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Bird Conservation Along the Lower Colorado River: Exploring a Complex Conservation Scenario Through Four Exercises

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EXERCISE 1: FACTORS AFFECTING RIPARIAN BIRDS AND BIRD HABITATS ALONG THE COLORADO RIVER

In this exercise, you will reflect on the *Bird Conservation Along the Colorado River* case study and consider some of the diverse anthropogenic and environmental factors that affect bird habitat and populations. You will organize information and connections presented in the case study through concept mapping. Concept maps consist of ideas, terms, or contributing factors arranged around a page/white board/computer screen, with lines or arrows to illustrate linkages. These maps help synthesize ideas, identify cause and effect, and encourage deep understanding of the material.[i] Refer to the example concept map below (Figure 1) to help you in the exercise. (Note: there is not a single correct way to structure concept map; there are multiple ways to depict relationships among the factors that affect bird habitat and populations.)

Step 1

In small groups of 2–3, list factors discussed in the case study that have affected riparian birds and habitats in the past and present, both negatively and positively. Then, create a concept map on this theme. You can create this using pencil and paper, or using concept mapping software.[ii] You should build a map that helps you answer this question: "what factors have affected and affect the status of bird habitat?" The concept map should note linkages, show hypothesized cause and effect relationships, and ultimately include effects on bird populations.

Step 2

Take the concept map a step further by considering what factors might affect birds in the future, and how those factors fit into your current concept map. For example, intensifying climate change, human demography, invasive species, or politics. If using paper and markers, this can be done in a different color.

Step 3

Your instructor will put two concepts on the board: bird habitat and bird populations. Each group will choose a volunteer to add one or more factors and appropriate linkages to the board. As a class, work together to complete the concept map.

[i] For more information on concept maps and resources and tools see BYU Center for Teaching and Learning's webpage: https://ctl.byu.edu/tip/concept-mapping.
[ii] See Wikipedia (https://en.wikipedia.org/wiki/List_of_concept-_and_mind-mapping_software) for a description of several options.

Step 4 (Optional)

After your class-wide map has been created, your instructor may decide to hold a short "poster session", where you'll circulate silently to review the maps generated by each group. If maps were created with software, images can be shared via the course website, discussion forum, or via projector.

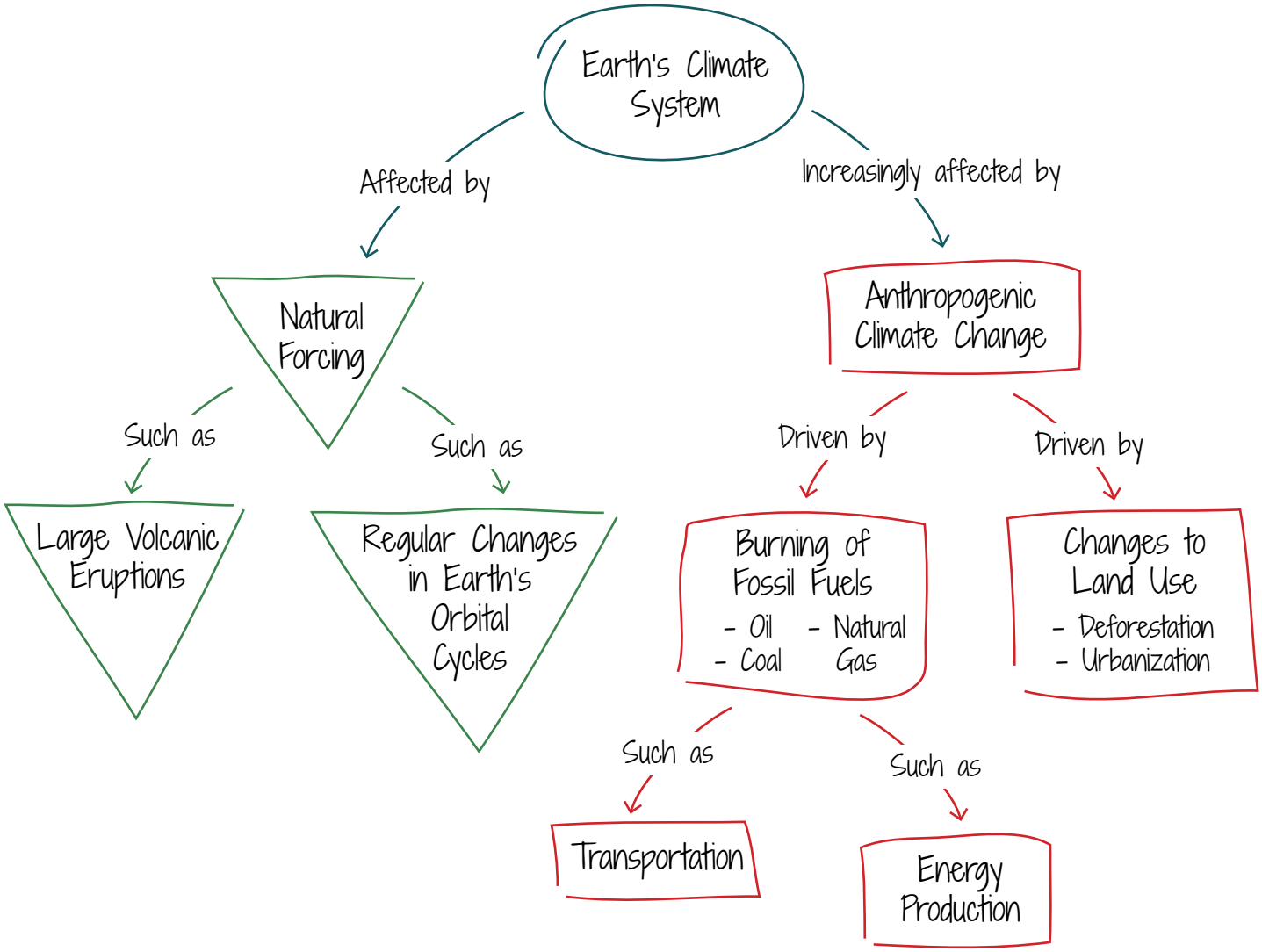

Figure 1. Example of a concept map. In this concept map, Earth's climate system is the central concept and factors that affect the system are drawn with examples and labels on the arrows. Note there are varying ways these maps can be drawn and visualized.

EXERCISE 2: CONSERVATION ACTIONS

As you've learned from the case study, conservation actions come with different sets of opportunities, challenges, and limitations. Most often, land managers decide which conservation action (in this case preservation, restoration, or creation) to pursue based on which lands are available and what condition, in terms of habitat quality, they are in for the species targeted for conservation. Further, conservation practitioners need to take into consideration issues of limited budgets and time commitments to projects weighing how best to optimize their chances of a net benefit for wildlife across a landscape.

Step 1

Using the template provided, list the advantages and disadvantages of the three primary categories of conservation actions discussed in this case study.

CONSERVATION ACTION	ADVANTAGES	DISADVANTAGES
Preservation		
Restoration		
Creation		

Step 2

Based on your understanding of the case study, explain in your own words why long-term monitoring is important in regards to these conservation actions.

EXERCISE 3: APPLYING DATA TO MANAGEMENT DECISIONS

Introduction

Wildlife managers are faced with many decisions when choosing the best conservation action for their system. Often there is not a clear right or wrong answer, as each decision comes with benefits and drawbacks. In real life, determining the best course of action requires careful consideration of a wide variety of factors, including: evaluating which species, ecosystems, or landscapes should be targeted and why; the biological effectiveness of conservation actions; any social impacts; as well as the logistics of implementation, including financial, legal, and political considerations.

To estimate the biological effectiveness (or the realistic, expected benefits) of conservation actions to riparian birds, long-term monitoring data are extremely useful. With these data, managers can 1) objectively measure the effects of the action over time, as discussed in the case study, and 2) compare and contrast different conservation benefits for different species. Here, we provide you with real bird-monitoring data from the lower Colorado River to demonstrate how you can estimate benefits from different conservation actions on native riparian birds.

In this exercise, you will play the part of a professional wildlife manager facing the choice of which conservation action to take: habitat preservation, restoration, or creation. The options provided for this exercises are only hypothetical examples of potential conservation actions. In reality, land managers face a large number of options for conservation plans. For the sake of expediency, you will focus on the question of biological effectiveness in consideration of financial constraints, but many factors could influence your decision.

Directions

Step 1. Consider the cost of each conservation action

With a $500,000 grant, you are able to implement one of three conservation actions. Use what you have learned in the case study and data from the table provided below to choose one optimized conservation plan. Be prepared to describe your conservation plan and defend your choice to the class (see below for a complete set of instructions).

1. *Habitat Preservation*
   Identify and protect existing, high-quality riparian habitat.
2. *Habitat Restoration*
   Purchase low-quality riparian habitat and improve this area by planting with native species and restoring flooding dynamics.
3. *Habitat Creation*
   Create new riparian habitat on agricultural land.

Potential Conservation Actions

Habitat Preservation
You have identified high-quality habitat for protection on the Bill Williams River, and in this case, it happens to be available to purchase. Because this habitat includes valuable commodities such as river access, surface water, and native forest, it is fairly expensive. Although it is not under immediate threat of development, it might be in the future. With your grant, you may decide how to allocate your funds between two habitat types: forest (tall woody habitat) for $7,000/hectare, and shrubland (low woody habitat) for $5,000/hectare. Forest is limited in this area, and a maximum of 35 hectares is available for purchase. Shrubland is unlimited. The site will be protected and water rights secured as long as you own it, and no further action is required.

Habitat Restoration
With the funding available, you would be able to acquire 140 hectares directly adjacent to the lower Colorado River. The habitat is currently low-quality and dominated by dry saltcedar. Your cost for the restoration project includes two years of planting cottonwood, willow, and baccharis plants and building infrastructure for flooding to promote native-habitat growth and a diverse avifauna on the property. After two years, your land will include 25 hectares of forest (tall woody habitat) and 115 hectares of shrubland (low woody habitat). Maintaining

this site will require a small amount of work beyond this two-year window, with management of water levels and maintenance of water flow infrastructure. These future costs are not included in the initial budget, therefore consider that you will need to apply for additional funding in the future to maintain this site for perpetuity.

Habitat Creation
Your budget for this project could cover the purchase of a block of 160 hectares of agricultural land (currently very low-quality habitat for breeding birds) including water rights and watering infrastructure. Also included in this budget are three years of plantings with native trees, shrubs, and other plants. Because you have much more control over created habitats than other types of conservation actions, you can distribute the area however you wish among three habitat types: cottonwood-willow, mesquite, and mixed. All three vegetation types require the same initial investment, so there are no restrictions in planting. However, consider that mesquite requires less water to maintain in the future. The created habitat is above the floodplain and will require continued maintenance and flooding to persist. These costs are not included in the initial budget, therefore consider that you will need to apply for additional funding in the future to maintain this site for perpetuity.

Step 2. Consider the species you are trying to protect

As a project manager, you have to justify your decision on what conservation action you plan to implement. Stakeholders, funders, and regulatory agencies need to be convinced that this is the best use of precious resources. Therefore, for this exercise, we ask you to calculate the benefits of your actions to your target species. The data in the table included below are derived from actual survey data obtained by the Great Basin Bird Observatory and other groups performing long-term monitoring on the Colorado River. You can use these to estimate how many territories you will preserve or create through your conservation action.

Questions to consider when choosing a species-oriented conservation action:

1. Which species do you want to target with this conservation action, and why?
2. Will this conservation action also more broadly improve the diversity of riparian bird species in the area, and if so how?
3. What is the longevity of this project? Will you be able to maintain this area into the future?
4. What will this conservation action not allow you to do on your site?

Step 3. Calculations

Use the Table 1 to calculate the species diversity and total number of bird territories that can be supported with your conservation action and different habitat types. Use these calculations to justify your decisions about how you will carry out your conservation plan. Because there are many possible outcomes depending on which conservation action you choose, and how much of each habitat type you plan to buy/plant, you don't need to perform each possible calculation to determine your conservation action. However, you should consider multiple potential choices (at least five) to strengthen your argument for your chosen action.

1. Calculate the total number of bird pair (breeding) territories by multiplying the territories/hectare by the number of hectares you will provide with your conservation action within that habitat type. *Read all below steps first to ensure you calculate correctly.*
2. *For the habitat preservation option*, use Region 7 (the Bill Williams River). Note that numbers of each species are different for tall woody and low woody habitat types, both of which may be present in your conservation area.
   For the habitat restoration option, use Region 11 (areas along the Colorado River near Imperial National Wildlife Refuge). Note that numbers of each species are different for tall woody and low woody habitat types, both of which will be present in your conservation area.
   For the habitat creation option, use habitat creation data. Note that numbers of each species are different for cottonwood-willow, mesquite, and mixed habitats; it is up to you to decide how much of each habitat type to include in your conservation area, and which makes the most sense given your target species.

3. Because birds require a certain amount of space to breed, they will only use a patch of habitat if it is large enough for an entire territory. Therefore, when calculating number of territories, you must round *down*. For example, 1.3 Yellow Warbler territories gives you a total of 1 territory (2 birds). A calculation of 0.8 Summer Tanager territories gives you a total of 0 territories (0 birds). If you want more territories, you need to dedicate more hectares to that habitat.
4. However, you need to consider all habitats within your conservation area together to calculate total number of territories. Thus, if you have 0.3 Black-tailed Gnatcatcher territories in tall woody and 1.8 Black-tailed Gnatcatcher territories in low woody, you can add these together to get 2.1 territories, and round down to a total of 2 territories.
5. Note: Yellow-billed Cuckoos require a large patch size of at least 20 hectares to begin establishing territories. Any patch of suitable forest habitat smaller than 20 hectares will not support Yellow-billed Cuckoos for the purpose of this exercise. (Note that other species may require larger patch sizes than their territory sizes as well, but this is particularly evident with the Yellow-billed Cuckoo.)

Step 4. Defend your Decision

In at least 200 words, explain the following:

- Which conservation option did you choose and why?
- Which species did you select as target species and why?
- Include at least five alternative options that you considered for your conservation plan, with calculations to indicate why that option wasn't chosen.
- What is the expected longevity of your conservation action?
- Downsides to your conservation plan; what you will not achieve?
- Include your calculations of number of hectares of each habitat and total cost, and numbers of territories (for a pair of birds) of each species.

Step 5. Present your Decision

Following the exercise, each group will briefly present their conservation project plan (about 5 minutes each), describe the highlights, and explain why they made this decision. Your instructor then may facilitate a discussion based on the your experience.

Key for Table 1

Region 7	Bill Williams River (intact riparian)
Region 11	Mainstem section of the Colorado River (degraded riparian)
TW	Tall woody habitat type
LW	Low woody habitat type
HC	Habitat creation sites
CW	Cottonwood-willow habitat type
SCC	Species of Conservation Concern in the United States

Federally Threatened is a US Fish and Wildlife Service designation of a species that is likely to become endangered within the foreseeable future throughout all or significant portions of its range.

State Endangered although not recognized as endangered throughout the species' range by the federal government (i.e., Federally Endangered), the species is considered to be in danger of extinction within that particular state.

Species of Special Concern (SSC) or *Species of Greatest Conservation Need (SGCN)* is any species that does not meet the criteria of an endangered or threatened under federal standards, but is particularly vulnerable, and could easily become an endangered, threatened, or extirpated species in that region due to restricted distribution, low or declining numbers, or specialized habitat.

No Status means the species is not of conservation concern.

Table 1. Bird species in the Lower Colorado River, their habitat requirements for a pair of birds (in territory per hectare) and conservation status. See Key for Table 1 for more information.

	PRESERVATION		RESTORATION		CREATION			
SPECIES (TERRITORIES/ HECTARE)	**REGION 7 TW**	**REGION 7 LW**	**REGION 11 TW**	**REGION 11 LW**	**HC CW**	**HC MESQUITE**	**HC MIXED**	**CONSERVATION STATUS**
Western Yellow-billed Cuckoo[1]	0.01	0.00	0.00	0.00	0.09	0.00	0.00	Federally Threatened
Arizona Bell's Vireo	0.14	0.11	0.00	0.03	0.03	0.00	0.05	SCC, State Endangered (California)
Gila Woodpecker	0.04	0.08	0.01	0.01	0.00	0.00	0.00	State Endangered (California), SCC
Lucy's Warbler	0.39	1.59	0.00	0.00	0.04	0.15	0.04	SCC, California SSC
Sonoran Yellow Warbler	0.65	0.78	0.05	0.00	0.04	0.00	0.01	Regional SCC, California SSC
Summer Tanager	0.04	0.10	0.00	0.00	0.01	0.00	0.00	California SSC
Yellow-breasted Chat	1.12	1.27	0.09	0.49	0.06	0.02	0.11	California SSC
Crissal Thrasher	0.01	0.03	0.00	0.00	0.02	0.03	0.03	California SSC
Abert's Towhee	0.15	0.37	0.04	0.12	0.25	0.35	0.33	Arizona SGCN
Common Yellowthroat	0.54	1.49	0.48	3.05	0.19	0.15	0.45	No status
Song Sparrow	1.51	2.66	0.41	2.12	0.06	0.06	0.29	No status
Black-tailed Gnatcatcher	0.05	0.26	0.05	0.42	0.07	0.33	0.13	No status
Verdin	0.18	0.41	0.07	0.46	0.15	0.49	0.41	No status
Marsh Wren	0.00	0.00	0.20	0.40	0.00	0.00	0.00	No status
Bewick's Wren	0.61	0.91	0.00	0.00	0.00	0.00	0.00	No status
Black-chinned Hummingbird	0.06	0.26	0.04	0.10	0.12	0.05	0.07	No status
Anna's Hummingbird	0.00	0.00	0.01	0.07	0.06	0.06	0.08	No status
Ash-throated Flycatcher	0.04	0.15	0.02	0.03	0.02	0.03	0.04	No status
Blue Grosbeak	0.03	0.05	0.00	0.00	0.22	0.11	0.25	No status
Bullock's Oriole	0.01	0.00	0.01	0.00	0.11	0.02	0.10	No status
Western Kingbird	0.00	0.00	0.00	0.01	0.07	0.02	0.04	No status
Ladder-backed Woodpecker	0.10	0.11	0.03	0.07	0.12	0.04	0.10	No status

[1] From Parametrix, Inc., and Southern Sierra Research Station. 2015. Yellow-billed Cuckoo Surveys and Population Monitoring on the Lower Colorado River and Tributaries, 2014 Annual Report. Submitted to the Bureau of Reclamation, Boulder City, Nevada. Prepared by S.E. McNeil and D. Tracy, Southern Sierra Research Station, Weldon, CA; and J. Lisignoli and T. Hurt, Parametrix, Inc., Albuquerque, NM. March 2015. All other data from the Great Bird Basin Observatory (GBBO), unpublished data.

EXERCISE 4: BEYOND THE CASE STUDY: CONTRIBUTE TO LONG-TERM MONITORING THROUGH CITIZEN SCIENCE

Introduction

In the United States, the popularity of birdwatching is growing, with roughly 47 million (approximately 20% of the population) people considering themselves birdwatchers (USFWS 2011). In addition to recreation, birdwatchers can participate in citizen science programs where bird observations are entered, often through smartphones, into global databases that can be accessed and used by the public and researchers alike. Generally, birders who practice citizen science this way already have some birding skills. However, even beginning birders can engage by reporting the birds that they already know how to identify.

The most important bird citizen science programs are the following:

1. **eBird** (www.ebird.org): Most birders are already familiar with this online hub for all bird observations. This online database allows amateur birders and researchers can submit their bird observations in real time using the eBird app on smartphones. The resulting database provides scientists and naturalists access to real-time data about bird distributions and abundance. Some areas also have "avicaching" programs, which encourage birders to visit a particular location of interest in areas with little or no data. The program also actively encourages the collection of standardized count data[i], which specially trained observers can use to make valuable contributions to a conservation project. This program rewards birders for birding by keeping their individual birding lists (checklists[ii] for particular visits, as well as life lists), but also allowing them to see what other birders have reported and where. All eBird data are publicly available free of cost. For more information on eBird and how this data can be used: http://ebird.org/content/ebird/about/.
2. **The Christmas Bird Count** (https://www.audubon.org/conservation/science/christmas-bird-count): This annual survey has been conducted nationwide every year for over 100 years during the three weeks around Christmas. Each region has established areas to survey with a Christmas Bird Count, and local birding clubs, Audubon chapters, or online birding groups coordinate the volunteer effort each year.
3. **North American Breeding Bird Survey** (https://www.pwrc.usgs.gov/bbs/): More advanced birders can participate in this annual survey, which adheres to strict protocols and requires excellent birding skills. Breeding Bird Survey (BBS) routes have been surveyed by volunteers nationwide for the past 50 years, and thus, they are the reason we even know which birds are declining and which ones are not. This database will also allow us to assess the impacts of climate change on birds. BBS surveys are coordinated by one person or organization in each state, and contact information can be found on the above-mentioned website.

Directions

This exercise will either be conducted as part of a class field trip, or completed individually.

Go to a location within your town or city and create and submit a checklist to eBird (see description above). The location may be assigned, or you may be allowed to choose a place. The location chosen will depend on your local area, but could be any natural or semi-natural area, or even on your school's grounds or campus! Try using published field guides or apps such as Merlin to identify birds.

Scientists can use these observations, along with millions of others around the world, to track bird movements and populations over time. Even a short checklist, such as a 10-minute count at a feeder or water source, is useful. With citizen science, anyone can contribute

[i] Counts can be stationary, or walks up to five miles; typically from five minutes to five hours.
[ii] A checklist includes counts of all species identified at a specific location, date, and time.

valuable data to long-term monitoring of birds and other organisms.

REFERENCES

[USFWS] US Fish and Wildlife Service. 2011. US Fish & Wildlife Service Birding in the United States: A Demographic and Economic Analysis Addendum to the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. US Fish & Wildlife Service, Division of Economics, Arlington, VA. Available from http://www.fws.gov/southeast/economicImpact/pdf/2011-BirdingReport--FINAL.pdf (accessed March 21, 2016).