.

Habitat loss has been listed as a major cause of species declines across the globe (Brooks et al. 2002), and tremendous effort is expended by local, state and federal natural resource agencies to better understand relationships between human development, habitat conditions and biological integrity. Patterns of species occurrence, location, distribution and life history information are all critical pieces of information for successful biological monitoring programs. Thus, these monitoring programs also require professionals with strong backgrounds in natural history and field biology (Schmidly 2005).

In 2006, the academy passed a resolution expressing support of active maintenance, development and protection of natural history and research collections. This resolution was followed by an excellent review of the status of research collections within South Dakota and threats to their continued survival (Gabel et al. 2007). While not addressed in the academy resolution, field station support, field-based organismal curricula and recruitment of field biologists to faculty positions within South Dakota institutions also appear to be on the decline. Clearly, these trends should alarm the academy and urge more proactive effort to highlight the tremendous contributions and opportunities that accompany such programs. Many (most?) university students enter a biology major resulting from their deep interest in living things. Natural history is a major force driving that interest and should be recognized in its own right as a mechanism of recruiting new students.

What steps can the academy take to highlight the role of natural history and organismal biology within our state? The academy is comprised of scientists representing a variety of science disciplines. As scientists, we are in the best position to recognize the value of taking holistic and integrated approaches to problem solving.

1) The academy should promote instruction in natural history and field study by environmental education groups and K-12 educators.
2) The academy should promote collaboration among institutions with active field biology training programs.
3) The academy should promote integrated efforts in the study of biological questions at molecular, whole-organism and ecosystem levels.
4) The academy should recognize and communicate the relevance of natural history programs, natural history collections and field stations.
5) The academy should promote face-to-face interaction between providers and stakeholders of biological information to communicate the relevance

and contribution of all scientific disciplines toward improved understanding of how the World works.

In addition to focus on those action items listed above, diversity within our membership should be enhanced. Clear lines of communication should exist between educators, researchers, natural resource managers and business leaders. The academy membership is primarily comprised of post-secondary faculty and students (75%) with only small numbers participating from federal and state agencies, industry and museums (SDAS 2005). Even more troubling is low participation by secondary educators. Efforts to enhance representation and participation by all stakeholder groups would facilitate communication of information needs by managers and discoveries by scientists.

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