

Department of Environmental Sciences
College of the Environment
Western Washington University

ESCI 309 RIPARIAN CONSERVATION IN THE GRAND CANYON

Instructor: John McLaughlin
4 Credits

[This syllabus is subject to change. Many changes will be made before fall quarter. Subsequent changes will be announced in class or online.]

Course Description

In its course through the Grand Canyon, the Colorado River traverses gradients in elevation, geologic time, biogeography, federal-tribal relationships, recreation management, and conservation initiatives. Many concepts fundamental to modern geology were developed there, but basic questions about the canyon's origin remain unresolved. The canyon also lies between the two largest reservoirs in the U.S., in the middle of an over-allocated river basin beset by increasing water demands during a protracted drought. Water and river management issues there presage challenges throughout much of the western United States. Conservation in the canyon has a rich history, including ancient and contemporary Indigenous legacies, opposition to dam construction, managing recreational uses, mitigating dam impacts, protecting endangered species, limiting invasive species, and reintroducing California Condors. Students in this course will learn about concepts defining these gradients, issues, and programs – and have an opportunity to encounter them directly on a post-course river journey through the canyon. The post-course river trip will be independent of WWU. During class meetings we will discuss the concepts, design group research projects, practice Leave No Trace methods, conduct expedition planning, and address risk assessment and management. Class meetings will emphasize active participation; students will be expected to complete assigned readings and view assigned video presentations prior to meetings. There will be several all-day sessions on weekends dedicated to river safety training, skill development, and research project development. Satisfactory completion of the course is required for participation in the post-course Grand Canyon trip.

Prerequisite: Application required.

Grading

Personal goals (10%), Tolerance self-assessment (10%), Tribal profile (10%), GC issue report (10%), Literature review (10%), Research proposal (10%), Revised research proposal (10%), Safety training performance (10%), River skills self-assessment (10%), Participation (10%)

Learning Outcomes

- (1) Develop basic understanding of Grand Canyon geologic history and ability to recognize rock types and layers within stratigraphic profiles.
- (2) Gain an appreciation for the diversity of Indigenous peoples connected to the Grand Canyon, their relationships with the Canyon, and contemporary interests.
- (3) Understand similarities and differences between the Colorado River system before and after installation of Glen Canyon and Hoover dams.
- (4) Recognize lower, middle, and upper riparian zones, plants characteristic of each zone, and effects of river management in each zone.
- (5) Understand goals of the Glen Canyon Dam Adaptive Management Program and implementation results to date.
- (6) Develop understanding and competency in processes of research design.
- (7) Develop conceptual and experiential understanding of behaviors and regulations intended to limit recreational impacts on desert rivers and riparian systems.
- (8) Gain knowledge and experience in river expedition planning, including risk management, itinerary, gear, and food planning.
- (9) Develop conceptual and practical understanding of individual and group behavioral norms to maintain safety, camp and travel efficiency, and minimize impacts.
- (10) Develop understanding of effective expedition behavior and competence in effective teamwork.
- (11) Develop understanding of river rapid structure; ability to recognize tongues, waves, laterals, holes, eddies, strainers, and pillows; and ability to identify safe navigation routes through rapids. Develop conceptual understanding and basic competence in river risk management skills and principles.
- (12) Increase personal and scientific self-efficacy, grounded in experience.

Readings

[Some sources may change, pending ongoing negotiations over Colorado River water allocations implications for Grand Canyon conservation.]

American Whitewater. 2005. Safety Code of American Whitewater. [online]

<https://www.americanwhitewater.org/content/Wiki/safety:start>

Austin D and B Drye. 2011. The water that cannot be stopped: Southern Paiute perspectives on the Colorado River and the operations of Glen Canyon Dam. *Policy and Society* 30:285-300.

Collier M et al. 1996. Dams and Rivers: A Primer on the Downstream Effects of Dams. USGS Circular 1126. U.S. Geological Survey, Tuscon, AZ. [online] <https://pubs.er.usgs.gov/publication/cir1126>

CRRG (Colorado River Research Group). 2019. The Emerging Tribal Role in the Colorado River Basin. Quinney College of Natural Resources, Utah State University, Logan, UT.

Cook BI, TR Ault, JE Smerdon. 2015. Unprecedented 21st century drought risk in the American Southwest and Central Plains. *Sci.Adv.* 1: e1400082. doi: 10.1126/sciadv.1400082

Cooley C. 2021. Born into these lands and waters. Science Moab, Soundcloud. [online]

https://soundcloud.com/user-495802209/born-into-these-lands-and-waters?utm_source=clipboard&utm_campaign=wtshare&utm_medium=widget&utm_content=https%253A%252F%252Fsoundcloud.com%252Fuser-495802209%252Fborn-into-these-lands-and-waters

Readings (continued)

Drake H. 2019. Eight ways to support women in science. *Eos*, 100. [online]
<https://doi.org/10.1029/2019EO126093>

Grand Canyon National Park. The Action Guide to Preservation: Colorado River. National Park Service, U.S. Department of the Interior. [online]
https://www.nps.gov/grca/planyourvisit/upload/GRCA_ActionGuidetoPreservation.pdf

Grand Canyon Trust and Indigenous knowledge holders. 2020. The Voices of Grand Canyon. The Grand Canyon Trust, Flagstaff, AZ. [online]
<https://storymaps.arcgis.com/stories/b22a6a09bb2344ff845d9efd3e4152f7>

Hamill JF, TS Melis. 2012. The Glen Canyon Dam Adaptive Management Program: Progress and immediate challenges. in PJ Boon and PJ Raven, eds. *River Conservation and Management*. Wiley. [online] <https://onlinelibrary.wiley.com/doi/pdf/10.1002/9781119961819.ch26>

Konrad CP et al. 2011. Large-scale flow experiments for managing river systems. *BioScience* 61:948-959.

LaGrave K. 2019. How Grand Canyon National Park Will Look in 100 Years. *Outside Magazine* Feb. 25, 2019. [online] <https://www.outsideonline.com/2390720/grand-canyon-100>

Melis TS, ed. 2011. Effects of Three High-Flow Experiments on the Colorado River Ecosystem Downstream from Glen Canyon Dam, Arizona. USGS Circular 1366. U.S. Geological Survey, Flagstaff, AZ. [online] <https://pubs.usgs.gov/circ/1366/c1366.pdf>

Milly PCD, KA Dunne. 2020. Colorado river flow dwindles as warming-driven loss of reflective snow energizes evaporation. *Science* 367:1252-1255. doi: 10.1126/science.aay9187

National Park Service. 2023. Grand Canyon Geology. Grand canyon, AZ. [online]
<https://www.nps.gov/grca/learn/nature/grca-geology.htm>

Necefer L. 2024. The interplay of law, culture, and the Colorado River. *American Whitewater* 64(2):14-19.

Ostis N. 2017. *NOLS River Rescue Guide*. Stackpole Books, Mechanicsburg, PA. (selections)

Schmidt JC, et al. 1998. Science and values in river restoration in the Grand Canyon. *BioScience* 48:735-747.

Stevens LE, KA Buck, BT Brown, NC Kline. 1997. Dam and geomorphological influences on Colorado River waterbird distribution, Grand Canyon, Arizona. *Regulated Rivers: Res. & Manage.* 13:151-169.

Stevens L. 2019. *The Colorado River in the Grand Canyon: A River Runner's Map and Guide*, Red Lake Books, Flagstaff, AZ.

Strazza S. 2024. River Sister. *American Whitewater* 64(3):36-39.

Udall B, J Overpeck. 2021. The twenty-first century Colorado River hot drought and implications for the future. *Water Resources Research* 53:2404-2418. doi: 10.1002/2016WR019638.

Walters JR, SR Derrickson, DM Fry, SM Haig, JM Marzluff, JM Wunderle Jr. 2010. Status of the California Condor (*Gymnogyps californianus*) and efforts to achieve its recovery. *Auk* 127(4):969-1001. doi: 10.1525/auk.2010.127.4.969

Video Presentations

- Blackmer-Raynolds C. 2017. The Confluence. [online] <https://vimeo.com/184970801>
- Canyon REO. 2010. Canyon REO Grand Canyon Outfitting Orientation, videos 1-10, 12. [online] <https://www.youtube.com/canyonreo>
- Christensen R. 2024. *We Are Grand Canyon*. Intertribal Working Group, Grand Canyon National Park, and Grand Canyon Conservancy. Bristlecone Media. [online] <https://www.nps.gov/media/video/view.htm?id=99ADF75A-282B-4210-A2FD-3040EDFA7E1B>
Also available on YouTube: [We Are Grand Canyon](#)
- Collier Z. 2020a. Reading Water (Basic Level). Gear Garage, episode 151. [online] <https://www.youtube.com/watch?v=M7opYZcdD1w>
- Collier Z. 2020b. Reading Water (Intermediate Level). Gear Garage, episode 152. [online] <https://www.youtube.com/watch?v=MxX8fRCIdx0>
- Collier Z. 2020c. Reading Water (Advanced Level). Gear Garage, episode 153. [online] <https://www.youtube.com/watch?v=6oMiToT9fcw>
- Collier Z. 2021. Techniques for Catching Eddies in an Oar Raft, Gear Garage, episode 213. [online] <https://www.youtube.com/watch?v=mU5ZjpD-oGk>
- Collier Z. 2022a. Entering and Exiting Eddies as a Team, Gear Garage. [online] <https://www.youtube.com/watch?v=-WzXkYMqN8c>
- Collier Z. 2022b. Rambling, Ranting, and Raving about the Downstream Ferry for Oar Boats. Gear Garage. [online] <https://www.youtube.com/watch?v=cLkTatfaENA>
- Curtis R. 2014. Risk Assessment & Safety Management Model (RASM) [online] <https://www.youtube.com/watch?v=DHP1JhSMjmU&feature=youtu.be>
- Gold A. 2019a. Geographic and Physical Overview of the Colorado River Basin. CIRES videos, University of Colorado, Boulder, CO. [online] https://www.youtube.com/watch?v=TAj6SpSQ40c&list=PL_h79kf2zxaijiLqGdFoHsPAnDiuChHRI&index=19
- Gold A. 2019b. Water Storage and Delivery Infrastructure. CIRES videos, University of Colorado, Boulder, CO. [online] https://www.youtube.com/watch?v=ekMiGNarIrg&list=PL_h79kf2zxaijiLqGdFoHsPAnDiuChHRI&index=7
- Gordon E. 2019. Impacts of Climate Change in the Interior West. CIRES videos, University of Colorado, Boulder, CO. [online] https://www.youtube.com/watch?v=Fz7nOnHX4F8&list=PL_h79kf2zxaijiLqGdFoHsPAnDiuChHRI&index=16
- Grand Canyon National Park. 2021. Non-Commercial River Trip Orientation, videos 1-11. National Park Service. [online] <https://www.youtube.com/playlist?list=PL34-ozNGa7CT42r1p3jyfiLGb9H3cRFfH>
- Hunt M. 2021. Tips for Rowing the Big Rapids in the Grand Canyon. [online] <https://www.youtube.com/watch?v=xtesXsEaSwA>
- Lander P. 2019 History and Development of Water in the West. CIRES videos, University of Colorado, Boulder, CO. [online] https://www.youtube.com/watch?v=qq6JCVguHtM&list=PL_h79kf2zxaijiLqGdFoHsPAnDiuChHRI&index=5
- Los Angeles Times. 2023. Colorado River in Crisis: A Los Angeles Times documentary. [online] <https://www.youtube.com/watch?v=k8DovzEMxpY>
- McBride P. 2019. Into the Grand Canyon. Presentation to the World Economic Forum. [online] <https://www.youtube.com/watch?v=HQFKT4X63II>

Video Presentations (continued)

Nania J. 2019. Native American Tribes and Water. CIRES videos, University of Colorado, Boulder, CO. [online]

https://www.youtube.com/watch?v=MpCNyzgpGdw&list=PL_h79kf2zxaijiLqGdFoHsPAnDiuChHRI&index=6

Novak K. 2019. The Colorado River Basin Water Supply and Demand Study. CIRES videos, University of Colorado, Boulder, CO. [online] https://www.youtube.com/watch?v=GgYI2gaW-qg&list=PL_h79kf2zxaijiLqGdFoHsPAnDiuChHRI&index=22

Perry C, B Kraushaar. 2022. A River Out of Time. Northwest River Suppliers, Moscow, ID. [online]

<https://community.nrs.com/duct-tape/2022/12/26/a-river-out-of-time/>

Schmidt J. 2019. Physical Attributes of the Colorado River and Experimental Flows in the Grand Canyon. CIRES videos, University of Colorado, Boulder, CO. [online]

https://www.youtube.com/watch?v=hbjuUSrxBtU&list=PL_h79kf2zxaijiLqGdFoHsPAnDiuChHRI&index=23&t=305s

Squillace M. 2019. Environmental Flows and the Endangered Species Act. CIRES videos, University of Colorado, Boulder, CO. [online]

https://www.youtube.com/watch?v=deEEDdPFQ4c&list=PL_h79kf2zxaijiLqGdFoHsPAnDiuChHRI&index=10

Washko S, A Metcalfe, N Cooley. 2022. River guides are science guides: Making Waves Episode 49.

Society for Freshwater Science. [online] <https://youtu.be/5u9SOa0o5gE>

Policies and Resources

COVID-19 Policies: we will practice COVID-19 safety throughout the course and the post-course trip.

COVID-19 Guidelines on campus

Please make your health and the health of others in your sphere your highest priority.

If you feel sick, stay home, take care of yourself, and do not attend class meetings. No penalty will be applied for classes missed for health reasons, even if your illness turns out to be a mild cold.

Seek medical attention if your symptoms become severe, particularly high fever or difficulty breathing.

Please contact the instructor to arrange accommodations if you must miss multiple classes due to illness or self-isolation.

Additional guidelines may be added, following WWU policy and guidance for fall 2024, and updated information about the status of the pandemic. The protocol will address on-campus meetings and weekend field experiences.

COVID-19 Guidelines for field trainings

At least five days prior to field training days, participants avoid contexts with medium and high risk of exposure to COVID and other infectious diseases.

Additional “COVID bubble” guidelines will apply to the post-course Grand Canyon river trip, to be discussed during risk management class meeting.

Information about COVID-19 symptoms, treatment, prevention, and safety are at the following web sites.

WWU: <https://www.wvu.edu/coronavirus>

WA Department of Health: <https://www.doh.wa.gov/Emergencies/NovelCoronavirusOutbreak2020/HealthEducation>

COVID-19 FAQ, WADOH: <https://www.doh.wa.gov/Portals/1/Documents/1600/coronavirus/COVIDExposed.pdf>

US CDC: https://www.cdc.gov/respiratory-viruses/guidance/?CDC_AAref_Val=https://www.cdc.gov/respiratory-viruses/guidance/respiratory-virus-guidance.html

WWU Course Policies: We will observe all university policies regarding academic honesty, disability accommodation, religious accommodation, equity, and equal opportunity. Please review those policies at the following site. <https://syllabi.wvu.edu/>

In particular, accommodation for students with documented disabilities should be established within the first week of class and arranged through the Disability Access Center: <https://disability.wvu.edu/>

Students seeking religious accommodation should provide written notice to the instructor within the first two weeks of the course.

WWU provides resources for additional student needs.

Students with medical needs may find help at the Student Health Center: <https://studenthealth.wvu.edu/>

Students with emotional or psychological concerns may find help at the Counseling Center:

<https://counseling.wvu.edu/>

The Office of Student Life can help with difficult personal or family issues and in navigating the university bureaucracy: <https://wp.wvu.edu/officeofstudentlife/>

Students with challenging personal circumstances are encouraged to contact the instructor before those issues impact work in the course, or as soon as possible. We will not consider this as weakness or a request for favors. We will have better opportunities to develop strategies to help you succeed if we begin early.

Course Schedule

Date	Topics	Readings, Videos	Assignments
Sept 26	Introductions: people, place, norms, logistics Grand Canyon introduction Ropes and knots, part 1	Course norms LaGrave 2019 Drake 2019	Personal goals
Oct 1	Personal goal sharing GC Geological history and formation Grand Canyon stratigraphy, part 1 <u>Colorado River geomorphology</u> After class: • expedition menu review • expedition financing	Collier et al. 1996 Stevens 2019, pp.67-86 Gold 2019a NPS 2023 Strazza 2024	Tolerance self-assess. Rock layer summary
Oct 3	Grand Canyon Indigenous history Indigenous GC-relationships and interests GC stratigraphy, part 2: demonstration After class: expedition menu decisions	Austin & Drye 2011 Christensen 2024 Cooley 2021 GCTrust 2020 Blackmer-Raynolds 2017 McBride 2019 Nania 2019	Tribal profile
Oct 8	CO River water development and management Dam history and status, environmental politics Water negotiations and futures Climate change impacts After class: • personal gear review • expedition itinerary review, part 1	Cook et al. 2015 Milly&Dunne 2020 Kolbert 2021 Udall&Overpeck 2021 Necifer 2024 Gold 2019b Gordon 2019 Lander 2019 Novak 2019 Perry&Kraushaar2022	
Oct 10	Tribal profile presentations <u>Grand Canyon development proposals, projects</u> After class: personal gear check-in	[Devel. Prop videos & reading]	GC issues report
Oct 15	Sediment dynamics and dam impacts Riparian zones: pre/post dam comparison Glen Canyon Dam Adaptive Mgmt. Program Plant restoration & Tamarisk removal Ropes and knots, part 2	Hamill&Melis 2012 Konrad et al. 2011 Schmidt et al. 1998 Melis et al. 2011 Stevens et al. 1997 Schmidt 2019 Squillace 2019	
Oct 17	GC river running history, management, status GC recreation management: permit allocations, seasonal regulations, LNT gear & practices, <u>boat spacing, noise and overflight management</u> After class: expedition work group organization	[GC videos] Washko et al. 2022 Stevens 2019	
Oct 22	LNT principles and practices Camp LNT gear and protocol River kitchen structure and operation: demo.	GCNP action guide GCNP 2021 (video) Canyon REO videos	
Oct 24	Expedition behavior, leadership roles Sphere of influence assessment Research project interests and opportunities	Drake 2019 Ostis 2015, pp.241-246	Research literature review

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	Research team organization Research project development and proposals		
Oct 29	Expedition planning Ropes and knots, part 2 <u>Food organization, labeling, packing</u> After class: GC itinerary planning, part 2		
Oct 31	River navigation and risk management Communication: river signals, visual & whistle Boat sequencing and spacing River running: CLAP; Scouting: WORMS River reading and hazards Navigation tools, skills, strategies Whitewater swimming and self-rescue Flipped and pinned boat procedures	AW Safety Code Whitewater Videos Hunt 2021 Collier 2020a,b,c AW safety videos Collier 2021, 2022a Collier 2022b	
Nov 5	Grand Canyon river research opportunities Risk management approaches; safety I and II RASM and application to river expeditions COVID safety protocol Environmental Briefing Incident protocol and response Emergency communication	Curtis 2014	Research proposal
Nov 7	Research proposal check-in NPS orientation video review <u>Boat rigging principles and guidelines</u> After class: • Boat rigging plans and boat maps • Personal gear packing demonstration	GCNP 2021 (video) Canyon REO videos	
Nov 12	California Condor reintroduction Native fish conservation and reintroduction <u>Additional topics TBD – research proj.interests</u> After class: expedition travel plan	Walters et al. 2010	
Nov 14	Research proposal check-in River skills self-assessment Post-2026 Operations DEIS status & review		Rev.research proposal River skills checklist
Nov 19	Expedition logistics <u>River skills discussion</u> After class: • GC Travel plan • Rigging day plan • Launch day plan		Research sampling protocol Research data forms
Nov 21	Research group and gear organization		
Dec 3	Post-2026 Operations DEIS check-in <u>_____</u> After class: Final expedition preparations		

Weekend Training Schedule [dates under revision]

Date	Topic	Readings
Sat. Oct 19	River safety training (8 hours)	AW videos
Date TBD	River reading and navigation training (10 hours)	Hunt 2021
Sat Nov 23	Research or expedition preparation (8 hours)	

Grand Canyon River Expedition

After the course, there will be a trip down the Colorado River through the entire 280 mile length of the Grand Canyon. The trip, originally planned as an AS Outdoor Center program, will be entirely independent of WWU. The trip will occur during winter break, returning before winter 2025 classes begin. Some trip preparation discussions are listed in the schedule above, to occur after class meetings. Those discussions will not be part of the course, and are listed here for your convenience only. For details, please see the online folder containing trip information resources.

Supplementary Resources

Adler RW. 2007. *Restoring Colorado River Ecosystems*. Island Press, Washington, DC.

Fedarko K. 2013. *The Emerald Mile: The Epic Story of the Fastest Ride in History Through the Heart of the Grand Canyon*. Scribner, New York, NY.

Fedarko K. 2024. *A Walk in the Park: The True Story of a Spectacular Misadventure in the Grand Canyon*. Scribner, New York, NY.

Polsey A and J Munger. 2021. *River and Rescue Safety Field Guide, 2nd ed.* Sierra Rescue International, Inc., Truckee, CA.

Rainey, W. 2007. *Carving the Grand Canyon: Evidence, Theories, and Mystery*. Grand Canyon Conservancy, Grand Canyon, AZ.

Teal, L. 1994. *Breaking Into the Current: Boatwomen of the Grand Canyon*. Univ. Arizona Press, Tuscon, AZ. (selections)

Whitney SR. 1996. *A Field Guide to the Grand Canyon*. The Mountaineers Books, Seattle, WA.