For example, in lake Igaliku, we fixed 3 sediment traps at 5 m, 10 m, and 15 m depth, spanning the epilimnion, thermocline, and hypolimnion, respectively. Additionally, we deployed an interval sediment trap (Fig. 2B) at the bottom of lake Igaliku in 2018 summer. This interval sediment trap has a motor we programmed before the trap was deployed so it will rotate the sample bottles every 30 days, allowing for monthly sediments samples to be collected.

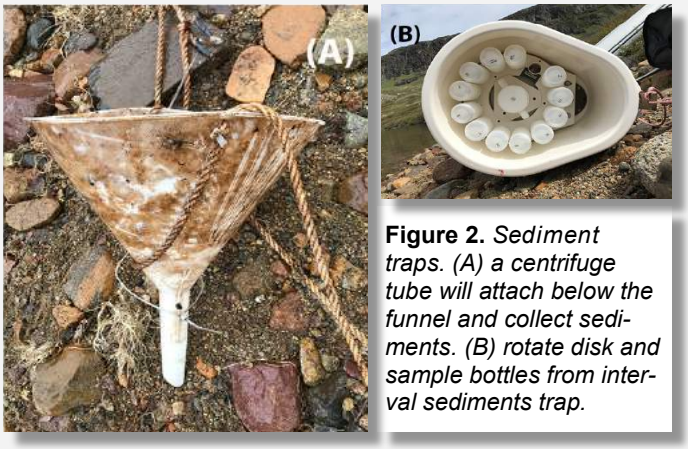

Figure 2. *Sediment traps. (A) a centrifuge tube will attach below the funnel and collect sediments. (B) rotate disk and sample bottles from interval sediments trap.*

Presently, we are working on analyzing the yearly fixed trap samples from 2016–2017 and 2017–2018. In the future, we will work on the monthly sediment samples and try to build a better calibration based on the *in situ* data. The ultimate goal will be reconstructing temperature during the late Holocene with our improved calibration.

Acknowledgements

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Holocene vegetation changes under changing climate conditions at Thoreau's Bog, Mount Monadnock

By Karen Saunders, PhD candidate, and Hana Kiewicz-Schlansker, MS Environmental Studies, Antioch University New England

At 965 m, Mount Monadnock in southwestern New Hampshire is one of the most popular hiking destinations in the world. Foot traffic from more than 100,000 visitors each year has damaged fragile montane ecosystems that were previously been impacted by anthropogenic disturbance from agriculture, logging, and fire since European colonization in the 18th century. Most of the many small peat pockets, fens, and bogs on the upper slopes of Mount Monadnock have been severely degraded by the impact from hikers. Given these conditions, we are conducting an analysis of macrofossils from Thoreau's Bog, which lies near a less hiked trail, to illuminate the the vegetation dynamics of the bog under changing climate and disturbance conditions during the last 8,000 years.

Thoreau's Bog is located in a syncline on the northeast slope of the mountain at an elevation of approximately 823 m, surrounded by high-elevation spruce-fir forest. *Sphagnum* spp. dominate the bog's present-day vegetative community, which also includes *Ilex mucronata* (L.) M. Powell, Savol., & S. Andrews, *Eriophorum angustifolium* Honckeny, and other species. A 2.5 m core was extracted in April of 2015. We obtained a radiocarbon date of 2410±30 BP (2685–2350 cal BP) at 49 cm from the extracted core's surface, and a date of 7420±30 BP (8335–8180 cal BP) at 247 cm below the surface. We are assessing plant macrofossils, charcoal, and total organic content to reconstruct bog development, changes in the vegetation, and fire history.

Increasing organic matter and gradual changes in macrofossil assemblages in the lower section of the core, including abundant Nymphaeaceae sclereids and *Sphagnum* leaves, indicate a shallow pond environment with a gradually encroaching *Sphagnum* mat in the lowest 90 cm of the core. A rapid midcore disappearance of Nymphaeaceae sclereids accompanied by an increase in *Sphagnum* leaves indicates a decrease in open water and a change to a *Sphagnum*-dominated community. This is followed by a decrease in *Sphagnum* and an increase in wood fragments and charcoal, indicating a mid-Holocene multi-century drier spell with repeated fires in the vicinity of Thoreau's Bog.

Figure 1. *Hana Kiewicz-Schlansker coring at Thoreau's Bog.*

Our next steps are to obtain additional radiocarbon dates for construction of an age/depth model and to complete analysis of the upper centimeters of the core to give a picture of more recent vegetation dynamics at Thoreau's Bog. Our research is part of the ongoing long-term research carried out by the Monadnock Ecological Research and Education (MERE) Program, a collaboration between students and faculty at Antioch University of New England and Mount Monadnock State Park.

A 320-year reconstruction of snowpack from tree rings in the Chuska Mountains, Navajo Nation

By Becky Brice, PhD candidate
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The recent, prolonged drought and increasing aridity with climate change on the Navajo Nation has led to dramatic and lasting impacts to water resources and ecosystems, and has raised questions about the viability of native communities in this already arid place. Rising temperatures pull moisture away from the surface water critical to livestock and municipal supplies, and sap water from soil moisture essential for plant growth and water storage. Snow, the dominant source for surface water in the Chuska Mountains of the Navajo Nation, is projected to decline across the western United States with a warmer future. This is a worrisome for the Navajo Nation who disproportionately rely on local snow-fed water supplies from the Chuska Mountains.

Snowpack and the water contained in snowpack varies from one year to the next, with runoff tightly linked to these fluctuations (Cayan, 1996; Cayan et al., 1998; Mote et al., 2018). Region-wide studies suggest an overall decline in western U.S. snowpack in the future, but instrumental records of Chuska Mountain snow indicate a minor and insignificant decline over the last 30 years. Despite little change in snowpack, tribal members have reported that snow-fed surface waters in the Chuska Mountains have begun to go dry. Given the disconnect between region-wide snow declines, undetectable trends in the limited Chuska snow records, and lowering lakes levels long-term information about snowpack in the Chuska Mountains is essential.

Figure 1. *Collection of snowpack measurements in the Chuska Mountains with collaborators Carlee McClellan (Senior Hydrologist, Navajo Nation Water Management Branch) and Irving Brady (Senior Field Technician, Navajo Nation Water Management Branch).*

My research was motivated by the Navajo Nation Department of Water Resources' questions concerning Chuska Mountain snowpack. The Navajo water managers' interest is centered on understanding the natural context of snowpack variability in their only headwaters in light of a changing climate. Our collaboration was guided by use-inspired science principles and we produced the first Chuska snowpack reconstruction for the Navajo Nation. I used tree rings collected from the Chuska Mountains and snowpack measurements collected at Navajo-managed snow course sites (Fig. 1) to reconstruct snowpack from 1694 C.E. to 2014 C.E.

The reconstruction shows that the short instrumental record of snowpack in the Chuska Mountains only captures a portion of the range of natural variability (Fig. 2), potentially leading to management strategies insufficient to address the full-range deficit or surplus potential in the natural system. Snow droughts are recurring and persistent in the reconstruction. Some extended high snowpack intervals also appear in the early part of the reconstruction, but few have the duration of low snowpack years. One exception is a long wet period in the first part of the 20th century, resulting in a remarkable thirty-three years of high snowpack in these mountains. The most severe snow drought in the last three centuries was from 1728–1742. The two droughts in recent memory for the Navajo are the most recent drought (beginning approximately 2000 to present) and the 1950's drought. The extended drought of the 2000's does not rank among the ten lowest snowpack periods in the reconstruction, but the low-snow years in 2002 and 2006 were among the worst single-year snow droughts over the entire 300 years. Critically, the 1950's drought, from which Navajo tribal members report experiencing severe impacts to their livelihoods, is rivaled and exceeded by 5 other dry snowpack periods prior to the 20th century. The severity and persistence of past snow drought, which occurred without anthropogenic forcing, signal potential future declines in Navajo snowpack if warming trends continue. The Chuska Mountain snowpack reconstruction is a source of information that can supplement, inform, corroborate, and support existing tribal knowledge, and can in turn help to guide decision-making among Navajo water managers.

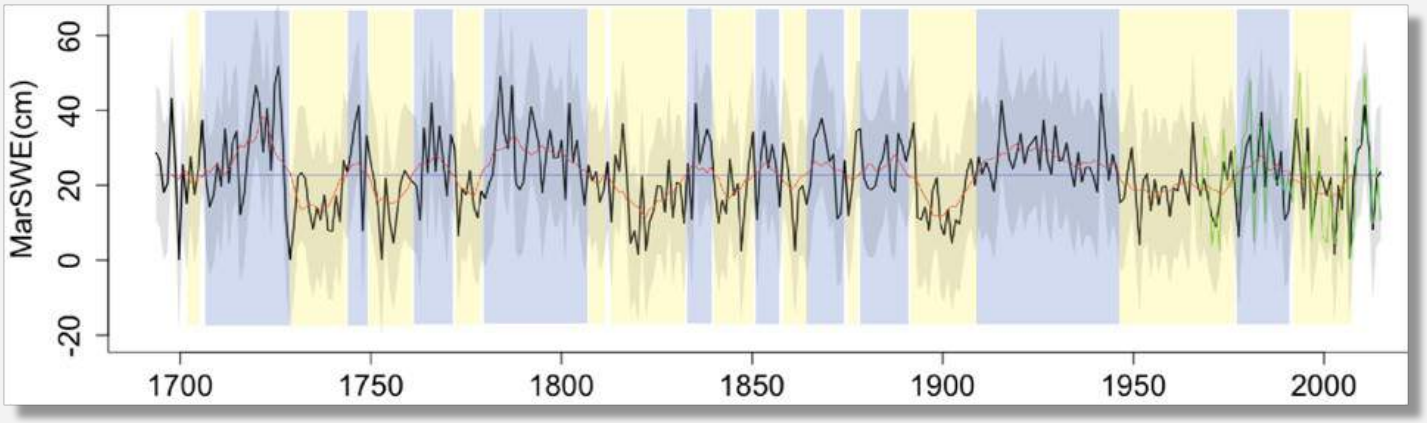

Figure 2. *Chuska snowpack (MaxSWE) reconstruction (1694-2014 AD; black line) for the Navajo Nation. Multi-year periods of above and below average conditions are highlighted in blue and yellow bars, respectively. The 95% confidence interval is shown in grey shading. The blue line is the long-term reconstructed mean. The red line is the 10-year moving average. The green line is the instrumental series.*

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Recent Graduates

Camille Tamo (2019) Late Holocene Environmental Change Across the Canadian Arctic. MSc thesis, Department of Geography, Environment and Geomatics, University of Ottawa. Advisor: Konrad Gajewski.

Abstract: Lake sediment cores spanning the last 2000 years from four sites across the Canadian Arctic Archipelago (CAA) document the responses of terrestrial and freshwater ecosystems to regional climate variability. Biogenic silica (BSi) records in cores from Banks Island, NWT (Lake B503; 72.3245, -123.4036, 84 m asl), Bathurst Island, Nunavut (PR01; 75.6497, -99.1144, 30 m asl), Prince of Wales Island, Nunavut (SW08; 72.3177, -97.2678, 104 m asl), and Ellesmere Island, Nunavut (CV03; 79.9211, -82.9348, 363 m asl) were used to examine the relationship between diatom production and climate. A pollen record from Prince of Wales Island provided the first high-resolution July temperature reconstruction for the last 1000 years for the central CAA. Dissolution was evident in three out of the four lakes; core SW08 contained no BSi above detection and cores CV03 and PR01 only contained values above detection in the uppermost sediments, suggesting that the preservation of biogenic silica (BSi) in the sediment is likely influenced by sedimentary carbonates. A BSi sequence from core B503 showed that diatom production was affected by climate changes such as the Medieval Climate Anomaly and the Little Ice Age. The vegetation on southern Prince of Wales Island underwent marked transitions during the Little Ice Age and Medieval Climate Anomaly, which was mainly observed in the proportion of Cyperaceae and Poaceae. The mean July temperature reconstruction showed a long-term cooling from 1080–1915 CE with a sustained cold period from 1800–1915 CE prior to 20th-century warming. A synthesis of paleoclimate records from across the Arctic demonstrated that pollen-based reconstructions record both high and low frequency climate variability, when sampling resolution is sufficient, and can improve regional climate reconstructions.

The thesis is available at https://ruor.uottawa.ca/handle/10393/38837.

Jaclyn Skinner (2018) Understanding Complex Late and Terminal Woodland Sites in the Red Wing, Minnesota, Area. MSc thesis in Anthropology, Minnesota State University, Mankato. Advisor: Ron Schirrmer.

Jamison Jordan (2018) Across an Ecotone: An Analysis of Late Prehistoric Artifacts from Southern Minnesota. MSc thesis in Anthropology, Minnesota State University, Mankato. Advisor: Ron Schirrmer.

Josh Anderson (2018) A Macromorphological Analysis of End Scrapers from Sites Associated with Two Phases of the Oneota Tradition, the Blue Earth and Spring Creek, in Southern Minnesota. MSc thesis in Anthropology, Minnesota State University, Mankato. Advisor: Ron Schirrmer.

Jasmine Koncur (2018) The McClelland Site (21GD258) and the Oneota Tradition in the Red Wing Area. MSc thesis in Anthropology, Minnesota State University, Mankato. Advisor: Ron Schirrmer.

Melissa Oubre (2018) Predicting Invasive Carp Habitat Suitability in the Minnesota River Basin, Minnesota. MSc thesis in Biology, Minnesota State University, Mankato. Advisor: Phillip Larson.

Zach Hilgendorf (2018) The Efficacy of Best Management Practices on Peak Discharge and Contaminant Loads in Agricultural Drainage Systems, Blue Earth River Watershed, South-Central Minnesota, USA. MSc thesis in Biology, Minnesota State University, Mankato. Advisor: Phillip Larson.

Devon Libby (2018) Assessing Historical Planform Channel Change in an Altered Watershed with Quantification of Error and Uncertainty Present in a GIS/Aerial Photograph-based Analysis; Case Study: Minnesota River, Minnesota, USA. MSc thesis in Biology, Minnesota State University, Mankato. Advisor: Phillip Larson.

Vinson Williams (2018) A Geospatial Approach to Assessing I/I in Wastewater Infrastructure: Case Study of Minneapolis/St. Paul, MN. MSc thesis in Biology, Minnesota State University, Mankato. Advisor: Phillip Larson.

New Publications

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Anderson, L., Edwards, M., Shapley, M.D., Finney, B.P., Langdon, C. (2019) Holocene thermokarst lake dynamics in northern Interior Alaska: the interplay of climate, fire, and subsurface hydrology. *Frontiers in Earth Science* 7:53. doi:10.3389/feart.2019.00053.

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2018 CANQUA-AMQUA POST-CONFERENCE FIELD TRIP GUIDEBOOK

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Announcements

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Conference Announcements

GSA 2019
22–25 September
Phoenix, Arizona, USA

T127. The Importance of Minerals in Recording Paleoenvironmental Conditions and Governing the Biogeochemistry of Lacustrine Systems

Session Organizers:
Jason R. Price (jasonrprice01@gmail.com) and David W. Szymanski (dszymanski@bentley.edu)

Abstract

Lakes can be very sensitive to environmental changes, with past changes recorded in bottom sediments, and present-day changes reflected in water chemistry. Detrital and diagenetic minerals in lake-bottom sediments provide paleoenvironmental proxy data, and present-day mineral weathering provides sources and sinks of solutes to lake water. Consequently, we have proposed a topical session for the 2019 Geological Society of America Meeting being held in Phoenix, Arizona entitled, "The importance of minerals in recording paleoenvironmental conditions and governing the biogeochemistry of lacustrine systems". This session is intended to highlight cutting-edge research at the nexus of mineralogy and limnogeology.

Within lake-bottom sediments, detrital minerals, including, but not limited to, heavy minerals and secondary/tertiary clays, are capable to recording paleohydroclimatologic changes within the lake's watershed over geologic time. Present-day environmental changes are reflected in a lake's water chemistry, which is often dominated by mineral weathering reactions in natural systems. The dissolution of bedrock minerals yields solutes to lake waters which, in turn, governs environmental factors such as biological productivity and acid neutralizing capacity. Despite the critical influence of minerals on lacustrine systems, the link between mineralogy and limnogeology is often over-looked. The purpose of this session is to bring together researchers who use mineralogy to study lacustrine systems. Potential research may include, but is certainly not limited to, atmogenic dust deposition, primary mineral weathering, formation of secondary/tertiary weathering products, and detrital and/or diagenetic/authigenic minerals in lacustrine sediment. Presentations may address lakes of any size, either ancient or modern.

If you conduct limnogeologic research that utilizes mineralogy, please consider submitting an abstract to this session. **The abstract deadline of 11:59 p.m. Pacific Time on 25 June 2019 will be here soon.** Even if you do not submit an abstract for this session, we hope that you will attend the session. If you have any questions, please do not hesitate to contact either of us. We hope to see you in Phoenix in September!

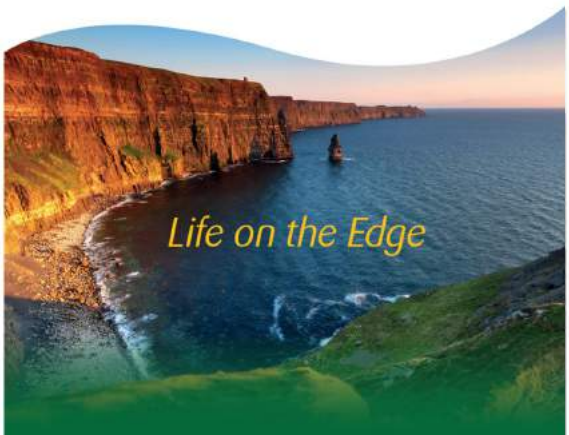
QR | QUATERNARY RESEARCH

Reception for Authors, Reviewers, Editors and Editorial Board Members of Quaternary Research

On board the MV Cill Airne
July 26 at the INQUA 2019 Congress in Dublin

Quaternary Research, the official journal of AMQUA, is published by Cambridge University Press on behalf of the Quaternary Research Center (QRC) of the University of Washington. This year the QRC will be celebrating its 50th Anniversary, and in the coming year, *Quaternary Research* will celebrate 50 years since the publication of its first issue in September 1979. The QRC and CUP are pleased to invite you to a reception on board the MV Cill Airne to help recognize these half century achievements. The MV Cill Airne is docked on the Liffey River just a 2-minute-walk from the Convention Center. Festivities will begin at 7 pm with complementary drinks and light snacks. We look forward to seeing you on the Emerald Isle.

Do stop by the CUP Booth at the Conference Center to get a ticket for a free drink. Please look out for more information as the date approaches.



Quaternary Research in Ireland and the Irish Quaternary Association (IQUA)

Ireland's famously beautiful landscape contains a wealth of evidence for a dynamic Quaternary history. With dramatic glacial landforms, varied coastlines, extensive peatlands, innumerable lakes, and a rich archaeological heritage, the island has long fascinated Quaternary scientists. Indeed, Ireland has a history of Quaternary research dating back to the nineteenth century, including famous visits by Agassiz in 1840 and Carvill Lewis in 1885, and its diverse Quaternary archives continue to provide fruitful avenues for research.

The Royal Irish Academy (RIA) 'Committee for Quaternary Research in Ireland' was established in 1934, providing a key stimulus for the study of Ireland's Quaternary history. In the 1970s, the Irish Quaternary Association (IQUA) was founded with a view to co-ordinating and energising all aspects of Quaternary research in Ireland and passing on existing expertise through conferences and especially field excursions. Notable contributors over the lifetime of the Association include Frank Mitchell, Francis Synge, Alan Smith, Bill Watts, Marshall McCabe and Willie Warren. The INQUA Congress held in Birmingham in 1977, which included excursions to Ireland led by Watts and Synge, gave a further impetus to Quaternary studies in Ireland. Frank Mitchell, as President of INQUA for the intercongress period 1969–1973, and later through his classic book, Reading the Irish Landscape, also greatly helped in highlighting the multi-dimensional character of the Quaternary record in Ireland.

Currently, IQUA is a thriving organisation with well over 100 members, and disseminates information about its activities through its webpage (www.iqua.ie) and email list. The link between the RIA and INQUA continues to be positively fostered by active Quaternary scientists represented via the RIA's Geoscience Committee (formerly the National Committee for Geology), and by funding IQUA's national delegates to attend INQUA congresses. Furthermore, the recipient of IQUA's inaugural Frank Mitchell Award for Distinguished Service to Quaternary Research and Teaching, Pete Coxon, has served as both IQUA President (2008-2012) and as Secretary-General of INQUA (2003-2011), thus strengthening the link between IQUA and INQUA.

The following links will give you a sample of the Congress facilities and Ireland's Quaternary science community and landscape:

The Irish Quaternary Association (IQUA): **http://www.iqua.ie**

IQUA Field Excursions: **http://www.iqua.ie/publications.html**

The Convention Centre Dublin (the Congress Venue): **http://www.theccd.ie**

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