Supporting Professionals
Who Study, Protect, and Manage
North America's Rivers

Fall 2023
Volume 36, Issue 3

RMS Journal

Training the Next Generation of River Professionals and Scientists

Students Overcome Multiple Challenges to Conduct River Research

by John McLaughlin

Rivers are powerful teachers. Readers of this journal surely appreciate this wisdom, but its practical significance seems to escape many colleges and universities. The vast majority of undergraduate instruction is confined within classroom walls. Field programs of all kinds have been declining nationwide, a trend accelerated by the COVID-19 pandemic. Student frustration with online learning mirrored similar experiences with lecture-based instruction, leading many to reevaluate college options. Simultaneously, the need for well-trained river professionals has increased with deepening river conservation concerns, growing recreational demand, and thinly stretched agency resources. River-based field education programs provide compelling responses to these issues. This article summarizes student research and experiences in one program, which is linked to a national network of river-based field courses.

Sampling aquatic macroinvertebrates in the Elbow Creek burn zone on the Grande Ronde River.

River field courses fulfill several important needs. First, they provide essential training and experience for river scientists and other river professionals. Field training develops abilities to recognize river concepts in reality, discern river hazards, and practical skills. River variability and uncertainty provide opportunities to develop problem-solving skills, helping students become more resourceful, resilient, and self-confident. Second, students work in teams toward shared goals, which helps them develop interpersonal skills needed for effective leadership. Third, field courses help students make connections to real rivers, leading to sense of place and motivating river stewardship. For

(continued on page 16)

(continued from p.1)

some, these connections kindle a sense of wonder and curiosity that sustain scientific careers. Fourth, field courses often contribute to improved learning and academic performance in all contexts. Finally, river field courses provide access to experience, equipment, and skill development that are less available to some identities. In this way, river field courses can help river professions become more representative of the larger population. Each of these field course outcomes becomes more enduring when experiences are immersive, involving multiple days working and living in river environments.

Each spring, I teach a 15-credit block of field courses (Environmental Science Field Camp) centered around scientific field research expeditions. Students work in small groups to design research projects, which they implement during two expeditions. Prior to the program, most students have completed instructor-designed projects but few have conducted their own "authentic" research. Consequently, I mentor students closely throughout project development and implementation to facilitate their transition from student to scientist. I provide similar training and mentoring in river skills and procedures. Prior to each expedition, students identify their research interests, review the scientific literature to identify knowledge gaps, formulate research hypotheses, and design sampling protocols. After feedback and revision, they test their protocols at local field sites. Then the entire class participates in the expedition, during which each research group implements their protocol. After the expedition, we analyze the data to evaluate the hypotheses. The projects culminate in written scientific reports and presentations in a university-wide research symposium. Some students also presented their work at conferences beyond the university and we have submitted some reports for publication in scientific journals. For students, this experience is powerful and rare: few students engage in science at this level before grad school.

Student composition in the program has been more diverse than the university's student population and most river professions. In 2021, one third of students were people of color. In 2022, 45% of students had underrepresented identities as people of color or LGBTQIA+. (In spring 2020 the university's COVID response banned travel and required all courses to be online. In spring 2023 I was on sabbatical leave conducting river research, during which I did not run the program.) The program orientation and subsequent activities emphasized an inclusive social environment, which also facilitated effective teamwork during expeditions.

Students measuring amphibian habitat upriver from dams and reservoirs removed on the Elwha River, Olympic National Park, WA.

In recent years, the field expeditions centered on Northwest rivers, spanning ten days each. The first expedition traveled up the Elwha River on the Olympic Peninsula, Washington, focusing on science to inform ecosystem restoration following humanity's largest dam removal to date. We reached field sites via backpacking along a route lengthened considerably after river floods eliminated road access. The second expedition has been a 92-mile raft trip down the Grande Ronde River to its confluence with the Snake River, launching on the Wallowa River ten miles upriver from the confluence with the Grande Ronde. During the COVID-19 pandemic, I integrated infection risk into a comprehensive risk management program. That program was designed to reduce risk of infection and other incidents below that of staying home. We implemented a COVID-free 'bubble' strategy for each expedition, in which students avoided pre-expedition exposure, tested negative immediately prior to the expedition, and avoided outsider contact throughout the expedition. This strategy facilitated close collaboration throughout expeditions, and provided students a welcome alternative to online instruction that prevailed during the pandemic.

Student research projects addressed diverse river components in 2021 and 2022. Along the Elwha River, some studied amphibian habitat use and responses to riparian restoration following dam removal. Other groups surveyed carnivore habitat use, factors associated with invasive plant distributions, and effects of large woody debris on floodplain sediment deposition. On the Grande Ronde River, students studied habitat selection of river-dependent birds, butterfly-plant relationships, riparian songbird-habitat relationships, invasive plant distributions and habitat suitability modeling, large woody debris distribution, and impacts of wildfire on aquatic macroinvertebrates.

Research projects before the pandemic were similarly diverse, and focused on Elwha River restoration. In 2018, student teams studied insects and spiders in vegetation restored to the Elwha's largest reservoir bed, amphibian distributions on the former reservoir, ungulate browse impacts on trees and shrubs establishing in the reservoir, beaver browse selection, and responses of river-dependent birds to dam removal. In 2019, students studied amphibians and wetlands in the larger reservoir and another valley above the dams and reservoirs, ungulate browse in the upper valley, fungal distributions, and habitat selection by Spotted Sandpipers.

Below are some noteworthy results from several projects.

Amphibian responses to Elwha restoration have been rapid and dynamic. Initially, only one or two species were restricted to streams flowing over bare sediments on the former reservoir adjacent to pre-dam forests. During the next few years, trees and shrubs grew rapidly in damp sediments along the streams, restoring amphibian habitat. In addition, high river flows left ephemeral ponds adjacent to the active channel, which amphibians used as breeding sites. Now multiple amphibian species are found in habitats throughout the former reservoir. Students' analyses have shown that amphibians are found most consistently in larger and more complex wetland habitats.

Students establishing a plot to measure ungulate browse on the former Mills reservoir, after removal of Glines Canyon Dam, Olympic National Park, WA. All photos: John McLaughlin

Logs support Elwha restoration by protecting plants from deer and elk. Ungulates impact riparian habitats when intense browsing limits growth of trees and shrubs. Browse impacts are particularly relevant to river restoration, where woody plants provide shade and stabilize banks. Students studied the potential for large logs to reduce browse on both the Elwha's largest former reservoir and an upriver valley that serves as a model for restoration. They measured browse in four contexts: open areas without wood, adjacent to single logs, between two parallel logs, and fully surrounded by wood. They found large wood can reduce browse up to four-fold, but only where wood surrounded plants. These results have important restoration applications: clusters of logs can support growth of forest islands, which could accelerate riparian forest restoration.

River-dependent birds responded rapidly to dam removal. Removing dams affects habitats and food sources used by river-dependent birds. Students measured responses to these changes by surveying birds along the Elwha River from the mouth to a valley upriver from the former dams and reservoirs. Then they compared their surveys with data collected before dam removal using the same method along the same reaches. Their results showed large increases in species that use early successional habitat, along reaches most changed by dam removal. Little change has yet occurred in species that depend on late successional habitat structures or fish abundances that will require decades to restore. These results suggest river-dependent birds can serve as indicators of river restoration, from early to late in the restoration process.

River-dependent birds use habitat without regard for ownership or WSR designation. Students recorded bird habitat use vs. availability while rafting down the Grande Ronde River. Then they evaluated habitat selection using graduate-level statistical methods. Their results were clear and consistent with habitat associations known for each species. Results became stronger along arid reaches downriver where trees were sparse. The birds responded to specific habitat structures, which merit priority in river management. Students found little influence of private vs. public ownership or Wild and Scenic designation, perhaps due to consistently high river habitat quality or WSR suitability of the

Students at Glines Canyon, Olympic National Park, site of the largest dam removed on the Elwha River.

undesignated lower river.

Wildfire impacts to aquatic invertebrates decline downriver. Wildfire is known to decrease aquatic macroinvertebrates in burned reaches, but it was not known how far downstream this impact extends. A student team studied this issue one year after the Elbow Creek Fire, which burned nearly 23,000 acres along 13 river miles on both sides of the Grande Ronde River. They sampled macroinvertebrate species composition and abundances above, within, and below the burn zone. They found a dramatic reduction in macroinvertebrate diversity and abundance in burned reaches, relative to baseline samples measured upriver from the burn. Macroinvertebrate diversity and abundance increased logarithmically with distance downriver from the burn, and did not approach the baseline for a considerable distance (Figure 1). These results warrant additional study on other rivers and fires, in ways that control for other factors along the Grande Ronde that may have affected the results. Regardless, the results may have important implications as wildfires become larger, more frequent, and more severe. Because macroinvertebrates are key components in aquatic food webs, the results also are relevant to salmon restoration in a changing climate.

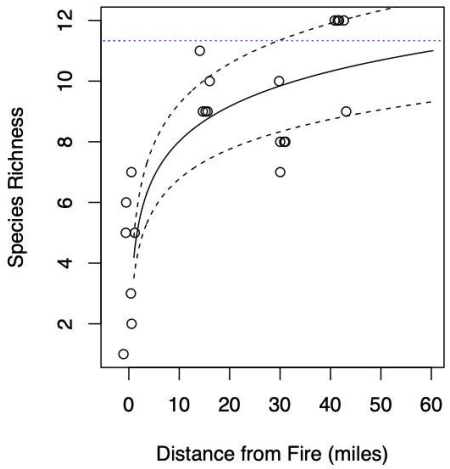

Figure 1. Relationship between aquatic macroinvertebrate species richness and distance from the Elbow Creek Fire burn zone, Grande Ronde River. Circles indicate number of macroinvertebrate species found in each sample. The solid line plots a logarithmic regression model fit to species richness data, R2 = 0.70. Dashed lines plot one standard error above and below the model. The height of the horizontal dotted line near the top of the figure is the average species richness from samples collected upriver from the burn zone. Similar results were obtained for macroinvertebrate abundances. *Figure created by Brock Diehl, Fern Keely, and Adriano de Oliveira, who also designed the project and collected the data.*

Students overcame multiple challenges while achieving these results. Field challenges included bankfull flows, snowstorms, gale-force winds, limited campsites within the burn zone, long hikes to study sites, and inquisitive cattle. Social challenges included learning to work closely with diverse peers within a tight timeline. Conceptual challenges involved climbing steep learning curves regarding both scientific research and outdoor skills. The university imposed financial obstacles: while institutional funds pay for laboratory courses, students must pay extra for field course expenses. The university also imposed myriad senseless bureaucratic requirements, but those impacted the instructor more than students. Transformative student outcomes each year suggest efforts to overcome these challenges were successful.

Evidence from diverse sources show the program has been effective. Students' presentations usually amounted to at least half of the department's contribution in the annual university-wide research symposium. Elwha research projects have filled important information gaps in the Elwha restoration program, contributing to Olympic National Park's research effort and the Park's symposium series. Grande Ronde expeditions support the local river economy: our raft rentals typically initiate the outfitter's season, providing business during a slow time. Many students described the program as life-changing, where they came to view themselves as scientists, develop close friendships, and clarify their professional directions. Many students reported their experience propelled them in directions they had not considered for themselves, including graduate school, scientific careers, or river guiding jobs. Some of these students had identities under-represented in those professions, so they will contribute to future profession diversity. Finally, the program contributes to the portfolio of river field courses promoted by the River Field Studies Network (RFSN; https://riverfieldstudies.com/ and RMS Journal, Fall 2019, p.18), which helps instructors at other schools innovate their river courses or develop new courses.

The program can be improved with future opportunities. First, we could collaborate more closely with river management agencies. I have been sharing Grande Ronde eagle location data with BLM staff, but research results would be more useful if the projects were designed around specific management needs. Second, we could reduce student costs to make the program more accessible. We are initiating scholarships in the coming year to support students who would be excluded by course fees. We also are developing a gear lending library to support students who need outdoor gear. Third, we could link more closely with the River Studies Leadership Certificate (RSLC) program. When I become the university's RSLC faculty advisor in fall 2023, I hope to enroll more students in RSLC across the university and within Field Camp. More broadly, positive and negative program experiences can inform instructors at other institutions. The RFSN is working to increase collaboration and knowledge sharing among river instructors across the nation. We also are providing instructor training and support to develop river field courses at more institutions.

In conclusion, rivers and river management face a difficult and uncertain future, but we launch with valuable assets. Experiences described in this article and comparable successes reported by colleagues across the River Field Studies Network outline productive strategies to prepare for that future. The next generation of river professionals will have a deep understanding of river science and river stewardship. ❖

Students at UNCO were already participating in some river-based field work, and the certificate program will build upon those experiences with its interdisciplinary framework and focus on river careers.
Photo: Chelsie Romulo, Inset: Sharon Bywater-Reyes

University of Northern Colorado offers new pathway to river-based careers

River Studies and Leadership Certificate now available through River Management Society partnership

by Bekah Price

Undergraduate students who are passionate about river science, recreation, and conservation at the University of Northern Colorado (UNCO) are one step closer to launching their dream river careers. Through a new partnership with the River Management Society (RMS), the school now offers the River Studies and Leadership Certificate (RSLC).

"The RSLC is designed to prepare students for diverse and rewarding river-based careers," explained Angie Fuhrmann, RMS River Training Center Coordinator. "It offers interdisciplinary coursework, hands-on professional experience, and the opportunity to learn from current industry professionals. Students will explore river systems from multiple perspectives, including life and earth sciences, policy and conservation, socio-cultural and economic factors, education, and recreation."

The certificate's coursework requirements closely align with several UNCO bachelor's programs, making it an accessible add-on for students enrolled in Earth Science, Environmental Studies and Sustainability, Geography, Ecology, and Recreation and Tourism.

Students enrolled in the RSLC program will showcase their work at the RMS Symposium or in the RMS Journal. They will also enjoy complimentary RMS memberships, networking opportunities with river professionals and fellow students nationwide, and invitations to workshops and river trips.

Dr. Sharon Bywater-Reyes, the school's RSLC advisor, said, "We are excited to offer this opportunity to our students as it elevates our programs with a focus on career preparedness and personalized learning. Graduates will possess a strong understanding of river science, recreation, and management, benefiting both our community and local government organizations." ❖

To enroll, students should contact Dr. Bywater-Reyes at:
sharon.bywaterreyes@unco.edu

The River Management Society established the River Studies and Leadership Certificate in 2018 to underscore the holistic, interdisciplinary approach essential for students aspiring to river-related careers. For more information, contact Bekah Price at bekah@river-management.org.