



Mapping Species Richness

- Description:** Students color a map that shows how many species of birds live in different areas of New Mexico, then overlay other maps to learn what factors are important to species richness.
- Objective:** Students will learn that in the arid Southwest, the highest number of kinds of birds (species richness) live along rivers, i.e. places with water.
- Materials:** Mapping Species Richness map for each student to color
Mapping Species Richness data sheet for each student
colored pencils
copies of the following maps: New Mexico Rivers and 1,000-foot Elevation Contours (included in this activity). These could be on clear acetate, to overlay on the students' maps and/or show on an overhead, or student can hold paper copies up to a window to compare. Other maps such as the New Mexico highway map or other New Mexico maps may be used as reference.
- Background: Terms:**
- Biodiversity:** biological diversity. In considering the ecological condition of an area, biological diversity refers to the variety of organisms present, looking at all levels of classification as well as genetic variability, and the variety of ecosystems in which the organisms occur.
- Community:** an association of interacting species inhabiting an area. An example would be a pond community with all the animals and plants that depend on the pond and live in or near the pond.
- Flyway:** the path taken by birds during their annual migrations. Many birds will take the same route following a river or mountain crest as landmarks for their journey.

22. Mapping Species Richness



- Grades:** 6–12
- Time:** two class periods, plus homework
- Subjects:** science, math extension
- Terms:** biodiversity, community, flyway, riparian, species, species diversity, species evenness, species richness



Riparian: relating to, living near or located on the bank of a natural fresh watercourse such as a river, stream, pond or lake.

Species: a population of organisms, such as one type of bird, that is able to interbreed and produce fertile offspring.

Species diversity: a combination of the number of species in a community (species richness) and the relative abundance of the species in the community (species evenness).

Species evenness: the relative abundance of a type of organism in the community, or how many individuals of each type (species) there are. For example, a site with five individuals each of 10 species has a greater evenness than a site with 41 individuals of one species and one individual of each of nine other species.

Species richness: the number of species in a community or location. This contrasts with the abundance or numbers of individuals. Species richness is simply a measure of the number of types of organisms present without regard to the number of individuals. Thus a site with 10 different types of birds present has a higher richness than a site with five species present, even if the latter site has 100 individuals and the first site has 50 individuals. Caution: Be aware that identical richness numbers don't mean that the same species of birds occur at different sites with the same richness value.

Scientists in many fields use color to look for patterns. For example, geologists create colorful maps of where different types of rocks are found and then study the patterns that appear in order to understand the geology of an area. In this activity, students illustrate the number of species of birds found in different areas of the state by coloring a map in a “color-by-number” style. Then students may compare their species richness maps to other types of maps to look for patterns.

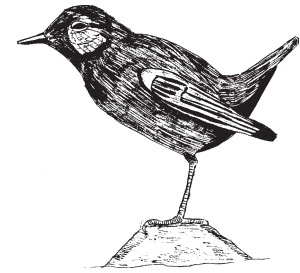
When scientists and resource managers prioritize which natural places on Earth to preserve, one factor they are particularly interested in is the number of species of organisms present at a given site. Biological diversity, or biodiversity, includes species richness—sites with more species are said to have higher biodiversity. Although sites with fewer species can also be ecologically quite important, sites that support more species are especially valuable and these are typically targeted for conservation. Habitats that have been greatly reduced in extent and are now rare are also important conservation priorities, since they often support species found nowhere else.





Animals live throughout the state, but if you look specifically where those animals live, far more kinds are found along the streams, rivers and lakes of New Mexico than in drier uplands. In New Mexico, less than 1% of the state is riparian, but large numbers of vertebrate animal species depend on those riparian areas for at least part of their lives.¹ For example, deer will wander far and wide, but they must come to water to drink regularly. This is particularly noticeable with species of birds. More species of birds are found in riparian habitats than in all other vegetation types combined. This activity is designed to demonstrate the importance of the bosque ecosystem to birds in New Mexico. In 1984, the report of a study of animal life along the Middle Rio Grande Valley counted 277 species of birds sighted during two years. This was over 60% of the total number of birds known from New Mexico.²

Around 500 species of birds have been seen in New Mexico. For this activity, birds that appear irregularly or infrequently are not considered; they are not a substantial part of the ecological community. There are at least 324 birds routinely seen somewhere in the state, and these are the ones included in this activity. The numbers in the chart are extrapolated from actual records compiled by the United States Geological Survey's GAP Analysis Project and simplified in some cases to easily demonstrate ideas to students. One or two sites are used to illustrate larger regions. For each site we have grouped the total numbers of bird species that can be seen in the area if you observe regularly throughout the year. Some birds may live there in the winter and migrate in the spring; some may only be seen in the spring or fall migration; some will nest in that area; still others will live in one spot all year long.



American dipper

Procedure: Introduce the activity with a question, "Where do most birds in New Mexico live?" Then have students develop a hypothesis about their answers; write them down. Think about testing the hypotheses: "How would we find out?"

Begin with the following scenario: "Biologists have studied birds all over the state and recorded the numbers of birds in many different habitats and geographic areas of the state. Your task is to use these data to determine what areas in the state are most important to birds. To do this, you will make a map of species richness. Start by looking at the locations and number of species found at each location and then color that area of the state with the appropriate color-coded number."



1. Give the students the Mapping Species Richness data sheet and map showing statewide locations and the number of bird species found at each location.
2. Instruct students to match locations on the map to the number of birds found.
3. Students assign a color to each of the categories in the map key. We recommend that a bright red or orange be used for the highest number of species. Official maps go through the color spectrum with blue for fewest species, grading to green, yellow, orange and then red as the highest category—the largest number of species.
4. Have students color the Mapping Species Richness map. Some areas include more than one site, with a similar number of species. Remind students that numbers for the regions are extrapolated from data from one or a couple of sites within each region. Therefore students may find more than one site within the region they are coloring.
5. When the students have finished their maps, have them compare their maps to other maps. Pose the original question, “Where do the most species of birds in New Mexico live?” Can they answer that question? Ask, “What other questions could we ask from this data?” Assist them in comparing their maps to other maps and ask: “How does the species richness of birds relate to this?” For example, overlay the Rivers of New Mexico map. Is there a relationship between the rivers and the species richness? Overlay the elevation contour map. Ask students if there is a relationship between elevation and numbers of birds.

Discussion after maps are colored:

The main theme: where is the highest diversity of species of birds?

Where are the rivers on this map? Is there a relationship between rivers and the bird species richness? Overlay the Rivers of New Mexico map. Students should be able to see that the rivers/riparian areas have a very high richness—therefore many different kinds of birds.

Why? What is different there?

What are the most important things to determine where and why birds occur where they are?

What are those things all animals need to survive? Where are you safe from predators? Food, water, shelter, and space in the proper arrangement. Water is extremely important in the dry Southwest.





There is more water, but what else is there? When you look at the bosque compared to the dry areas above the floodplain, how is the floodplain different? There are tall trees, a greater density of plants, larger plants. With taller plants, there are more nest sites for birds (canopy and cavity nesters), for example. More insects live on the large trees and over water, so insect eaters find more food there; more insect eaters and there will be more predators to eat them . . .

Where are there the fewest species? Can we look at other maps to see why so few species live there? Some types of areas have very few species—lava flow areas such as El Malpais and desert areas such as Chaco Canyon in the Great Basin desert.

Look at Sites 2 and 4, which appear to have the same number of species. Do they have the same species? Look at the habitats. These are very different environments; even though they may have similar numbers of bird species, the actual types of birds will be very different.

Where do we find sandhill cranes in New Mexico? Why are they there? Why are they in this corridor? Talk about migration flyways: many birds will follow rivers in their migration. Others, such as hawks, fly along mountain ridges as landmarks for their journey. Sandhill cranes fly from the northern U.S. and Canada to winter in a warmer place—New Mexico. They are abundant in the Middle Rio Grande Valley because there is food, water and safe places to roost. Several refuges plant crops for wintering birds to eat through the season. (See the “Crane Migration” activity that follows for additional information.)



belted kingfisher

What does the number of species in an area say about the health of the local environment? A large number of species indicates a healthy habitat—a high biodiversity. Be careful: even though there are few bird species at El Malpais, the plants and animals that live there have important adaptations that allow them to survive in the unique lava flow environment. Also, introduced/exotic species will increase the species richness but not the biological diversity.

Assessment: Students can write a statement of conclusion regarding their original hypothesis and indicating the results testing that hypothesis. If the data did not address their hypothesis, have them state this. Then have them summarize the results of doing this activity.



Extensions: Students can research birds—where they are and which habitats they live in. What kinds of birds live in a particular area on their maps? There is a list of birds of the Middle Rio Grande in Appendix F in the Middle Rio Grande Guide.

Have students choose a species of bird that lives in the bosque to research.

Write about the habitats that species needs, the food it eats, the type of nest it uses, etc.

Why does it live in the bosque? Are there other places it could/does live?

Does it migrate?

Where does it spend the summer and winter?

Math extensions: There are at least 324 bird species that routinely occur in New Mexico. Calculate the percent of statewide species at a few key locations on the maps they colored.

Figure the percentages of the map categories.

Adapting to younger students: You are a “birder” (you watch birds) and want to see wintering geese.

Where would you go? What about this area makes it a good place to see geese?

Why would you go to rivers to find ducks?

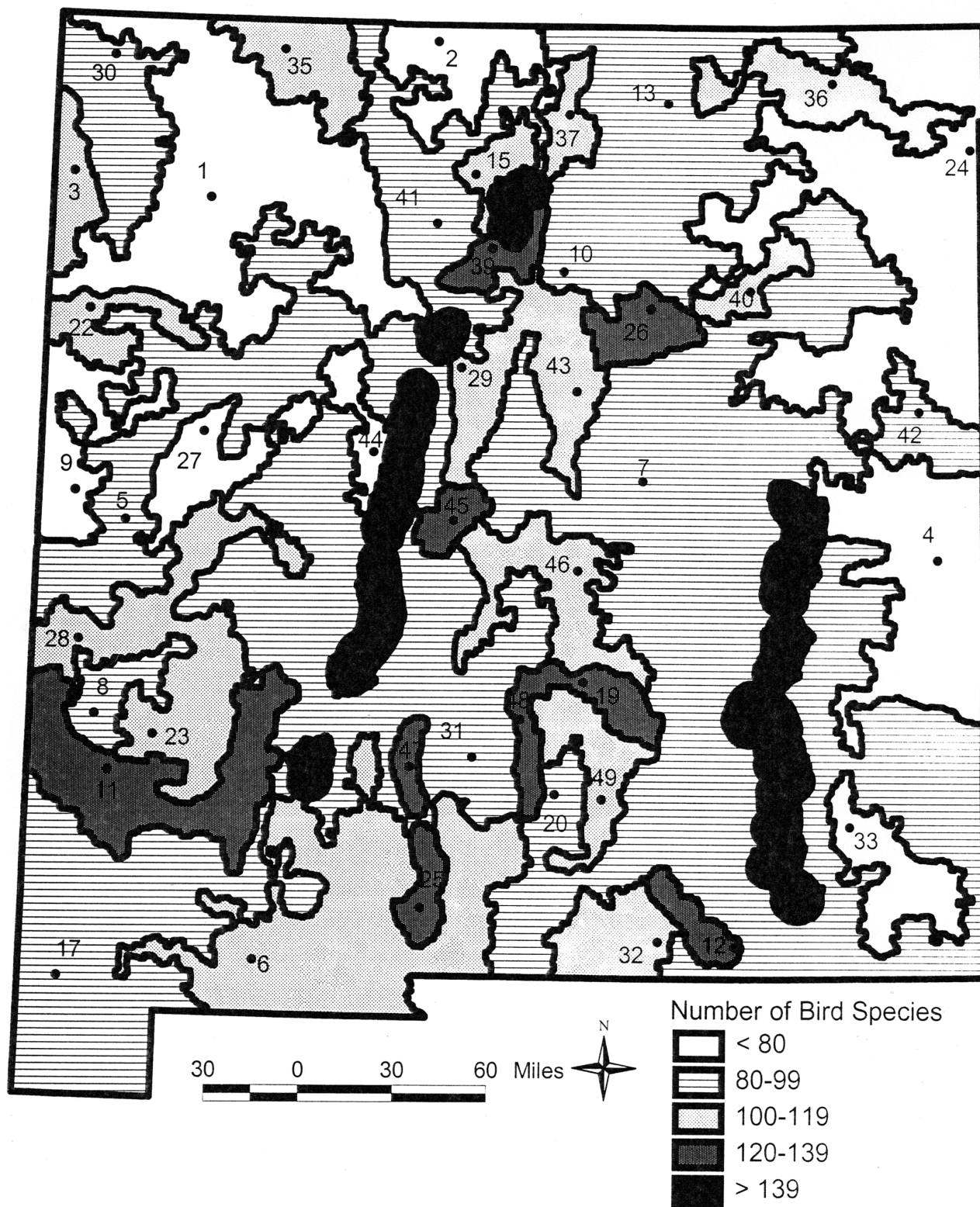
Many birds migrate, but not all; compare birds that migrate and those that do not.

References: ¹ Knopf, P.J., R.R. Johnson, T. Rich, and R.C. Szaro. 1988. Conservation of riparian ecosystems in the United States. *Wilson Bulletin* 100:272-284.

²Hink, V.C., and R.D. Ohmart. 1984. Middle Rio Grande biological survey. Report submitted to U.S. Army Corps of Engineers, Albuquerque, NM.



Teacher Key: Bird Richness

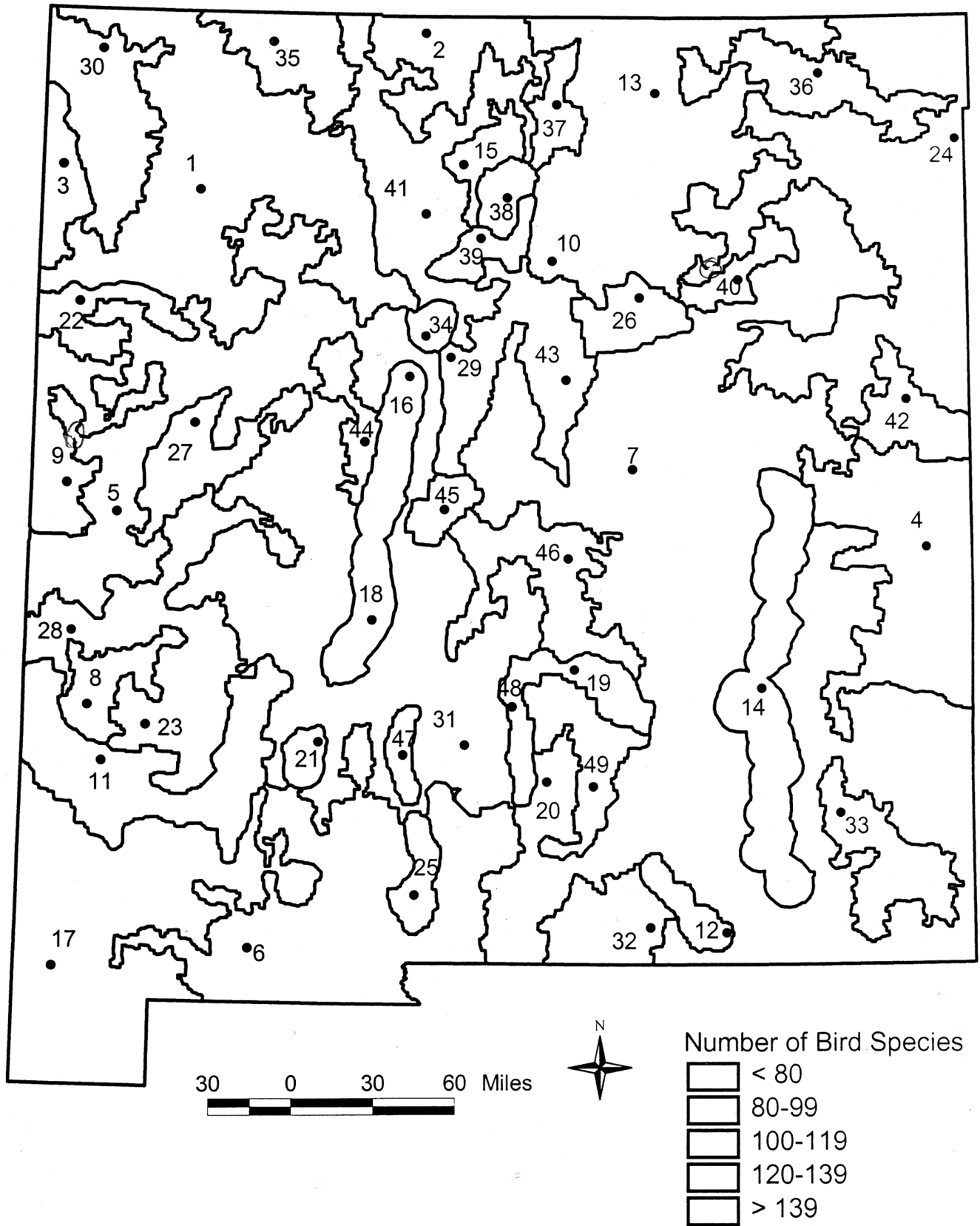


Mapping Species Richness Data Sheet

| Site # | Name | Species Richness |
|--------|--|------------------|
| 1 | San Juan Basin | 43 |
| 2 | Chama | 65 |
| 3 | Chuska Mountains | 113 |
| 4 | Portales | 53 |
| 5 | Quemado | 94 |
| 6 | Rock Hound State Park | 103 |
| 7 | Vaughn | 92 |
| 8 | Whitewater Baldy | 86 |
| 9 | Zuni Salt Lake | 55 |
| 10 | Randall Davey Audubon Center | 94 |
| 11 | Gila Riparian Preserve | 124 |
| 12 | Rattlesnake Springs Preserve | 121 |
| 13 | Phillmont Scout Ranch | 82 |
| 14 | Bitter Lakes Refuge | 159 |
| 15 | Abiquiu | 115 |
| 16 | Rio Grande Nature Center State Park | 143 |
| 17 | Animas | 98 |
| 18 | Bosque del Apache National Wildlife Refuge | 169 |
| 19 | Capitan | 133 |
| 20 | Cloudcroft | 82 |
| 21 | Elephant Butte Reservoir | 145 |
| 22 | Gallup | 103 |
| 23 | Gila Cliff Dwellings National Monument | 112 |
| 24 | Kiowa National Grassland | 52 |
| 25 | Organ Mountains | 125 |
| 26 | Las Vegas National Wildlife Refuge | 120 |
| 27 | El Malpais | 14 |
| 28 | Reserve | 117 |
| 29 | Sandia Crest | 106 |
| 30 | Shiprock | 84 |
| 31 | White Sands National Monument | 92 |
| 32 | Crow Flats | 102 |
| 33 | Loco Hills | 72 |
| 34 | Santa Ana Pueblo | 157 |
| 35 | Navajo Lake State Park | 114 |
| 36 | Capulin | 101 |
| 37 | Arroyo Hondo | 118 |
| 38 | Alcalde | 152 |
| 39 | White Rock | 123 |
| 40 | Cañon Largo | 116 |
| 41 | Fenton Lake | 86 |
| 42 | The Caprock | 92 |
| 43 | Clines Corners | 110 |
| 44 | Rio Puerco | 78 |
| 45 | Mountainair | 124 |
| 46 | Corona | 114 |
| 47 | San Andres Mountains | 134 |
| 48 | Three Rivers Petroglyphs | 126 |
| 49 | Mayhill | 118 |



Bird Richness



1,000-foot Elevation Contours

