



FINAL REPORT

The Bosque Education Guide and New Mexico STEM Ready! Science Standards

New Mexico Department of Game & Fish,
Share with Wildlife Award FY 2022-FY2023
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Project Objective

This project will provide curriculum for New Mexican teachers to support their students' exploration, discovery, and learning in outdoor natural areas and establish the foundation for understanding the vital importance of riparian and aquatic ecosystems to native wildlife, including Species of Greatest Conservation Need. The overall project includes updating field activities in the *Bosque Education Guide* to correlate with recently adopted *New Mexico STEM Ready! Science Standards*, translating six Natural History activities into Spanish, presenting three educator workshops including a Title 1 focus, and disseminating the updated curriculum.

Project Value, including Key Habitats and Conservation Action

The New Mexico Department of Game and Fish *State Wildlife Action Plan for New Mexico* (SWAP)¹ gives all riparian woodlands and aquatic habitats top priority (Tier 1) for habitat conservation due to their limited extent and disproportionate importance to many wildlife species. These habitats provide many resources not available in surrounding arid uplands, and support many Species of Greatest Conservation Need (SGCN). Educating the public about the importance of these habitats, and the complexity of these ecological systems, is an essential part of conservation efforts. People who understand the value of a place are more likely to support its preservation.

In addition, the importance of outdoor learning for all students is now recognized as fundamental, not only for the wellbeing of the students themselves but also for increasing their curiosity about the natural world and thereby increasing their interest in protecting it. New Mexico educators need standards-based resources to support outdoor learning, as well as to teach about the importance of protecting riparian and wetland habitats. In 2018, the New Mexico Public Education Department (PED) adopted new science standards called the *New Mexico*

STEM Ready! Science Standards (NMSR!SS)², which include both the national Next Generation Science Standards (NGSS)³ and six New Mexico-specific standards. Teachers across the state need significant support implementing these new standards and may also need encouragement and resources to promote using outdoor learning with their students.

The *Bosque Education Guide*⁴ (hereafter referred to as the *Guide*), as a whole, focuses on riparian and aquatic ecosystems and their importance in New Mexico. Through many engaging activities, students learn about these unique ecosystems, the diverse animals and plants that depend on them, and the value of these habitats to our communities. The *Guide* provides an extensive curriculum with 45 activities and background information centered on New Mexico's riparian and aquatic ecosystems prior to human activity, on the altered environment after human-caused changes, and on how we can manage for ecosystem health and diversity in the future. Activities are project-based and many include data collection and analysis. Many feature wildlife and their habitats; we provide information for 58 animal species in the *Guide*, including illustrations and descriptions. These species include six SGCN from the Middle Rio Grande and two additional species for San Juan watershed educators. The *Guide* supports NMDGF Conservation Actions regarding helping the public understand the value of riparian and aquatic ecosystems. By revising these activities to address the current science standards, teachers will be more likely to use them, so that students, and in turn their families, will learn about the importance of riparian and aquatic ecosystems. Increased public awareness and support for conservation are necessary to protect these habitats and the species that live there into the future.

Share with Wildlife funds have allowed this team to address the needs stated above in revising *The Bosque Education Guide*. This year's funding was focused on revising the field activities and giving educators the tools and confidence to take their students outside with standards-based learning. Many activities work in the schoolyard or in open space areas, whether in the bosque or other natural areas. These activities are cross-referenced to state educational standards, providing an invaluable resource for teachers covering a variety of topics not only in the sciences, but also in literacy, math, and social studies. These field activities, in particular, provide scaffolding experiences that lead from discovery and exploration to scientific data collection and participation in citizen science projects such as iNaturalist/Seek. By focusing on field activities, this project aligns with the State's call for increased outdoor learning, as stated in New Mexico Legislature's Senate Memorial 1 of 2021⁵. The activities included here are foundational for students to build connections as they explore, discover, and begin to appreciate the important natural areas along the state's rivers.

Revision Process

We began with a review of the existing field activities and brainstormed what should be maintained and what needed revision, with input from our team and advisors. Our goal was to give teachers a framework to use for exploration, discovery, and learning in outdoor natural areas. We then began to re-work the material with those ideas in mind, meeting weekly via Zoom. We added phenomena statements and lesson questions to help frame each lesson in the format of NMSR!SS/NGSS best practices. Several of the original activities were combined during the revision, resulting in seven new or revised final activities. By June, we had several activities in good draft form and asked our Teacher Fellows for their comments. By late August, the rest of the activities were completed and were sent to Teacher Fellows and other, informal

educators for review. After comments were incorporated, we worked with our graphics person to produce the final layout. “Chapter 3 Going Out: Field Activities” was ready for our January 21, 2023 workshop participants.

2023 Updates

We are pleased to share the completed activities funded through Share with Wildlife program support. The majority of the “Chapter 3 Going Out: Field Activities” were updated to the New Mexico STEM Ready! (NMSR!SS)/Next Generation Science Standards (NGSS). The activities are: *Bosque Field Journals*, *Signs of Humans—Scavenger Hunt in the Bosque*, *Naturalist Notebooks*, *Wildlife Detectives*, *Crawly Creatures*, *Dip Net Critters*, and *A Rose by Any Other Name*. Revised activities support outdoor learning with tools to help students discover and explore the bosque and wetland ecosystems. The activities fall into three basic categories. Nature discovery activities (*Bosque Field Journals*) help students develop baseline skills in observation and an interest in nature; Science Notebooks activities (*Naturalist Notebooks* and *Signs of Humans*) scaffold skills of recording observations in nature from simple discovery to more advanced, guided science journals; and wildlife and plant observation and identification activities (*Wildlife Detectives*, *Crawly Creatures*, *Dip Net Critters*, and *A Rose by Any Other Name*) engage students in searching for and identifying plants and animals from small terrestrial and aquatic invertebrates to large vertebrate wildlife.

Species of Greatest Conservation Need (SGCN)

The *Bosque Education Guide* includes SGCN in several places. There are animal cards with “first person” descriptions of SGCN species’ habitat needs, diet, and interesting information. In the “Going Out: Field Activities,” there is now a special section in the *Signs of Humans—A Scavenger Hunt in the Bosque* activity focused on eight SGCN. Students are invited to use these species to learn what each needs to thrive, with a focus on habitat changes affecting wildlife, posing the question, *Why have wildlife species become rare, threatened, or endangered?* The following species are included.

Middle Rio Grande species:

Rio Grande Silvery Minnow (*Hybognathus amarus*)

Northern Leopard Frog (*Lithobates pipiens*)

Bald Eagle (*Haliaeetus leucocephalus*)

Yellow-billed Cuckoo (*Coccyzus americanus*)

Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

New Mexico Meadow Jumping Mouse (*Zapus luteus*)

San Juan River species:

Colorado Pikeminnow (*Ptychocheilus lucius*)

Razorback Sucker (*Xyrauchen texanus*)

Several standards can be addressed with this activity, including one of the New Mexico Six Performance Expectations.

Teacher Fellows

It continues to be a challenging time for teachers. As we work past the pandemic shutdown and its effects, we still see the difficulties teachers are having. We contacted many teachers for help in reviewing activities over the course of the year. In the end, we had a group who reviewed material that was in draft form in the early summer, and a different group reviewing the rest of

the draft material in late summer and fall. We certainly appreciate all colleagues who were able to take time out of their busy lives to help improve these materials!

Educator Workshops

We held four full-day workshops this year.

Saturday, March 26, 2022 at Rio Grande Nature Center; 10 attendees

Saturday, July 16, 2022 at Rio Grande Nature Center; 13 attendees

Saturday, October 22, 2022 hosted by Whitfield Wildlife Conservation Area/Friends of Whitfield, Belen; for Los Lunas and Belen teachers [Title 1 Schools]; 15 attendees

Saturday, January 21, 2023 at Valle de Oro National Wildlife Refuge; 10 attendees

Total 48 attendees during this grant year.

In the July workshop, we had a request for sign language interpretation. We utilized the bulk of our balance in a Friends of Valle de Oro account to cover these interpretation services (\$960). One good outcome was that the request was from one educator, but during the workshop, there was another teacher with hearing loss who used sign language as well, so the interpretation services were useful to two educators. It was, however, an unbudgeted expense that impacted funds available for other BEG expenses, including printing.

Workshop attendees completed evaluations through questionnaires at the end of the day. Additional presentations (~2.5 hours) were given to adult groups of Master Naturalists in Bernalillo County and Belen. These adult volunteers will, in turn, work with other groups and individuals with a more solid understanding of bosque ecosystems and the role of management in protecting species and healthy ecosystem processes into the future.

Deliverables

1. “Chapter 3 Going Out: Field Activities,” now includes seven activities aligned with NMSR!SS/NGSS. All are formatted and ready for dissemination as both print and web-available resources. The “Appendix K: Standards” section was also updated with connections to the newly revised activities. (These items were completed with Share with Wildlife funding.)
2. Four educator workshops were conducted (original proposal was for three).
3. Additional activities were translated into Spanish. They will be available on our website (see #4).
4. The new activities posted on the *Guide*'s website, available free for download:
<https://nmnaturalhistory.org/educational-resources/sections/bosque-education-guide>
[Posting will be completed by NM Museum of Natural History & Science.]

Looking forward

We will continue to look for funding to address updating and translating the additional activities in the *Guide* for NMSR!SS compliance. These include geology, water, human influence, fire and service learning, as well as two additional field activities. The Department of Game and Fish has given invaluable support to the *Bosque Education Guide* for revising the wildlife- and habitat-focused activities. We will continue to present workshops to teachers, typically three to four per year, depending on funding of materials.

Spanish Translations

The “Chapter 4 River of Change” activities have been translated and formatted into Spanish using matching funds. Many of last year’s “Chapter 5: Natural History” activities have also been translated. We are working on additional activity translations. The English versions of these chapters were revised with recent Share with Wildlife funding. Having these materials in Spanish allows students to learn science and understand their local environments regardless of their English proficiency. They will be available on our website.

Website

The New Mexico Museum of Natural History & Science hosts the *Bosque Education Guide* website. The Museum has uploaded the revised activities that were supported by previous Share with Wildlife funding. We are working with their staff to upload the newest material. This provides free access to the *Guide* for anyone to download. Information about the newest materials will be shared with New Mexico science teachers via listservs when they are available on the website. <https://www.nmnaturalhistory.org/educational-resources/sections/bosque-education-guide>

Literature Cited

1. New Mexico Department of Game and Fish. 2016. State Wildlife Action Plan for New Mexico. New Mexico Department of Game and Fish, Santa Fe, New Mexico, USA.
2. New Mexico STEM Ready! Science Standards. (Effective July 1, 2018). Retrieved 5-18-21 from <https://webnew.ped.state.nm.us/bureaus/math-science/nm-stem-ready-science/nm-stem-ready-science-standards/>
3. NGSS Lead States. 2013. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press.
4. The Bosque Education Guide, Morris, Stuever, Ellis & Tydings. Curriculum for students to learn about their local ecosystem, 2003, 2008. <https://www.nmnaturalhistory.org/educational-resources/sections/bosque-education-guide>
5. New Mexico Legislature 3-1-2021. Senate Memorial 1 Task Force To Promote Outdoor Classroom. <https://legiscan.com/NM/text/SM1/id/2318303>

Thank you for supporting *The Bosque Education Guide*!

Comments from Bosque Education Guide Workshop Attendees March 2022 to January 2023

March 26, 2022 Workshop:

Please complete this sentence: Before this workshop, I never realized that...

- so many other teachers and stakeholders think like me and value the environmental ed of children here.
- porcupines live in trees.
- not all insects were considered "bugs."
- there were so many efforts to rehabilitate the bosque.
- cottonwoods only live 100 years.
- there was so much to learn about the bosque.
- bullfrogs are an introduced species.
- bosque means riparian forest.
- Great Blue Herons can perch in trees but Sandhill Cranes cannot!

July 16, 2022 Workshop:

- I think the workshop today was great! I learned so much about the bosque and how to incorporate the activities across age levels.
 - Learned a lot about how to incorporate nature-based observation and turn it into an informative/involved activity.
 - The best part was the bosque walk and the activity finding creatures or signs of them to talk about with the group. The binder and laminated kit provided are fantastic resources for us. Thank you so much for providing a great, informative workshop.
 - I enjoyed the outdoor component and learning about the flora, fauna and characteristics of the bosque.
 - I can't think of anything that stands out in need of improvement. The alignment of the activities with the current standards is very helpful and I hope to continue to see more of the activities updated with standards. Thank you for doing that work.
 - I see using these activities to teach New Mexico in a new way.
- Please complete this sentence: Before this workshop, I never realized that...
- the bosque was so different many years ago and how much human impact has changed it.
 - incorporating environmental education concepts could be easily incorporated into core curriculum/or applied to outreach education to where it can be made easily to understand or apply.
 - the bosque has oxbows!
 - cottonwood's life span was shorter than I thought, and there are male and female trees for cottonwoods. Did not know mistletoe grew on the cottonwoods.
 - there was so much thorough content available in the Bosque Education Guide.
 - this education center was here.
 - porcupines chewed on trees!
 - that we rely on flooding around the Rio Grande.
 - isopods are non-native.
 - the river was a population of its own. I always thought it was only snow and rain run-off. I also didn't realize we developed so closely around it. I thought preservation would have been top priority.
 - a juvenile crane is called a colt, adult male is a roan, adult female is a mare.
 - there were so many curriculum resources available for bosque environmental ed.

October 22, 2022 Whitfield Workshop:

- Great to experience the difference between the burned and unburned.
- See myself leading my class outdoors to be our classroom and use local areas like the ditches and fields to deepen learning.
- I think the workshop went really well—I was constantly thinking about how to implement this in my class.
- I can have students write explanatory essays regarding the change in the Rio Grande.
- Looking at curriculum that applies to NGSS. It was helpful knowing what was being talked about and how to apply it.
- The best part of the workshop was the entire day! From the hands-on activities hike and school based --everything was great!

Please complete this sentence: Before this workshop, I never realized that...

- there were so many resources available for me and my students.
- I had so much more to learn about where I live! I love the resources—especially the pictures of the animals and plants.
- there were so many opportunities for my students to experience the bosque.
- There was a lot I didn't realize and glad I learned (too many to remember).
- the salt cedar promoted fire spread.
- there are a lot of creative ways to teach my students.
- that using booklets and journaling can be used to deepen outside activities for learning about our surroundings and NGSS!
- there was so many invasive vegetation.
- some cranes come from Siberia. How old cottonwood trees live for.
- there were so many local resources available! They want to come to my class!
- Whitfield was in my backyard and that there are so many activities to do in the field.

January 21, 2023 Workshop:

- The workshop far exceeded my expectations! We all learned so much about the history and health of our bosque.
- I liked walking in the bosque, we saw a porcupine and waterfowl and cranes.
- I really liked the model which gave me a better visual/understanding of river dynamics.
- I have gathered some wonderful tools to integrate into my PBL [place-based learning] programs. The materials will definitely be put to use to tell the full story of the R.G.... this presentation gave me a new lens on how to improve.

Please complete this sentence: Before this workshop, I never realized that...

- the cottonwood was such an important part of this ecosystem.
- how much humans have altered the river with levees, dams, acequias, etc.
- male mosquitos eat nectar!
- the bosque curriculum was so extensive!

Photos from *The Bosque Education Guide* Workshops:



Teachers doing “Bosque Bugs Boogie” activity 3-26-2022



“Changing River” model activity—Rio Bravo 10-22-22



“Changing River” model activity—Rio Manso 3-26-2022



Looking at Canada Geese on the Rio Grande near Valle de Oro NWR 1-21-23



Animal sign: Canada Geese, near Valle de Oro 1-21-23