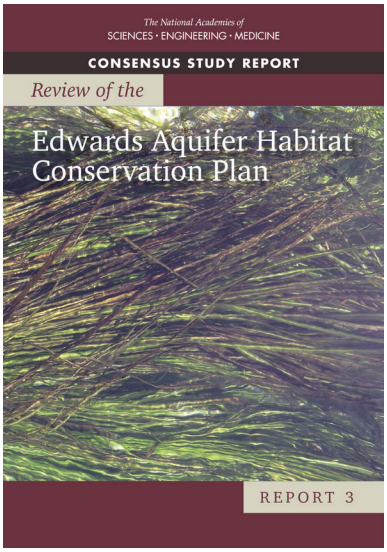
Consensus Study Report
HIGHLIGHTS
October 2018

Review of the Edwards Aquifer Habitat Conservation Plan: Report 3



The goal of the Edwards Aquifer Authority's 15-year Habitat Conservation Plan is to protect endangered species in Comal and San Marcos springs while supporting water needs in the region. This report, the final in a series of three, assesses whether the plan's biological objectives—which include flow, water quality, and habitat components—are likely to meet the biological goals of endangered plant and animal species. The report also assesses the effectiveness of the conservation measures undertaken to support the objectives, offering suggestions for improvement in areas such as stormwater control and riparian management.

The Edwards Aquifer in south-central Texas is the primary source of drinking water for over 2.3 million people in the San Antonio area and it supplies irrigation water to thousands of farms across the 3,600 square mile watershed (see Figure 1). The aquifer discharges at the two largest springs in Texas, Comal Springs and San Marcos Springs, which house several plant and animal species found nowhere else in the world.

Underlain by porous, permeable limestone rock known as "karst," large volumes of water move through the Edwards Aquifer's fractures, caves, and sinkholes in just days. As a result, the aquifer responds quickly to rainfall events, to drought, and to groundwater pumping. Periodic droughts have reduced flow in the Comal and San Marcos Springs, threatening the populations of endangered plant and animal species. Eight of the spring inhabitants are listed under the federal Endangered Species Act: the fountain darter, the San Marcos gambusia (presumed extinct), the Texas blind salamander, the San Marcos salamander, the Comal Springs dryopid beetle, the Comal Springs riffle beetle, the Peck's Cave amphipod, and Texas wild rice.

The Edwards Aquifer Authority (EAA) and four other local entities created a 15-year Habitat Conservation Plan (HCP) that outlines a broad array of management programs to help maintain the endangered species while managing withdrawals from the aquifer. After the HCP was approved in 2013, the EAA requested that the National Academies of Sciences, Engineering, and Medicine review the plan and its implementation. This report is the third and final product of a three-phase study to provide advice on various scientific aspects of the HCP to improve management of the Edwards Aquifer.

Figure 1. The Edwards Aquifer covers an area of approximately 3,600 square miles. The red line indicates the jurisdiction of the Edwards Aquifer Authority. Source: Edwards Aquifer Recovery Implementation Program.

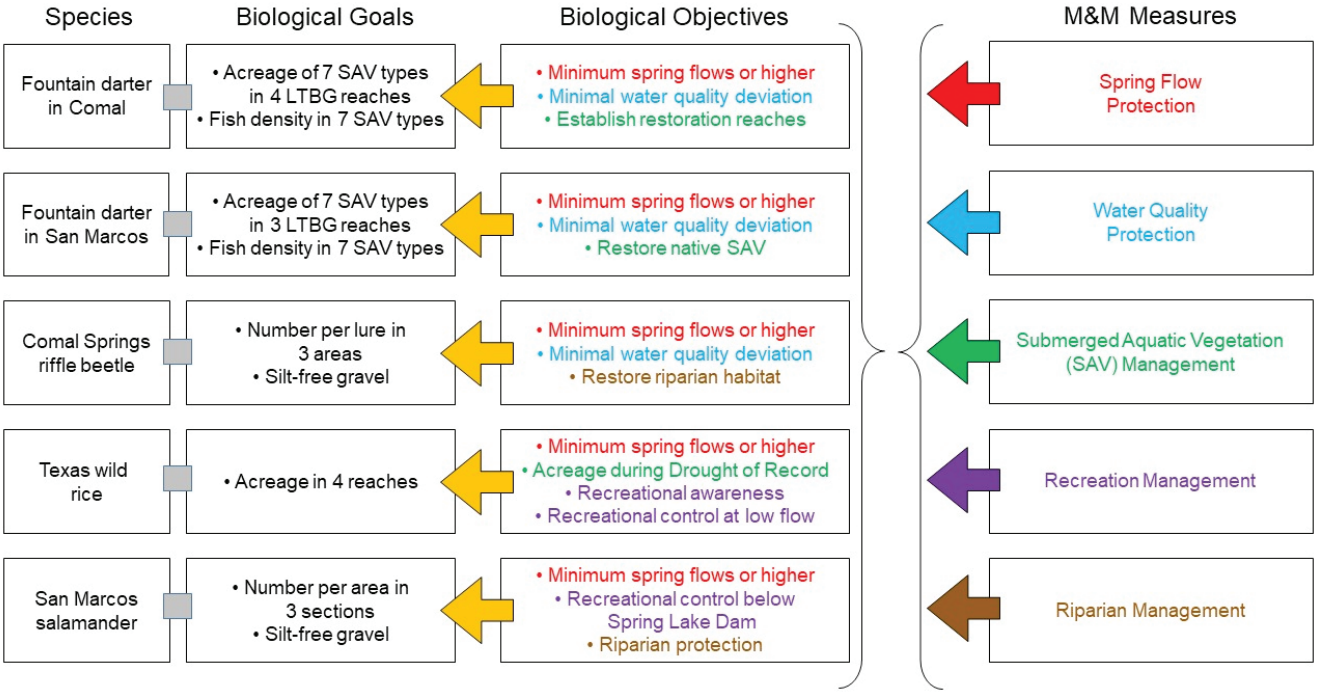


Figure 2. Linkages between the four listed "sentinel" species, their biological goals and objectives, and the minimization and mitigation measures. The gold arrows link biological objectives to the biological goals for each species. These arrows indicate that the spring flow, water quality, and habitat components of the biological objective will work in concert to reach a biological goal. The colors on the far right indicate classes of minimization and mitigation measures: red for measures to maintain minimum flows, blue for measures to maintain water quality, green for measures to manage SAV, purple for measures to manage recreation, and brown for measures to manage riparian areas. These measures are intended to achieve the objectives shown in the middle column, according to their corresponding color.

The third phase of the study focused on the biological goals and objectives found in the HCP for each of the listed species. Specifically, the study assessed whether the flow, water quality, and habitat components of the biological objectives can meet the biological goals. It also assessed whether the conservation measures in the HCP, known as minimization and mitigation (M&M) measures, can meet the biological objectives. These relationships are shown in Figure 2.

WILL THE BIOLOGICAL OBJECTIVES MEET THE BIOLOGICAL GOALS?

This report evaluated the biological goals and objectives for four listed species—the fountain darter, Texas wild rice, Comal Springs riffle beetle, and San Marcos salamander. There is considerably more data and information about these four species compared to the others, and some were identified as indicator species that can serve as proxies for the other listed species found in the Edwards Aquifer. The likelihood that the biological objectives can achieve the biological goals for each species is given one of four possible ratings: highly likely, likely, somewhat likely, and unlikely.

The Fountain Darter

The Fountain Darter

Fountain darters are fish that live in submerged aquatic vegetation (SAV) in the river systems of the Comal and San Marcos springs. The biological goals for fountain darter include maintaining coverage of SAV and minimum numbers of fountain darter per square meter of SAV. To reach these goals, the HCP set out objectives including restoring native vegetation, maintaining a certain spring flow, and maintaining water quality parameters such as dissolved oxygen, conductivity, temperature, and pH within certain limits.

It is <u>likely</u> that the biological objectives will meet the biological goals for fountain darter. Long-term monitoring, modeling, and research on fountain darter populations shows no recent downward trends in fountain darter densities by habitat type nor system-wide changes in SAV coverage since 2013, despite the drought and flood years of 2013-2014 and 2015, respectively. The Committee noted, however, that the use of the cumulative median density in determining whether the biological goals are being met is problematic because this metric is very insensitive to year-to-year changes in fountain darter densities.

Texas Wild Rice

Texas Wild Rice

Texas wild rice is an aquatic perennial grass found only in the headwaters of the San Marcos River in Hays County, Texas. The installation of a series of five dams changed the flow of the river and altered the physical habitat, which caused a decline in Texas wild rice. Recreation in the San Marcos River, including kayaking and tubing, has also been identified as a stressor on Texas wild rice.

It is likely that the biological objectives will meet the biological goals for Texas wild rice. This conclusion is based on empirical observations of recent gains in the coverage of Texas wild rice, even in the face of floods and droughts; on the compatibility of the flow objective with the habitat suitability modeling for Texas wild rice; and on the adaptive management changes that now include Texas wild rice as fountain darter habitat.

Comal Springs Riffle Beetle

Comal Springs Riffle Beetle

The Comal Springs riffle beetle (CSRB) lives near spring orifices, where it feeds on leaves and other detritus. The CSRB is sensitive to silt accumulations from sediment runoff, and therefore its biological goals are focused on maintaining silt-free conditions near spring openings, and on certain population abundances. The biological objectives are to maintain minimum flows and stable water quality, and to restore riparian habitat adjacent to spring openings to reduce silt accumulation.

It is somewhat likely that the biological objectives will meet the biological goals for CSRB. This conclusion is based on limitations associated with the lack of quantitative monitoring of CSRB populations and a lack of evidence that riparian restoration can eliminate or significantly reduce siltation at spring openings. To improve the rating, it will be important to continue to standardize and move toward quantitative sampling of CSRB, and to quantitatively monitor CSRB habitat sedimentation associated with continuing riparian restoration efforts.

San Marcos Salamander

San Marcos Salamander

The San Marcos salamander is a small, fully aquatic salamander that hides under rocks, gravel, and SAV. Its biological goals include maintaining silt-free gravel and specific populations at three sites where the salamander has been shown to occur over the past 50 years. Biological objectives include aquatic gardening at these sites, the regulation of recreational activity, and maintaining flow above certain levels. There is no water quality objective for the salamander.

It is somewhat likely that the biological objectives will meet the biological goals for San Marcos salamander. A robust monitoring program that could provide evidence of upward trends in number is lacking for this species. The rating could be improved by creating a water quality objective for the salamander, better regulating recreation on the San Marcos River, and augmenting the current sampling protocol with a new method to estimate proportion of area occupied and detection probability of San Marcos salamanders.

WILL THE MINIMIZATION AND MITIGATION MEASURES MEET THE BIOLOGICAL OBJECTIVES?

The committee considered five categories of M&M measures: (1) flow protection measures, (2) measures to protect water quality, (3) planting of SAV (including Texas wild rice) and removal of nonnative SAV, (4) recreation management, and (5) riparian restoration. For each category, the likelihood that the measures can achieve the biological objectives was rated highly effective, effective, somewhat effective, ineffective, or cannot be determined with available information.

Flow Protection Measures, including a water conservation program, aquifer storage and recovery, and a voluntary suspension of irrigation pumping, help to maintain the minimum flows required in the Comal and San Marcos systems. They comprised 71 percent of the HCP expenses, totaling $12.2 million through 2017. ***Restoration and Maintenance of Native SAV*** is particularly important for creating fountain darter habitat. Other measures include planting Texas wild rice and removing nonnative SAV. ***Recreation Management Measures*** include creating permanent river access points and preventing access at other locations, controlling recreational activities that might damage Texas wild rice, and educational efforts. **The flow protection measures, the SAV restoration measures, and the recreation management measures will be effective in meeting the biological objectives for relevant listed species.**

Water Quality Measures include stormwater control, golf course management, and the management and removal of floating litter and vegetation. **The water quality protection measures will be somewhat effective in meeting the water quality component of the biological objective for fountain darter in the Comal and San Marcos stream systems.** This rating is based on the difficulty in determining the effectiveness of stormwater control measures and uncertainty in how many projects will be implemented. To improve the rating, the Committee recommends tracking stormwater control project implementation and functioning.

Riparian Management Measures include restoring native vegetation along streambanks, stabilizing river banks, and preventing shoreline erosion and sedimentation. **The Committee was unable to determine whether riparian management measures will contribute to achieving the biological objectives of the CSRB.** This is due to a lack of quantitative monitoring to show that riparian measures are preventing siltation of adjacent springs, and to substantial maintenance requirements of erosion control structures. There is also the potential that riparian restoration activities could cause increased sedimentation of spring openings, with negative effects on CSRB.

OVERARCHING ISSUES

Recent research has yielded a better understanding of the Edwards Aquifer system than was available when the HCP was first developed. Hence, the Committee made recommendations on a path forward, that may suggest modifications to the HCP and the biological goals and objectives. These suggestions include:

- Developing robust goals for fountain darter population abundance. The ultimate goal is to ensure fountain darter populations are sufficiently large to provide a buffer against environmental variation and other factors that affect population size. This requires accurate estimates of fountain darter populations in each system, potentially using Population Viability Analysis modeling.
- Reconsidering the specific areal targets for replanting SAV species, which may not be necessary since there are relatively small differences in the number of fountain darters across the SAV species subject to active management. A relaxation of these targets and a stronger attempt to identify factors controlling SAV success could mean lower overall effort without sacrificing fountain darter habitat.
- Developing and implementing a plan for early detection of invasive species and rapid response to eradicate them before they become established. If a high-impact nonnative species were to become established, these systems could be permanently uninhabitable for one or more covered species.
- Considering the potential effects of catastrophic events on the Edwards Aquifer system. For example, an event the size of Hurricane Harvey could completely destroy the SAV in the Comal and San Marcos rivers, directly affecting Texas wild rice and fountain darter habitat and leading to erosion and sedimentation in some areas, affecting silt sensitive species. The Committee recommends evaluating such catastrophic events for possible inclusion in future HCP planning.

COMMITTEE TO REVIEW THE EDWARDS AQUIFER HABITAT CONSERVATION PLAN—PHASE 3

Danny D. Reible (*Chair*), NAE, Texas Tech University; **Jonathan D. Arthur**, Florida Department of Environmental Protection; **M. Eric Benbow**, Michigan State University; **Stuart E.G. Findlay**, Carey Institute of Ecosystem Studies; **K. David Hambright**, University of Oklahoma; **Lora A. Harris**, University of Maryland Center for Environmental Science; **Steve A. Johnson**, University of Florida; **James A. Rice**, North Carolina State University; **Kenneth A. Rose**, University of Maryland Center for Environmental Science; **J. Court Stevenson**, University of Maryland Center for Environmental Science; and **Laura Toran**, Temple University. Staff from the National Academies of Sciences, Engineering, and Medicine: **Laura J. Ehlers** (Study Director) and **Carly Brody** (Senior Program Assisant).

For More Information . . . This Consensus Study Report Highlights was prepared by the National Academies of Sciences, Engineering, and Medicine based on the Consensus Study Report *Review of the Edwards Aquifer Habitat Conservation Plan: Report 3* (2018). The study was sponsored by Edwards Aquifer Authority. Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of any organization or agency that provided support for the project. Copies of the Consensus Study Report are available from the National Academies Press, (800) 624-6242; http://www.nap.edu or via the Water Sciences and Technology Board web page at http://www.nationalacademies.org/wstb.

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