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Challenging Education

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**Bosque Ecosystem Monitoring Program (BEMP)**  
**New Mexico Department of Game and Fish “Share with Wildlife” Final Report**  
January 2, 2019 – December 23, 2019

The Bosque Ecosystem Monitoring Program (BEMP) is a partnership between the University of New Mexico and Bosque School. Since 1996, BEMP has collaborated with K-12 students and their teachers across New Mexico, and especially within Albuquerque, to track long-term change in the Middle Rio Grande’s *bosque* (riparian forest), engage students in community science, and educate participants about the bosque’s functions, hydrology, inhabitants, and challenges. BEMP’s mission statement (Community science, education, and stewardship: equitable and inclusive hands-on student research essential to the management of the Rio Grande ecosystem) is further advanced through the New Mexico Department of Game and Fish *Share with Wildlife* partnership, which facilitates educational outreach and immersive student activities focused upon the local species requiring immediate and meaningful attention – our Species of Greatest Conservation Need (SGCN).

The main objective of the Share with Wildlife (SwW) curriculum is to teach students about concepts directly related to SGCN, including animal adaptations, habitat suitability, how listing statuses are determined, why certain animal species are declining, and how humans can contribute to both the decline and recovery of animals. This curriculum was developed for and delivered to K-12 students in Bernalillo, Sandoval, and Valencia counties and used Bosque School and its adjacent bosque as a hub for many of its place-based components. BEMP also maintains 33 active research sites spanning 240 miles, from Santo Domingo/Kewa Pueblo to Mesilla Valley in Las Cruces. Nearly all of these sites are used for student-led community science data collection and place-based educational outreach where the SwW curriculum was also delivered. Between January 2 and December 23, 2019, BEMP staff spent **over 266 hours of combined SwW curriculum preparation and delivery**. BEMP educators delivered SwW curriculum to: **46 in-school classes, 14 Study Trip groups, 4 Yellow-billed Cuckoo Walk groups, 12 Monthly Monitoring data collection groups, one workshop, and one public outreach festival for a total of 187 contact hours with over 1,200 K-12 students and 200 adults**. Please note that some of the activities and lessons proposed in the Interim Report were not implemented, either due to a lack of staffing (the stand-alone Endangered Species Classroom Lesson) or to a lack of participants (the Endangered Species Study Trip). The Endangered Species Study Trip curriculum was fully developed by BEMP staff in partnership with Albuquerque’s 516 ARTS, but we did not receive enough participation requests to deliver this outreach. However, parts of this curriculum were used in our Yellow-billed Cuckoo Walks. BEMP also created a Yellow-billed Cuckoo Coloring Book not mentioned in the Interim Report. BEMP incorporated SwW curriculum feedback from the Share with Wildlife Coordinator, Dr. Virginia Seamster, throughout 2019.

**New BEMP Share with Wildlife initiatives  
created and implemented January 2- December 23**

**River of Change:**

One of BEMP’s foundational classroom activities is the “River of Change” lesson. Usually delivered within two separate classroom sessions, the River of Change centers around students constructing a large, interactive model of the Rio Grande that takes up much of their classroom floor. Three phases of the river are manipulated and discussed: Rio Bravo (the river as it was 2000 years ago), Rio Manso (the river as it exists now) and Rio Nuevo (the river as it could be in the future). Among many concepts covered in this lesson, BEMP educators explore how the river and its associated riparian habitats have changed over the past 2000 years due to a shifting climate and human impacts. Different riparian plant communities, such as cottonwoods, upland shrubs, and exotics, are represented by figurative laminated pieces, while individual plant and animal species are depicted on paired laminated cards; one card has an image of the organism and its name while the other has a short, written description. For the SwW contract, BEMP created seven new pairs of cards representing a combination of Declining, Threatened, Endangered, and Recovered plant and animal species (**Pages 6-9**). These species – the Bald Eagle, North American river otter, Pecos Sunflower, Rio Grande Chub, Rio Grande Silvery Minnow, Southwestern Willow Flycatcher, and Yellow-billed Cuckoo - offer students a wide range of habitats and conservation statuses to explore within this lesson. (Please note that after the BEMP Education Coordinator was informed by Dr. Seamster that the Pecos Sunflower was not included in New Mexico’s list of SGCN, we retained that species in our outreach to illustrate that New Mexico’s plants can also become Threatened or Endangered). Each student was given a species card and a description card that do not match. Students read their descriptions (or, for younger students, school and/or BEMP educators facilitate reading) and then tried to identify the correct species card. Once correctly matched, students determined what type of habitat supports that species and placed the species card within that habitat on the model. This prompted a discussion about why particular species need different types of habitat and how humans have contributed to their decline, recovery, or both. Different categories of conservation status were then discussed. Students were given cards with a single conservation status on each: Least Concern, Threatened, Endangered, or Locally Extirpated. While “Locally Extirpated” is not an official status, BEMP felt that it was an important concept to include, particularly as it relates to the North American river otter. How BEMP defined a Species of Greatest Conservation Need changed over the course of the year, evolving as we received feedback from Dr. Seamster.

When delivering this outreach to elementary school students, it became apparent that the description cards were too advanced for optimal impact. BEMP therefore created new “SGCN Factoid Cards” to help educate younger students about the aforementioned species. Pairs of students were given 2-3 small, triangular laminated cards that each contained a factoid about one of the species already placed on the Rio Grande model. Students read these aloud and then placed them near the species they described (**Pages 10-11**).

Additionally, larger versions of species cards were created to allow students to have a clearer picture of the target species. Finally, a new handout was created for this lesson where students were able to define and write down four terms central to the SGCN component of this lesson: endemic, keystone, Endangered, and Threatened (**Page 12**).

*This activity was delivered to 29 classes, grades 3-12.*

**BEMP Study Trip:**

BEMP's core place-based educational activity is the BEMP Study Trip. Groups of up to 60 students at a time join BEMP educators in a guided, interactive hike through the bosque for 4-6 hours. Students are given cards featuring images of various plant and animal species they are likely to see in the bosque during their hike, along with cards for animal tracks, scat, and other natural phenomena. As students spot what is depicted on their cards in the field, the group stops and descriptions on the back of the images are read aloud. In this manner, short discussions are generated each time the group stops. For the SwW contract, versions of the cards used in River of Change were shuffled in with cards depicting common bosque species and natural phenomena. After lunch alongside the Rio Grande, BEMP educators asked students about what species they had already seen, and what species they had yet to observe. Each SGCN was then discussed with the group, exploring why these organisms are either unlikely or impossible to observe in the Middle Rio Grande. Concepts such as local extirpation, habitat suitability, habitat fragmentation, exotic species, survey techniques, conservation measures, and species recovery were then explored, depending upon the available time. Most of the classes who participated in 2019 study trips had already engaged in the River of Change lesson and this place-based activity gives BEMP an opportunity to discuss concepts in greater detail while students are actively exploring their local ecosystem. The larger SGCN cards developed for the River of Change activity were also used for Study Trips.

*This activity was delivered to 11 Study Trip groups, grades 1-6.*

**BEMP Stormwater Science Study Trip:**

BEMP also delivers a Study Trip focused on stormwater science. Similar in concept and duration to the BEMP Study Trip, the Stormwater Study Trip involves students exploring the effects that storm events have upon the health of the Rio Grande and its bosque. Among other activities, students perform water quality testing at the river's edge and collect, identify, and use aquatic macroinvertebrates as bioindicators of ecosystem health. BEMP introduced participating students to several SGCN (Rio Grande Chub, Rio Grande Silvery Minnow, North American river otter, and the Southwestern Willow Flycatcher) and asked them to determine how different water quality parameters, such as turbidity and dissolved oxygen, might directly and indirectly impact these species. Students were then asked to consider how measures they can take to improve these parameters could potentially affect these species.

*This activity was delivered to three Stormwater Science Study Trip groups, grades 9-10.*

**BEMP Flora and Fauna of the Floodplain:**

This originated as the one-session "Fauna of the Floodplain" and evolved into a new, two-session "Flora and Fauna of the Floodplain" lesson during the contractual period. Many of the classes receiving this lesson already participated in the foundational two-part River of Change activity and thus had already been exposed to the target SGCN. This classroom lesson explores what plants and animals call the bosque home, the differences between native and exotic species, and which specialized adaptations allow them to survive in New Mexico's riparian habitats. This lesson used to focus exclusively upon commonly found animals of the Middle Rio Grande, but BEMP has since incorporated several SGCN into this lesson. For all but the youngest students, BEMP educators discuss adaptations of different species: for example the Bald Eagle's talons;

the North American river otter's nostrils, ears, and eyes being positioned on the top of its head; the Rio Grande Chub's subterminal mouth; the Rio Grande Silvery Minnow's silvering camouflage; the Southwestern Willow Flycatcher's rictal bristles; and the Yellow-billed Cuckoo's facultative nest parasitism. Different adaptations were discussed, defined as either structural or behavioral, and examined to determine how they aid in each species' survival within its individual habitat or habitats. BEMP educators then described a threat each species has faced, or currently faces, and students are asked if they can imagine an adaptation that would allow the species to survive this threat. From the Bald Eagle and DDT to the Southwestern Willow Flycatcher and the destruction of nesting sites, students are engaged in a meaningful conversation about how adaptations often cannot evolve fast enough to save species from these threats. The takeaway from this lesson was centered around conservation measures students can take to help protect local SGCN. For younger students (K-5), these range from conserving water to picking up trash, while older students (6-12) are encouraged to speak to friends and family about wildlife conservation, to use social media to educate and inform, and educated about how to contact state representatives to voice their concerns.

*This activity was delivered to 17 classes, grades 4-6.*

### **BEMP Monthly Monitoring:**

Monthly Monitoring is central to BEMP. One week each month, BEMP staff guide students through ecological data collection at sites along the Rio Grande. While these sessions are centered around collecting key BEMP datasets (litterfall, groundwater and ditchwater levels, and precipitation), immersive educational components are built into these trips when time allows. The SGCN cards used in BEMP Study Trips were also used during a number of Monthly Monitoring trips. The species image cards and their attendant descriptions were joined by additional cards representing common bosque species such as the North American porcupine, Spotted Towhee, and Golden Currant. When time was limited, students engaged in a short discussion about SGCN. When time allowed, students engaged in a matching game followed by a variant of previously described discussions about conservation status, habitat requirements, and what they can do to help protect these species.

*This activity was delivered to 12 Monthly Monitoring groups, grades 2-7.*

### **Yellow-billed Cuckoo Walk:**

High school students were led on an interpretive walk in the bosque to learn about SGCN with a special focus on the Yellow-billed Cuckoo. After learning about different conservation statuses, students were taught about how scientists determine the presence of this elusive species using response-to-playback surveys. Students then engaged in a performative exercise to demonstrate how this technique functions in the field. A large laminated image of the Yellow-billed Cuckoo was shown to students and then the BEMP educator played a cuckoo call using a smartphone. Students were asked to describe what the call sounded like, using words or phonetic phrases such as "cawk cawk cawk" or "cack cack cack." Other calls were then played to demonstrate the diversity of bird songs and calls, ranging from a towhee's "drink your teeeeeea" to a vireo's "here I am look at me." BEMP educators then showed students images of several fictional birds created by BEMP which were "related" to birds whose songs had just been played. For instance, instead of a Spotted Towhee, students were shown an image of a fictional "Verdant Towhee." Students were then asked to invent a song for these birds. For instance, instead of the towhee saying, "drink your teeeeeea," students might decide the Verdant Towhee says, "drink your coffeeeeee." These songs were then written down by all the students and the group was divided

in two. One half were to be a collection of fictional bosque bird species, and the other group were avian surveyors. The students playing birds were secretly assigned species so that the surveyors were unaware of how many individuals of each species were present. While the surveyors kept their eyes closed, the students playing birds were scattered and hidden in the bosque surrounding the surveyors. Over three, one-minute survey periods, the surveyors then listened for the fictional bird songs and recorded how many of each species responded. After the period ended, the “birds” returned to the group and revealed how many of each species were actually present. Then the groups switched so everyone had a chance to participate in both groups. Students learned how difficult accurate response-to-playback surveys are, how not detecting an individual does not mean an individual is not present, and why methodically repeating this process in the same environment is key to avian survey protocols.

***This activity was delivered to four classes, grade 10.***

#### **Yellow-billed Cuckoo Coloring Booklet:**

BEMP participated in the 2019 Albuquerque Railyard's Children's Zone outreach day. BEMP set up a table displaying images of student-collected data, animal artefacts, and equipment used during Monthly Monitoring. BEMP created a coloring pamphlet about the Yellow-billed Cuckoo for this event, which also included basic information about some key SGCN concepts.

Participants were provided with markers, colored pencils, and crayons and were engaged in conversations about SGCN by the attending BEMP educator. Following this event, Bosque School administration used the remaining booklets as a child-friendly educational activity for visiting families (**Entire booklet included at the end of this document**).

***This activity was delivered to 200 students, grades K-5.***

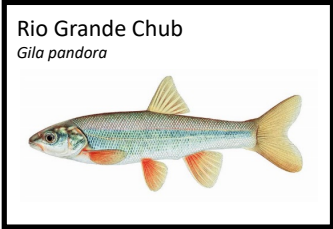
#### **Avian Journaling Workshop:**

The BEMP Education Coordinator led a birdwatching and avian journaling workshop at Valle de Oro. When one participant spotted a Bald Eagle, it prompted a long discussion about SGCN, recovery plans, and species listing statuses. While this activity was not planned as part of BEMP's SwW outreach, it turned into a deeply meaningful conversation involving many of the key principles and concepts central to our SwW outreach.

***This activity was delivered to one second grade student and 9 adults.***

Overall, BEMP's Share with Wildlife outreach was a great success. The ability for students to focus on a handful of New Mexico's Species of Greatest Conservation Need allowed them to better understand the ecology of these species and why so many of New Mexico's species require careful management and conservation. While it proved difficult to deliver SwW outreach during Monthly Monitoring sessions due to limited time with students in the field, BEMP compensated with additional place-based and classroom-based engagement. BEMP would gladly work with the New Mexico Department of Game and Fish in the future and will continue to teach BEMP participants about New Mexico's Species of Greatest Conservation Need.

Species of Greatest Conservation Need Cards



Hey! Don't call me fat! I'm just named that way. I'm a small, olive-gray organism with reddish fins. I like to swim in flowing pools of headwaters, creeks and small rivers. I eat zooplankton, aquatic and terrestrial insects, crustaceans, juvenile fish and detritus.

While I am locally common in New Mexico, my distribution and abundance are declining.

Primary threats to my species are stream degradation and non-native species, although more studies are needed to see how I am responding to a changing Rio Grande. What can you do to help my species survive?



Spoiler alert! My name describes my appearance. I hatched from a tiny floating egg and now eat algae and other plants I find floating in the water and on the gooey river bottom. I prefer slow-moving waters where the river meanders and braids. I only release my eggs when the river flow increases during the early spring to summer.

I was listed as Federally Endangered in 1994. Today you can only find me in the Rio Grande between Cochiti Dam and Elephant Butte Reservoir.

Try to think of some reasons I am currently Endangered and what you can do to help me!

Southwestern  
Willow Flycatcher  
*Empidonax traillii extimus*



I perch upright, scanning for insects flying over nearby water. Small modified feathers around my bill that look like whiskers help me catch flying insects.

I like to nest in dense riparian vegetation (mainly Willows) where I build a small cup-like nest in the summer. I breed in New Mexico but I fly south for the winter.

I'm currently Endangered largely due to the loss and degradation of the native riparian habitats I call home.

What are some other reasons my species is in trouble?  
What can you do to help me recover?

Bald Eagle  
*Haliaeetus leucocephalus*



As an adult, I have a dark brown body and despite my name, my head is covered in white feathers. My hooked beak is yellow and I have bare yellow legs and feet with huge talons. My wingspan can reach up to 8 feet! I spend my winters in New Mexico along the Middle Rio Grande Valley and in the upper watershed.

My population is finally recovering since the 1960s when I almost became extinct because of pesticides, lead poisoning, habitat loss, and hunting.

What do you think humans did to help my species recover?

North American river otter  
*Lontra canadensis*



I'm playful and sleek mammal with a thick, waterproof coat. I'm an excellent swimmer and diver and I can stay underwater for up to 8 minutes. Fish is my favorite food, but I also eat amphibians, turtles, and crayfish. I make all kinds of crazy sounds and also communicate with, my delicious musky odor (well, delicious to otters), urine and scat, and different types of body language.

Habitat loss has significantly reduced my range in the Rio Grande. Can you think of some other reasons my species has declined? What kinds of things can you do to help me return to the waters in and around Albuquerque?

Yellow-billed Cuckoo  
*Coccyzus americanus*



I'm not crazy, my name just makes it sound that way! You can recognize me by the bold white spots under my long tail. My favorite food is hairy caterpillars and I can eat up to 100 in one sitting! I need large patches of mature riparian woodland with lots of cover to breed and raise a family during summers in New Mexico and other parts of the U.S.

Alterations to the rivers I live alongside are some of the causes for my population decline and I am considered a Threatened species in New Mexico. Do you know what Threatened means? What can you do to help me and others like me?





I'm a beautiful plant that blooms from August to November. I live in different wet areas of New Mexico including the area I am named after. I like to grow in desert wetlands or desert springs (cienegas) with available water and high salt content.

I must look and taste delicious to animals because cows and other livestock like to eat me. Grazing is just one of the reasons I am Endangered in the state of New Mexico.

What are some other reasons you think I might be declining? What can you do to help me?

**LEAST CONCERN**

**THREATENED**

**ENDANGERED**

**LOCALLY  
EXTIRPATED**

I am an olive-gray  
fish with reddish fins  
I eat tiny animals that  
live underwater

Like the Silvery  
Minnow, I'm a fish  
whose numbers  
are also dropping  
I eat tiny aquatic  
plants

I am covered in feathers  
that are dark brown on my  
body and bright white on my  
head and tail  
I use my thick, hooked  
beak to eat my food

I use my sharp, pointed  
talons to catch fish in  
the river  
I fly to New Mexico  
to spend my  
winters there

I need tall native  
trees by the river to  
build nests in during  
the summer  
Every winter, I fly  
south

I use my long, curved  
beak to catch large  
caterpillars and  
tea or spessu  
bosque  
Although I have a long  
spotted tail, it is very  
hard to see me in the

I eat flies and other  
insects that I catch in the  
air  
My short, straight, pointed  
beak helps me catch my  
food

My petals are golden  
yellow like the sun  
I bloom from August to  
November

I nest in willows and  
saltcedars by the  
river

Every winter I fly  
south

My roots need moist soil

Cows like to eat me

I use my webbed feet to  
swim through the river

My thick  
waterproof fur coat  
keeps me warm in  
the water

My long tail helps me  
chase after the fish  
that I eat

I can hold my breath  
underwater for 8  
minutes

I am small  
and silver

I eat tiny aquatic  
plants

I am an Endangered fish

Cows like to eat me

Because I live  
underwater, any  
changes in the river  
affect me greatly

Because I live  
underwater, any  
changes in the river  
affect me greatly

### SGCN – Species of Greatest Conservation Need

- A species that is only found in New Mexico is considered \_\_\_\_\_
- A species that might be found in small numbers but plays a very important role in its ecosystem is a \_\_\_\_\_
- A species that is in danger of going extinct is \_\_\_\_\_
- A species that is in danger of becoming endangered is \_\_\_\_\_

### RIO NUEVO – What can we do to help the Rio Grande ecosystem?

- \_\_\_\_\_ : Putting cut branches into the ground, making sure the bottom reaches the groundwater, to grow new trees
- \_\_\_\_\_ : Changing the riverbank so that water is able to flow over parts of the shore again
- \_\_\_\_\_ : Organization that monitors the bosque to detect changes in the ecosystem over time

WHAT ELSE CAN WE DO?

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# EXTINCTION is a DRAG

A BEMP COLORING  
BOOKLET ABOUT A  
SPECIAL SPECIES  
OF GREATEST  
CONSERVATION NEED

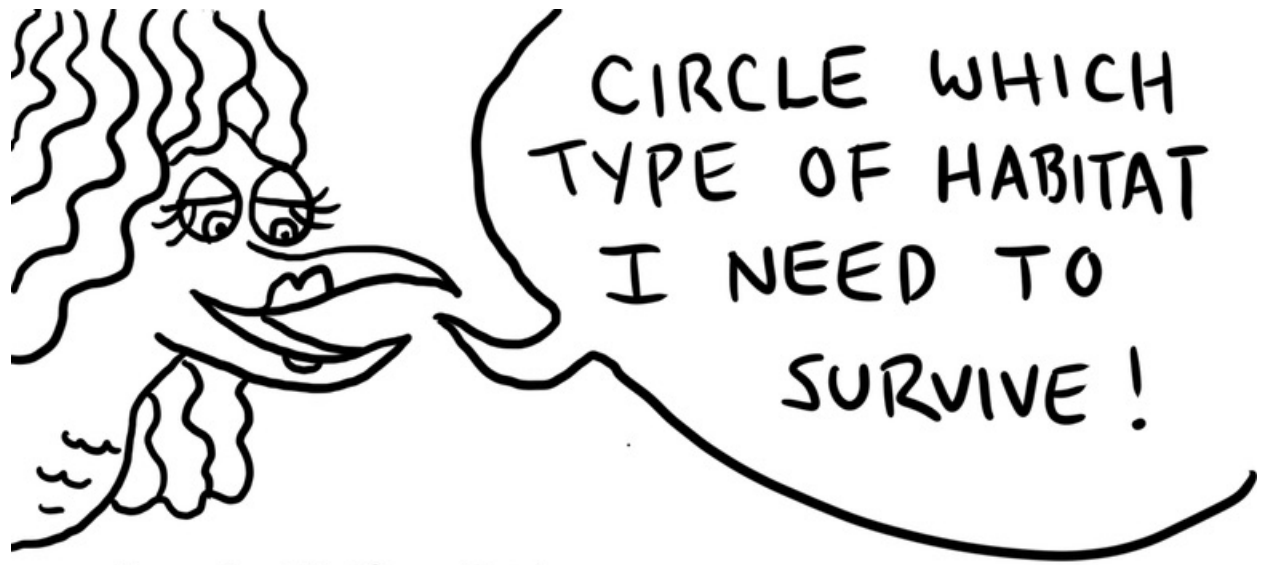


THIS IS  
YOLANDA THE  
YELLOW-BILLED  
CUCKOO.

YOLANDA IS A

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SPECIES,  
WHICH MEANS  
SHE MIGHT SOON  
BE ENDANGERED.



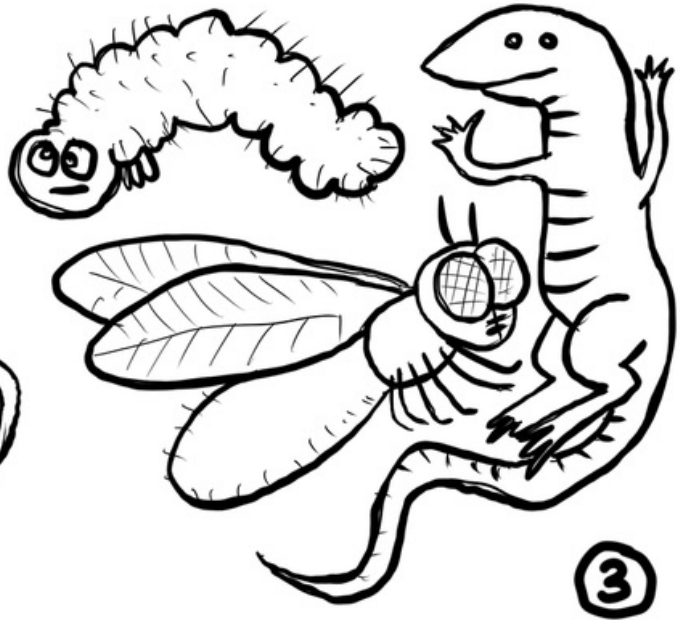
WHEN MAMA GETS HUNGRY  
(I CALL MYSELF MAMA  
WHEN I'M HUNGRY)  
WHAT KIND OF FOOD  
DO I LIKE TO  
EAT?



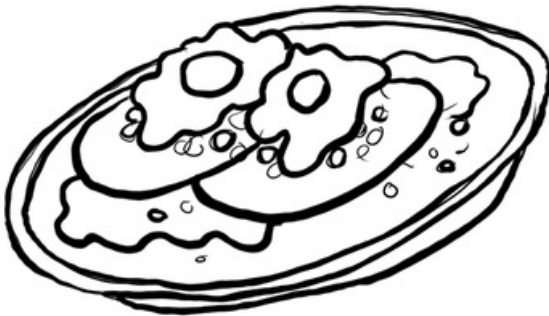
### A. JUICY FISH



### B. LIVE INSECTS AND LIZARDS



### C. HUEVOS RANCHEROS







MY MOTHER SAYS  
I HAVE A LOVELY  
SINGING VOICE.  
CAN YOU GUESS  
WHAT MY CALL  
SOUNDS LIKE?

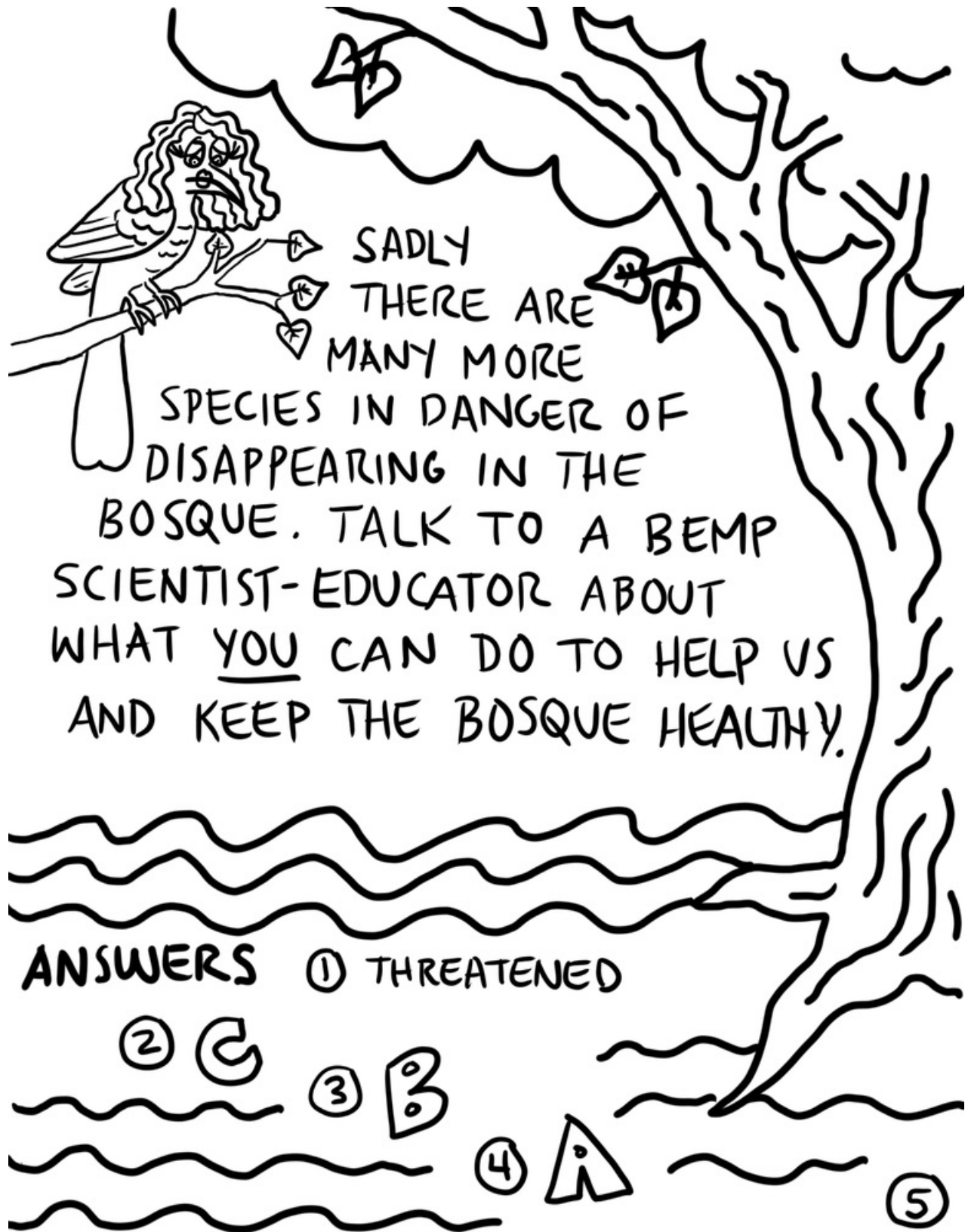
A. KA KA  
KOW KOWP

C. ERRY

BODY  
DANCE NOW

B. HAY  
GURL

HAY ④



SADLY  
THERE ARE  
MANY MORE  
SPECIES IN DANGER OF  
DISAPPEARING IN THE  
BOSQUE. TALK TO A BEMP  
SCIENTIST-EDUCATOR ABOUT  
WHAT YOU CAN DO TO HELP US  
AND KEEP THE BOSQUE HEALTHY.

ANSWERS ① THREATENED

② C

③ B

④ A

⑤