Project Summary
Rocky Mountains Cooperative Ecosystem Studies Unit

Project Title: Diatoms of Rocky Mountain National Park; biodiversity and bioassessment with a focus on the diatom genus Nitzschia; do diatom based indicators of water quality exist in Rocky Mountain National Park?

Discipline: Natural Resources
Type of Project: Research
Funding Agency: National Park Service
Other Partners/Cooperators: University of Colorado at Boulder
Effective Dates: 6/15/2014 – 12/31/2015
Funding Amount: 13,865

Investigators and Agency Representative:
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Project Abstract: TDiatoms are unicellular algae, serving as the base of the food chain in most aquatic ecosystems. They also play important roles in the processing of CO2, O2, as well as carbon and silica cycling, providing important ecological services in aquatic ecosystems. They have been shown to be excellent biomonitors in a wide range of aquatic ecosystems (Stevenson & Smol 2003) because of their diversity, population sizes, short generation times and high fidelity to specific ecological conditions.

For Colorado, while there are several studies using diatoms for ecological research (Wolfe et al. 2003), very few have focused on adding to and documenting the diversity of diatoms in the state. Patrick (in Patrick & Reimer 1966) described a new variety, and Kociolek & Thomas (2010) described a new genus and 4 new species from Pleasant Valley along the Front Range. However, no studies have focused on Rocky Mountain National Park (ROMO). National Parks of the United States are turning out to harbor many undescribed species, and contain very rich floras of diatoms. In Great Smoky Mountains National Park, for instance, a large number of new records and new species were discovered in a biotic survey of that region, including a new genus (Johansen et al. 2008) and 488 species of diatoms (Johansen et al. 2004). Collections from Glacier National Park (GLAC; made using methods similar to those proposed here) contain many new species (Winter & Bahls 2013; Bahls 2012; Bahls 2011; Bahls 2010; Kociolek et al. 2014), including taxa found in oligotrophic waters. Traditional emphasis on diatoms as biomonitors has been in aquatic habitats that have been impacted by anthropogenic disturbances.

Here we propose research on the diatoms of ROMO to be done in conjunction with a large survey of the parks waters by the Rocky Mountain Inventory and Monitoring Network (ROMN) during 2014 – 2016. We have three major objectives as follows.

In our first objective, we will move away from the traditional use of diatoms as primarily bioindicators in disturbed systems and instead focus on the unique community of diatoms in the largely reference quality and oligotrophic environments that characterize ROMO. By documenting patterns within the community of diatoms in the park we will develop methods that allow use of diatoms for the conservation of unique or pristine aquatic habitats in the park (Kociolek & Stoermer 2009). Moreover, by exploring responses in species occurrence and community structure across natural gradients where direct anthropogenic disturbances are less common, the role of diffuse and large scale processes like climate change and nutrient deposition (Baron et al. 2011) may be more effectively isolated in stream diatom communities and species-specific responses.

This work will complement similar research done on the response of plankton in the parks lakes. We will explore traditional bioassessment modeling of diatom communities including multimetric models (MMI, also known as an Index of Biotic Integrity) and a multivariate approach known as River Invertebrate Prediction and Classification (RIVPACS; Hawkins et al. 2000, Van Sickle 2008). We will use existing MMI modeling approaches (Karr and Chu 1997; Barbour et al. 1999; Fore and Grafe 2002) as well as methods developed by Schoolmaster et al. (2012, 2013a, b) and Grace et al. (2012). We will also explore diatom based “increaser metrics” that offer a diagnostic bioassessment of specific stressors such as sediment or metals. We will base our methods on modeling developed by Teply (2010a,b). These models have been applied to diatom data from GLAC (Schweiger et al. In Press a and b, Schweiger et al. In Review). Note that this modeling will require a complete sample from all the sites discussed below and will be done in conjunction with ROMN staff.

The second objective of our work will focus on the diatom genus Nitzschia and will develop specific models and predictions for this genus. Species of this genus are usually indicators of degraded

water quality, although pilot work in ROMO and in GLAC suggests a few species can occur in oligotrophic situations. Species in this genus may have an interesting and diverse set of responses to disturbance. We will identify Nitzschia ssp., and relate patterns in the abundance and distribution of Nitzschia ssp. with independent estimates of water quality, habitat structure and other biological indictors. The relationships will be explored using ordination techniques to relate location and environmental variables to presence and relative abundances of diatoms (Heino & Soininen 2007; Passy 2007). The genus is well known as a taxonomically difficult and our work will provide clarity on the identity of the members of this genus in ROMO. This will contribute to our understanding of the biodiversity of the Park, as new species will likely be identified. Finally, this will contribute to a book-length monograph of the genus Nitzschia for the USA—the first such work in the English language

Our third objective is to generate a flora of the diatoms of Rocky Mountain National Park. This would further allow us to evaluate and document water quality for the Park, create baselines of species presence and relative abundances for aquatic primary producers, and to assess the number of new, unique and/or rare species present.

Outcomes with Completion Dates: Final Report – 5/31/2015

Keywords: diatoms, biodiversity, and bioassesment, Rocky Mountain National Park, University of Colorado at Boulder