UNIVERSITY OF MINNESOTA ITASCA BIOLOGICAL STATION AND LABORATORIES

Over 100 Years Of Field-Based Education and Research

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CONTEXT OF FIELD STATIONS

Field stations are a critical part of biological and limnological infrastructure (National Research Council 2014). Many scientists are given their first research opportunities at field stations, the life of a field station often far surpasses those of individual scientists allowing for the curation of long-term datasets, and field stations are poised to play a key role in networking with each other and with networks that are organized formally (National Ecological Observatory Network) and informally (e.g., Global Lake Ecological Observatory Network, Nutrient Network).

ITASCA FIELD STATION HISTORY

The University of Minnesota Itasca Biological Station and Laboratories (IBSL) was recently described by a visiting field station director as a "quintessential field station." IBSL was established in 1909 and has been a fixture of the University since then by offering field biology instruction and research opportunities. Efforts to establish a field station in Minnesota likely started around 1892. After an unsuccessful attempt at another site, a field station focused on forestry education and research was founded by the University of Minnesota Twin Cities in northern Minnesota located within Itasca State Park. Itasca State Park was the first state park in Minnesota (founded 1891) and is the second oldest state park in the U.S.A. At the founding of the field station, the park and station established a close relationship that continues to present day.

LOCATION AND NATURAL FEATURES

The park spans 134 km^2 and includes over 100 lakes and the headwaters of the Mississippi River (Fig. 1). Lake Itasca, the source of the headwaters, is a relatively large (4.7 km^2) dimictic lake located directly adjacent to IBSL and is completely surrounded by the state park. The other lakes in the park are diverse with ranges in productivity, dominant plant communities (phytoplankton vs. macrophytes), depth, mixing patterns (holomictic vs. meromictic), and fish communities including some fishless lakes.

Minnesota sits in the middle of North America and at the junction of three continental watersheds, and its climate can be influenced by the Gulf of Mexico, the North Pacific Ocean and the Canadian arctic. Consequently, the climate in this part of the world can be quite extreme in terms of temperature, precipitation, and variation. In fact, variation in precipitation is a critical component determining where the forest-prairie boundary sits in North America and paleorecords show that this boundary has varied significantly in the past. IBSL is in close proximity to three biomes: eastern deciduous forest, northern coniferous forest, and prairie (Fig. 1).

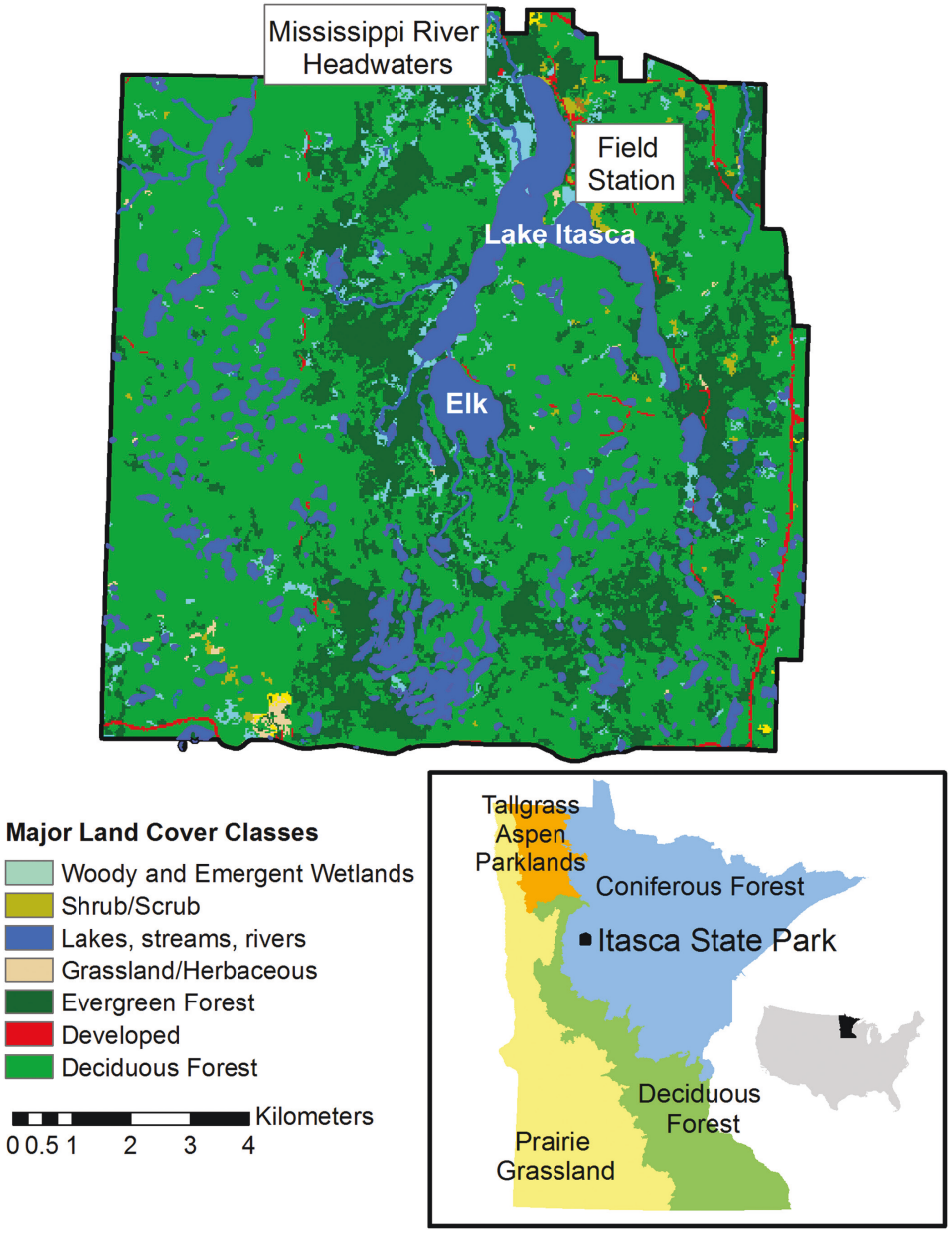

FIG. 1. Itasca State Park boundary and land cover with noted locations for the University of Minnesota Itasca Biological Station and Laboratories, Mississippi River headwaters and the two lakes that will be instrumented, Lake Itasca and Elk Lake. The inset shows the location of the park in relation to the Minnesota biomes.

FACILITIES

The station facilities juxtapose historical with contemporary (Fig. 2). Many of the cabins and buildings are from earlier decades and offer a sense of history for visitors. Thirteen lab and classroom spaces are modern and well-equipped. Of special note, in 2014 IBSL finalized construction on a

FIG. 2. Itasca Biological Station and Laboratories facilities. Campus Center exterior and auditorium (left panels), example classroom and lab spaces (middle panels), and example student and private faculty/researcher cabins (right panels).

$6.3 million new campus center (12,000 square feet) that is zero-energy, houses three technology-enabled laboratories/classrooms, two lab preparation rooms, an auditorium with flexible seating for more than 150 people, a computer lab and library, and administration offices. The station can comfortably accommodate around 150 people and regularly does so during the summer for large courses and meetings (Organization of Biological Field Stations annual meeting convened at IBSL in September 2017). The station has student cabins, fully equipped private faculty/researcher cabins, and a dining hall (Fig. 2).

EDUCATION

IBSL trains undergraduate and graduate students using the living classroom of Itasca State Park and the surrounding areas in northern Minnesota (Fig. 3). Initial courses focused on forestry, but by the 1930s courses were broader and included biological sciences. IBSL's signature and long-running courses are part of the Itasca Field Biology summer session within the College of Biological Sciences. These field-based courses are offered at the undergraduate and graduate level, and are generally 5 weeks in duration. Students are required to complete individual or team research projects. Undergraduates often report that their independent projects are their first complete research experience at the University of Minnesota. IBSL has been one of the best places in North America for students to gain a foothold on ecology and limnology. We note that many limnologists and biogeochemists spent time at the station as undergraduate or graduate students (examples include: Raymond Lindeman, John Magnuson, Tim Kratz, and Peter Vitousek). In recent years, many students taking courses as part of the Itasca Field Biology summer session have published their research findings in various scientific journals. This focus on authentic research experiences is further highlighted by a new study that used an IBSL field course to examine the effectiveness of course-based undergraduate research experiences in a field setting (Thompson et al. 2016).

The station also serves as an important vehicle for a course orientating incoming first year students to the College of Biological Sciences, referred to as Nature of Life at Itasca (NOL; ca. 600 students per year). All of these students come to IBSL in July for nearly 4 d where they take three abbreviated classes that can focus on anything from limnology to neuroscience. This program has been running since 2003 and has fostered a stronger community among students. IBSL is also used extensively for other University of Minnesota and regional college courses, undergraduate research training orientations, and incoming graduate student orientations.

RESEARCH

Some of the early innovators in ecology spent time at IBSL including Raymond Lindeman and Murray Buell. There is also a long-standing tradition of faculty and research labs focusing on lakes at the station (Fig. 3). A partial list beginning in the 1930s to present includes: Samuel Eddy, Gerald Cole, James Underhill, Robert Megard, Anthony Edward Walsby, Andrew Klemer, Eville Gorham, Walter Dean, Herbert Wright Jr., Melbourne Whiteside and more recently ourselves, Cotner and Knoll. Some of this past research includes extensive paleolimnology work conducted on Elk Lake, found inside Itasca State Park, with dozens of resulting publications. Robert Sterner and James Elser developed some of the key parts of their book on ecological stoichiometry (Sterner and Elser 2002) while teaching an Experimental Limnology course at Itasca over two summers. According to Sterner, they filled up chalk boards with musings about homeostasis that ultimately turned into chapter one of the book.

Current aquatic research efforts at IBSL are building upon this historic backbone by developing stronger collaborations with government scientists and improving infrastructure by investing in state-of-the-art limnological tools. A recent National Science Foundation award (NSF DBI 1722507) will instrument three lakes in Minnesota with (1) micrometeorological towers for measuring greenhouse gas fluxes to and from the lakes and (2) automated high-frequency buoys with extensive sensor packages. These tools will enable the understanding of the drivers and responses of aquatic ecosystems and their feedbacks with the atmosphere via carbon dioxide and methane fluxes,

FIG. 3. Historic and current field courses at IBSL (left panels), Lake Itasca and headwaters of the Mississippi River (upper right panel), and winter limnology research (lower right panel). Historic photo courtesy of the University of Minnesota Archives, University of Minnesota—Twin Cities.

as well as other greenhouse gases. The high frequency buoy platforms will measure physical, chemical, and biological parameters in the water column of these lakes and data will be available through the Global Lake Ecological Observatory Network (GLEON). These lakes represent the first three GLEON sites in the state of Minnesota and are excellent platforms for future research collaborations. In a growing world of networked science, these infrastructure improvements will foster additional collaborations and the ability to address aquatic questions at much larger scales than would otherwise be possible.

Two of the planned instrumented lakes are in Itasca State Park and adjacent to IBSL (Lake Itasca and Elk Lake) and the other, Cedar Bog Lake, is in the university's Cedar Creek Ecosystem Science Reserve. Cedar Bog Lake represents the very heart of the beginnings of ecosystem science globally as it was the focus of Lindeman's "Trophic dynamic aspect of ecology." Lake Itasca is one of the most visited lakes in the state because it is considered the headwaters of the Mississippi River and is the centerpiece of Itasca State Park. In addition to the wealth of paleolimnology research on Elk Lake, this lake also serves as one of 25 "Sentinel Lakes" in the state. In 2008, the Minnesota Department of Natural Resources (MN DNR) initiated a forward-thinking, statewide, long-term Sentinel Lakes Program to monitor and record biological and chemical changes in 25 representative lakes. Recent collaborations between IBSL and MN DNR scientists are leveraging their complementary data and research infrastructure.

PUBLIC ENGAGEMENT

IBSL is somewhat unique in that the station campus is fully within a popular state park. Itasca State Park receives ~ 550,000 visitors per year and this means the science coming out of the station is not done in isolation from the public. Initiatives over the past few years are focused on partnering with the state park naturalists to connect IBSL science with their large program audience (~ 25,000 per year). For example, last year the park organized an event during the total solar eclipse and as part of it, IBSL created an interactive display on zooplankton and how they are affected by sunlight (or lack of sunlight). A planned display for the park's visitor center will highlight the new aquatic instrumentation and connections with the global community of limnologists.

References

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THE GRIL
A Limnological Research Network

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THE GRIL: A PLACE OF ASLO

The GRIL—the Groupe de recherche interuniversitaire en limnologie et en environnement aquatique—is a limnology group based in Québec, Canada. In true Canadian style, it is a bilingual group going by the English name of the Interuniversity Group in Limnology and Aquatic Environments. The GRIL has been continuously financed by the Québec government for the past 25 yr as a Strategic Research Network via the provincial funding program (Fonds de Recherche du Québec—Nature et Technologie or FRQNT). The GRIL most recently (in 2017) had its funding renewed for another 6 yr.

A BRIEF HISTORY

The GRIL was created in 1989 through the actions of an enthusiastic group of limnologists from four Montréal-area universities: Université de Montréal (UdeM), Université du Québec à Montréal (UQAM), McGill University, and Université du Québec à Trois-Rivières (UQTR).