

ABSTRACT

Diatoms are a unique group of algae that are enclosed in a silica frustule (shell). The goal of this study was to provide undergraduate students at ASU – Newport an opportunity to experience the collection of various diatom species, learn to process samples on slides for identification processes, and to then catalog and analyze the species identified. From 2017-2019 students majoring in Natural Sciences at ASU-Newport began a catalog of diatom populations in Craighead County, Arkansas as part of an independent study project. Samples were processed in the laboratory to remove any organic contaminants and to isolate the silica frustules of target organisms. Diatoms were identified to taxonomic family and cataloged and reported to the Arkansas State University ARCTOS database.

INTRODUCTION

Arkansas State University – Newport (ASU-Newport) was founded in 1976 as White River Vocational Technical School, merged with Arkansas State University system in 1992, and has in the past decade has grown from a small technical campus to encompassing three campuses in northeast Arkansas. These campuses offer a variety of degrees in both technical programs and in 2-year Associate of Art and Associate of Science degrees designed to transition into a 4-year bachelors through 2 + 2 agreements with multiple universities in Arkansas.

In the fall of 2017, students majoring in Natural Sciences at ASU-Newport began a research project independent of course work to gain extra lab experience under the supervision and mentorship of Dr. Sarah Webb, Associate Professor of Life Sciences at ASU - Newport. Studies have shown that students who have hands-on scientific research experience are more likely to be successful in completion of both undergraduate and graduate programs (Gregerman *et al.* 1998; Bangera and Brownell 2017; Fechheimer *et al.* 2017). The project chosen was to catalog native diatom species from the region for three reasons: 1) there has not been a comprehensive study on the specific species of diatoms found in northeast Arkansas; 2) the scientific work involved in the project involves a variety of experiences (field collection, laboratory preparation of samples, and analysis of data) along with being low-cost; and 3) the local four-year university, Arkansas State University, has been working together within the biology department to catalogue a variety of organisms through the collaboration of multiple labs studying a wide variety of organisms. Arkansas State University works with ARCTOS, which is a collection of research-grade biological data that allows researchers around the world access to natural and cultural history collections (ARCTOS, <https://arctosdb.org>), and the ASU-Newport diatom collection will be contributed to that database as part of that collaboration.

Diatoms are photosynthetic algae belonging to phylum Ochrophyta and are extremely successful in both freshwater and marine environments. These algae are unique from other organisms due to their possession of silica cell walls. These organisms are responsible for an estimated 25% of the total oxygen production on earth (Werner 1977) and are important primary producers of organic material within ecosystems. Knowledge of diatom populations in water bodies is used in a variety of applications, including as a method of evaluating environmental health and in forensics as a method of “fingerprinting” a body of water (Dixit *et al.* 1992; Chapman 1996; Krstic *et al.* 2002). Each body of water contains its own unique population of diatom species and the source of a water sample can be pinpointed using those organisms (Peabody 1977).

Diatoms are studied frequently for a variety of applications, but while a significant amount of data has been collected on the ranges of species in fresh water bodies across Europe, little data exists for other areas including the United States (Finlay *et al.* 2002). The goal of our study was to establish a method of collection of local diatoms which would encompass different environments, and to assess whether collection location had an effect on which species were present at separate locations.

METHODS

Students collected diatom samples from ten sites in Craighead County, Arkansas, beginning in September 2017 and continuing through Fall of 2019. Samples including both water and sediment from designated study sites were collected and mixed ~50:50 with 70% ethanol in 2 mL sterile collection tubes. For processing, hydrochloric acid (HCl) was added to samples and heated to a boil for ~30 minutes to dissolve organic materials (Figure 1). Samples were then rinsed with deionized water and placed on glass cover slips to dry. Once dry, covers slips were adhered to slides using Permount™ mounting medium and allowed to dry for a minimum of 48 hours before examination. Each slide was examined at 1000x magnification and diatoms were identified to family, genus, or species as possible (Figure 2). Sites were labeled as either rural, urban, or roadside to examine whether environment had an effect on diatom assemblages.

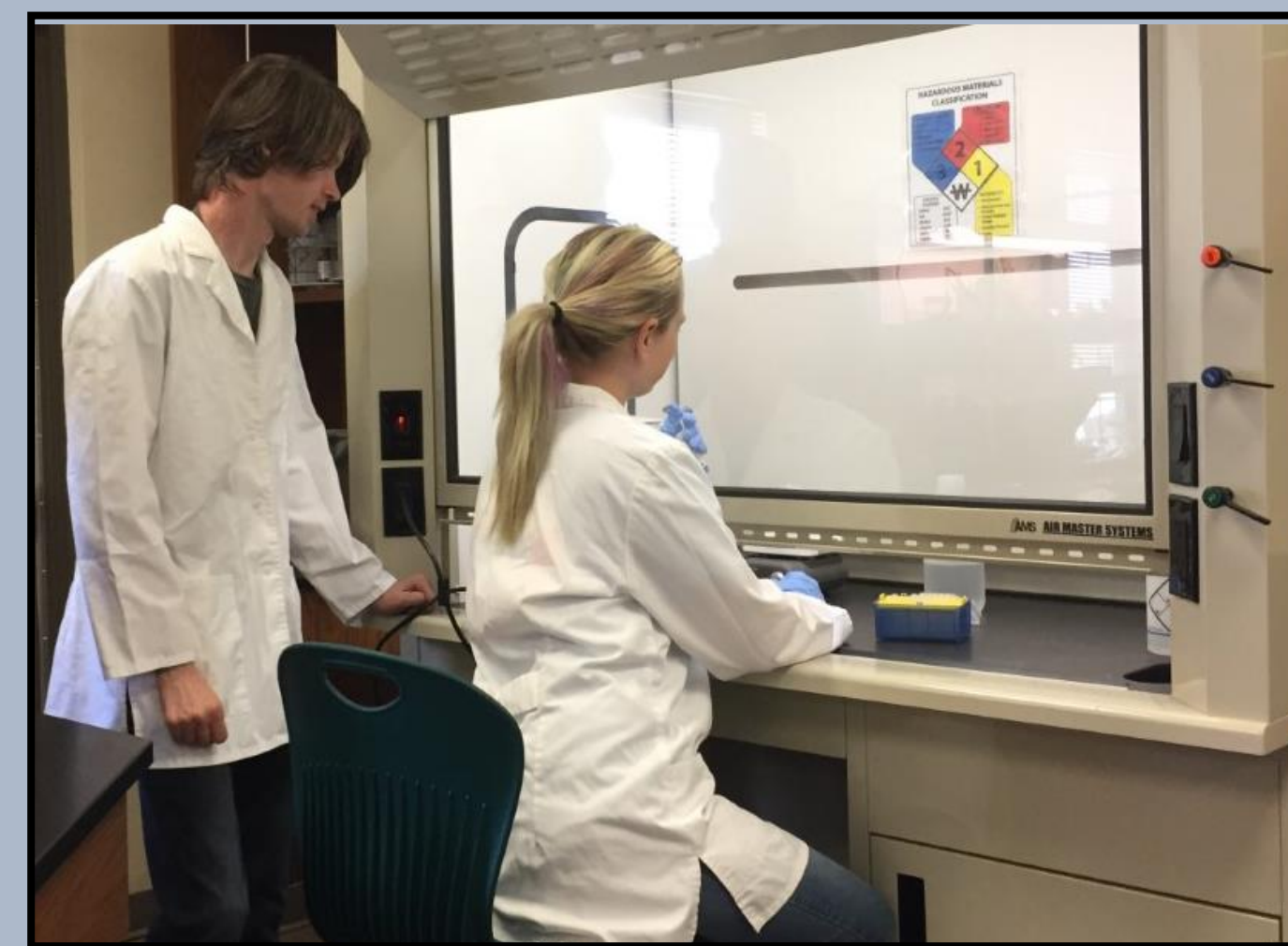


Figure 1. Students process diatom samples in the fume hood to isolate diatom frustules.



Figure 2. Students identify prepared diatom samples on slides in the laboratory.

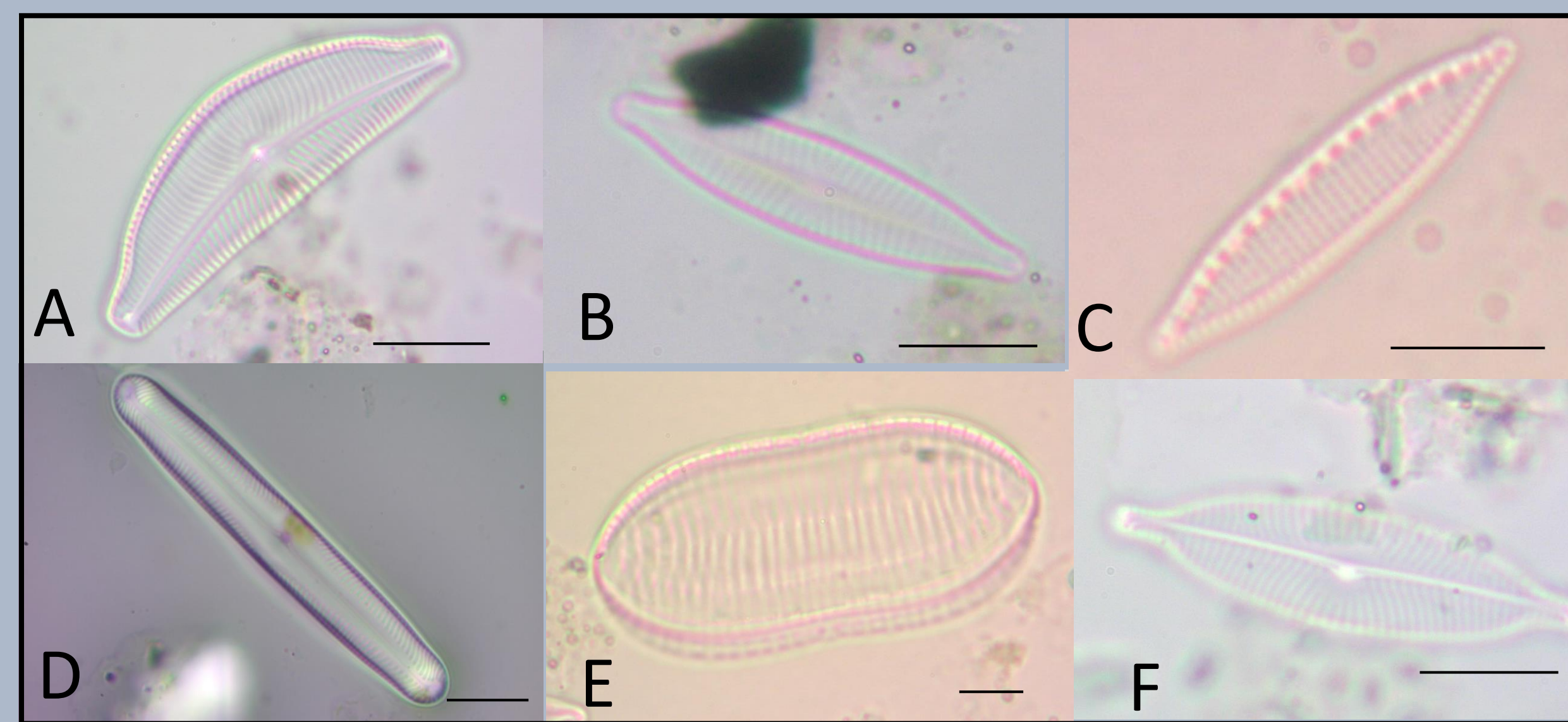


Figure 3. Diatom species collected from field sites in Craighead County, Arkansas. Imaged using ZEN AxioCam and imaging software (Zeiss). 1000x. Scale bar = 1 μm. A) *Encyonema*; B) *Craticula*; C) *Nitzschia*; D) *Pinnularia*; E) *Psammodidium*; F) *Cymblopleura*.

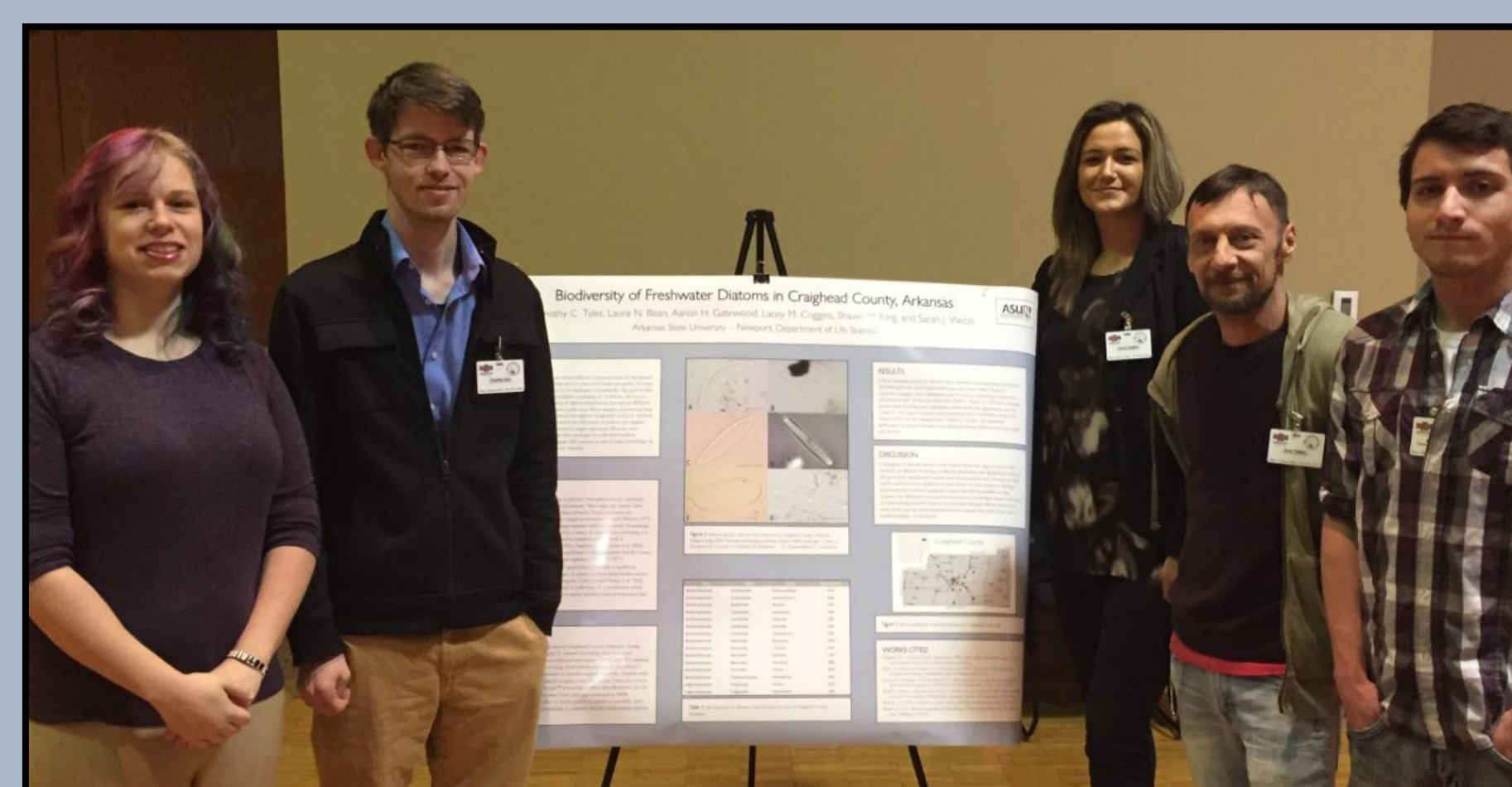


Figure 4. ASU-Newport students present their diatom research at the Arkansas Academy of Sciences conference at Arkansas State University in April, 2018.

RESULTS

Fifteen separate genera of diatoms were identified encompassing two classes (Bacillariophyceae and Fragilariophyceae) and seven orders. *Craticula*, *Grosigma*, and *Cymblopleura* were the most common genera present, identified at half of the surveyed sites (Figure 3). The least common genera were *Geissleria* and *Stauriforma*, which each only appeared at one site. The most common order identified was Cymbellales, which were found at 90% of the sampled sites. To date, no significant differences in species diversity were detected among different site types.

ASU- Newport students presented their research at the Arkansas Academy of Sciences in April of 2018 (Figure 4). Five students presented at that conference, two of whom began paid research positions in biology labs at Arkansas State University upon transfer to complete their bachelor's degrees in Biology in 2019. An additional student who later worked on the project in late 2018-2019 received the Superb Scholarship that is funded by the National Science Foundation, and includes money for her tuition, money for her personal research project, money for travel to scientific conferences, and money for a 6-week internship in the lab of her choice during the summer semesters while she is in school.

DISCUSSION

To date, the Natural Sciences students at ASU – Newport who have participated in independent study on diatoms have gained hands-on field, laboratory, and general scientific knowledge through work on this project which has directly contributed to their success as young scientists. In some cases this has come in the form of paid research positions and research scholarships. Many lab positions require some experience, and students who have been able to participate in hand-on research while working on their respective degrees are at an advantage in these cases. It is our intention that this research program continue to grow by applying for undergraduate research funding and encouraging students to participate in future research efforts. Additionally, science students who participate in research as undergraduate students have higher rates of academic success in their fields (Gregerman *et al.* 1998; Bangera and Brownell 2017; Fechheimer *et al.* 2017).

Cataloging of diatom species in the United States has lagged behind other research on diatoms, which focus more on diatom physiology and applications such as the previously mentioned forensic and environmental uses. Because the data can be useful in these applications and others, we have begun to catalogue species present around Craighead County which will be available to then examine the differences among local environments. Continuing research will focus on determining whether there is a correlation between diatom species in a water body and the environmental features around that water body, such as roads, buildings, or farmland.

WORKS CITED

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