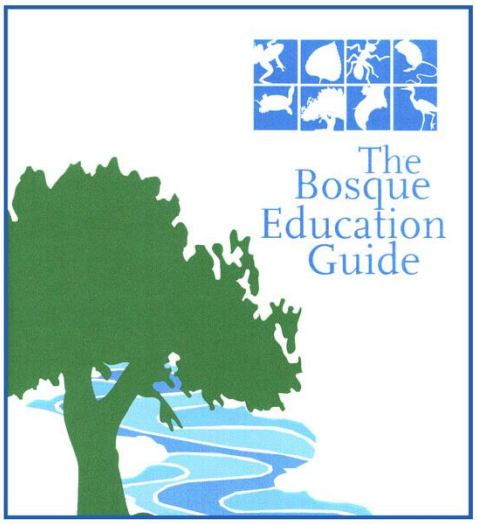

FINAL REPORT
Bosque Education Guide &
New Mexico STEM! Ready Science Standards

New Mexico Department of Game & Fish,
Share with Wildlife Award, FY 2020

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The award-winning *Bosque Education Guide*[1] (referred to hereafter as the *Guide*) provides an extensive curriculum about New Mexico's riparian and aquatic habitats, areas considered top priority for habitat conservation by the New Mexico Department of Game and Fish (NMDGF). The core of the *Guide* is the "River of Change" unit, including six activities that use the Changing River model to investigate the ecology of floodplain ecosystems and how humans have affected that environment. The model introduces students to the river and floodplain before they were impacted by human activity (Rio Bravo), to the ecosystem after human alterations (Rio Manso), and to a hopeful new era as we manage for ecosystem health and diversity now and into the future (Rio Nuevo). The *Guide* was first published in 1995 with support primarily from the US Fish and Wildlife Service through the Bosque Initiative, the NM Museum of Natural History & Science and the Rio Grande Nature Center (NM State Parks). The *Guide* underwent major revisions in 2003 and 2008, with additional activities added in 2016 and 2018, to keep it current and relevant for educators. To date, approximately 2,200 teachers have completed training workshops to learn how to implement the curriculum and have received complementary copies of the *Guide*, including supplemental teaching materials. This represents tens of thousands of New Mexico students who have been engaged by this program. The *Guide* continues to attract interest from teachers and is an important asset in the education of New Mexicans. All activities in the *Guide* have been cross-referenced to state educational standards, thus providing an

invaluable resource for teachers covering a variety of topics not only in the sciences but also in literacy, math and social studies. The *Guide* has been supported by NMDGF Conservation Education staff, who have helped develop activities emphasizing the importance of wildlife and habitat of the Rio Grande's upper watershed and to disseminate the *Guide* to teachers.

The New Mexico Public Education Department (PED) recently adopted new science standards, called the *New Mexico STEM Ready! Science Standards*[2] (NMSR!SS), which include both the national Next Generation Science Standards (NGSS)[3] and 6 New Mexico-specific standards. Teachers across the state need significant support and updated curriculum to teach to these new standards. Only the most recent activities in the *Guide* aligned with NMSR!SS, with the bulk of *Guide* activities requiring an update. The primary goal of this project funded by NMDGF was to redesign the core River of Change activities of the *Guide* to align with NMSR!SS. These changes were necessary to keep the *Guide* functional for New Mexico's teachers, who play an essential role in educating the future leaders and resource managers of our state.

Species of Greatest Conservation Need:
The revised River of Change activities address a variety of animal species in and along the Rio Grande, including these NMDGF Species of Greatest Conservation Need (SGCN): Northern Leopard Frog (*Lithobates pipiens*), Bald Eagle (*Haliaeetus leucocephalus*), Yellow-billed Cuckoo (*Coccyzus americanus*), Southwestern Willow Flycatcher (*Empidonax traillii extimus*), Rio Grande Silvery Minnow (*Hybognathus amarus*) and the New Mexico Meadow Jumping Mouse (*Zapus luteus luteus*). Each of these six SGCN are included with illustrations, habitat information, diet and interesting facts. These species are used in an activity where students place animals in their proper habitat along Rio Bravo—the bosque of the past. Then the model is changed to reflect the dams, levees and other human-created alterations to the river and ecosystem, including the introduction of non-native plant and animal species. Students are challenged to think about how native animals might be affected by these changes. It is always impressive to see elementary students' hands pop up with an understanding about the effect of these changes on native animal species. Students are then asked to consider ways to protect native species into the future. In this rewrite, the overview information on each of these species has been re-worked, giving teachers an excellent resource that they can share with their students. There is also information on two San Juan River SGCN fish, the Colorado Pikeminnow *Ptychocheilus lucius* and Razorback Sucker *Xyrauchen texanus*, with the illustrations and information cards available for teachers in that area.

Key Habitats and Conservation Actions:
The New Mexico Department of Game and Fish State Wildlife Action Plan for New Mexico[4] (SWAP) gives all riparian and aquatic habitats top priority (Tier 1) for habitat conservation due to their limited extent and disproportionate importance to many wildlife species. 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* 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.

Revision Process:
The Writing and Advisory Teams started with a brainstorming workshop about the new education standards and how they could connect to the Changing River model activities. The Writing Team then divided the activities and reviewed each of them in detail while considering how to address the standards. We asked the educators on the Team to review drafts and provide feedback on how the standards should best be presented in the curriculum.

At this point the COVID-19 pandemic hit. The Writing Team switched to video conference meetings and in-person school classes were adapted to online. We had identified additional educators who had agreed to review the new material, but their worlds were turned upside-down in needing to re-adjust all of their teaching to an online format. Ultimately, we had four classroom educators who reviewed material as paid Teacher Fellows. Nine additional professional reviewers, beyond the Writing and Advisory Teams, carefully read, commented on and recommended changes to improve the material; they were mostly agency educators and biologists. This included the Share with Wildlife coordinator for New Mexico Department of Game and Fish.

The decision on how the education standards are presented throughout each activity was directly the result of teacher comments: make the standards jump out, indicate them at the beginning, highlight them throughout in bold notations and add an overview at the end. Many teachers will not need the final summary, but others will greatly appreciate it.

We had hoped to have teachers test the new material with their students, but it was not possible during this pandemic. These are hands-on materials and the learning comes with building a model ecosystem, manipulating the pieces, comparing different time periods and considering the changes. They are not effective as online activities. These activities will be ready for classes to use once we are past this pandemic and in-person classes and workshops resume.

Curriculum Update:
The *Bosque Education Guide* core River of Change activities, including the Changing River model, were redesigned to incorporate New Mexico STEM Ready! Science Standards. The result includes six revised activities and an accompanying appendix; the finished material totals 167 pages. We targeted 3rd grade through middle school for these changes. The activities provide opportunities to address 23 Disciplinary Core Ideas (DCIs) from NGSS, depending on grade level or needs of teachers, and two Performance Expectations that specifically address New Mexico topics. The NMSR!SS includes six state-specific Performance Expectations, but only two are within the grade levels we addressed (5th and middle school.) Common Core English Language Arts connections for the elementary grades are also included in the appendix.

The *Guide* highlights for teachers the connections to NMSR!SS in three places:

1. Standards are listed at the beginning of each activity in a call-out “Standards Box”.
2. Specific questions and prompts help students critically think about the concept to be addressed. The appropriate Disciplinary Core Idea (DCI) code, Crosscutting Concept

(CCC) and/or Science and Engineering Process (SEP) that relate to each concept are highlighted directly in the text.
3. At the end of each activity, there are more detailed entries addressing how the activity particularly helps students with that specific DCI for grades 3, 4 and 5. Middle school DCIs are included in the appendix.

Each activity now begins with a KWL chart—What do students **Know**? What do they **Want** to know? And after the unit, What have they **Learned**? This helps set the stage for students playing a role in what they are learning, an important NGSS strategy. Prompts are included to use the lens of "Systems" to learn about the bosque ecosystem in each activity, a Crosscutting Concept of the NGSS.

A Standards Overview was added in an appendix. This includes:
1. A chart for quick reference which lists DCIs, CCCs, & SEPs by the activity where they can be implemented;
2. Details on how an activity can specifically address each DCI for middle school grades;
3. The New Mexico specific Performance Expectations and related DCIs for 5th grade and middle school; and
4. Common Core English Language Arts connections to grades 3, 4 and 5.

In addition, the Threatened and Endangered Species and the Introduced and Non-native Species sections have both been updated to reflect a more current status of these species and to highlight additional species. For example, the story of the tamarisk beetle, which has been introduced to reduce exotic saltcedar in the Southwest, has been added. Names of animals and plants, including recently changed scientific names, have also been updated.

Educator Workshop:
We planned to have one teacher workshop near the end of the project to present these new materials; however, because of New Mexico Department of Health's stay-at-home order due to the COVID-19 pandemic, in-person training was not possible. There was no budgetary impact on Share with Wildlife funds, as the workshop expenses were to be paid through matching funds. Our final Advisory Team meeting included some brainstorming about potential ways to conduct professional development for educators using these new NMSR!SS aligned materials and the full *Bosque Education Guide.* One option is to do a live video conference with a handful of teachers present and others participating online as we work through the Changing River model activities. This could be paired with an in-person workshop in the bosque to teach outdoor activities. A decision to move forward with this idea will be guided by our host partners' policies on programing: The Rio Grande Nature Center, New Mexico State Parks, New Mexico Museum of Natural History & Science and Valle de Oro National Wildlife Refuge.

In lieu of a workshop, we are working to inform educators about these new materials. The updated *Guide* will be posted on the website of the New Mexico Museum of Natural History & Science and we will announce its availability on educator listservs. We will eventually offer these new activities during our regularly scheduled educator workshops, which usually occur 2 or 3 times each year through our other funding sources. We will be touting NMDGF Share with Wildlife funding for the improvements, and will inform teachers that funding comes from the

special tax check-off system that all New Mexicans can support. NMDGF funding is credited in the updated chapter.

Summary:
The *Bosque Education Guide* Team has produced a valuable set of revised activities addressing the new science standards that are ready to share with teachers. Despite the upheaval in the lives of teachers and classrooms, this team was able to accomplish the goals set out under the Share with Wildlife grant award. We greatly appreciate the support of the NMDGF Share with Wildlife program to help align these curriculum materials and present them in a way that New Mexico teachers can meet their necessary standards while also accomplishing the important conservation goals of both the Department of Game and Fish and the *Bosque Education Guide.*

The full *Bosque Education Guide* is available online. The new material will be posted by Museum staff before the school year begins.
http://www.nmnaturalhistory.org/educational-resources/sections/bosque-education-guide

Literature Cited:

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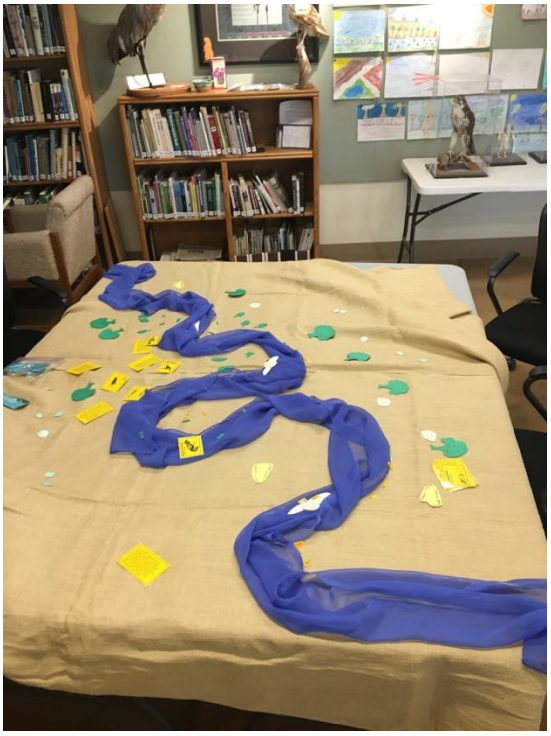

Changing River Model showing Rio Bravo, the prehistoric river (*left*)

Changing River Model showing Rio Manso, the altered river (*below*)

Who Lives Where? animal activity showing Species of Greatest Conservation Need (*above*)

Who Lives Where? San Juan River SGCN fish species (*below*)