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TEXAS

PARKS & WILDLIFE

The OUTDOOR MAGAZINE of TEXAS

The State of Wetlands

WHY WETLANDS
MATTER

BY LARRY MCKINNEY

FIGHTING FOR
INDEPENDENCE

BY JOE NICK PATOSKI

TOP 10 BOARDWALKS

BY SHERYL SMITH-RODGERS

RETURN OF
THE BAHIA GRANDE

BY KAREN HASTINGS

WASHING
THE WATER

BY WENDEE HOLT CAMP

RITA'S WAKEUP CALL

BY JOE NICK PATOSKI

BADLAND
BEAUTIES

BY E. DAN KLEPPER

PLAYAS
IN PERIL

BY RUSSELL A. GRAVES

DELTA DAWN

BY WENDEE HOLT CAMP

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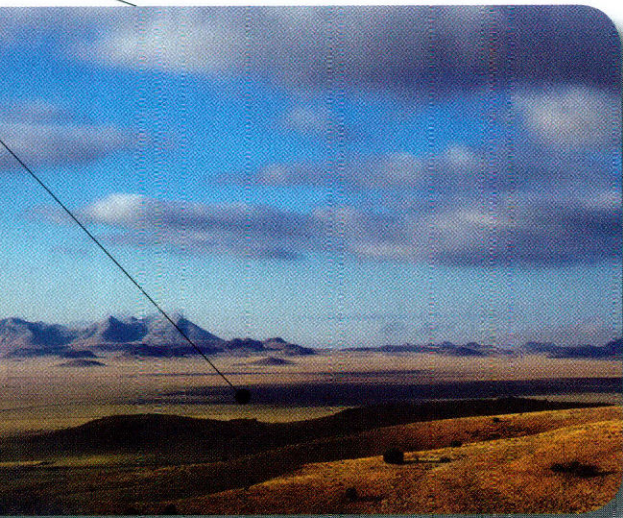
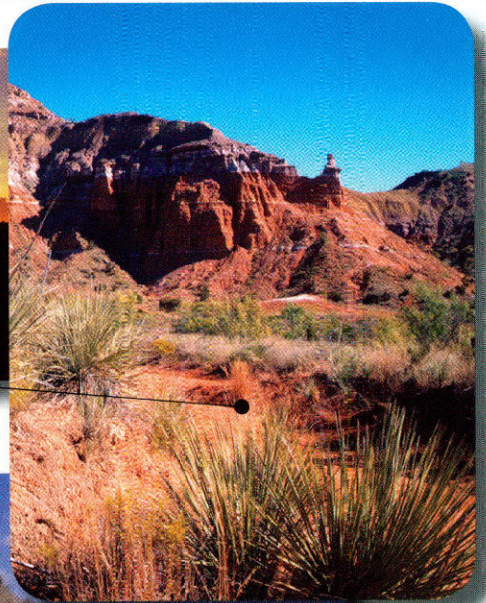
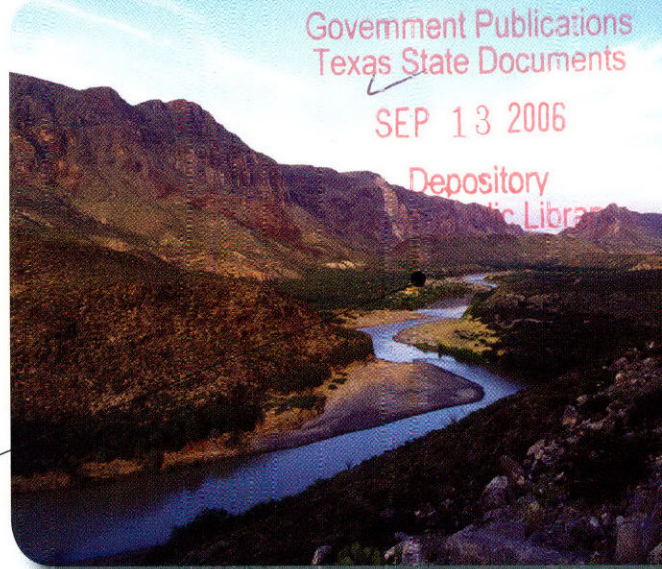


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Community support plays a key role in the largest wetland restoration project in U.S. history.

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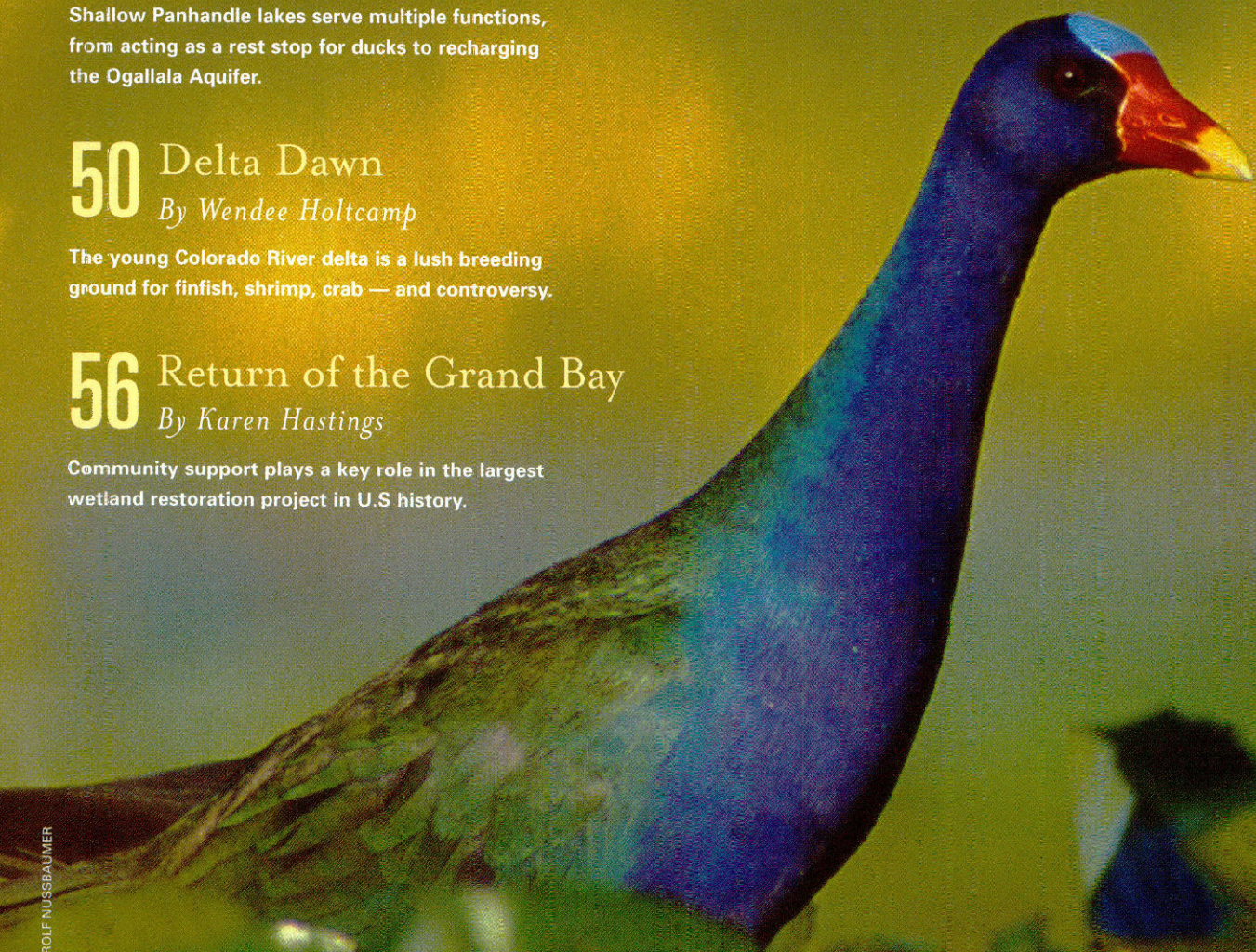
Wetlands at Richland Creek Wildlife Management Area act as a huge water filter, removing toxins the natural way.

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For the latest information on Texas' parks and wildlife,
visit the department's Web site: <www.tpwd.state.tx.us>

Covers

FRONT: Rainbow over the wetlands in Matagorda Island Wildlife Management Area.
Photo © Lance Varnell.

BACK: Boardwalks, like this one at the Cibolo Nature Center near Boerne, make wetlands more accessible. See the article that starts on page 76.
Photo by Earl Nottingham.

Previous spread: A purple gallinule makes its way across the surface of yellow lily pads.
Photo © Rolf Nussbaumer.

This page: Oak Creek in the Chisos Mountains of Big Bend National Park.
Photo © Laurence Parent.

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TEXAS

THE OUTDOOR MAGAZINE OF TEXAS

JULY 2006, VOL. 64, NO. 7

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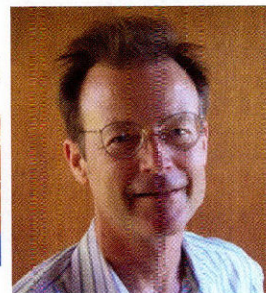
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In the Field



KAREN HASTINGS, (top left) is a freelance journalist and writer whose byline has appeared in most major newspapers in Texas, as well as *The New York Times* and state and national magazines. After 12 years with *The Fort Worth Star-Telegram* and several awards for reporting on state government, Karen moved to the Rio Grande Valley, where she and her journalist husband are raising a family of redheads.

WENDEE HOLT CAMP, (top right) reports on wildlife and environmental issues, ranging from Amerindian tribes in the Amazon to sea turtles in Costa Rica. Her articles have been published in *National Wildlife*, *Sierra*, and *Audubon* magazines, Discovery Channel Online, AnimalPlanet.com and NPR's All Things Considered. Based in Houston, she regularly contributes to *Texas Parks & Wildlife* magazine. Holtcamp has a Master of Science degree in Wildlife Ecology, and founded the nonprofit San Jacinto Conservation Coalition (www.sanjacinto.cc) in 2000 to raise awareness of the San Jacinto River in Houston.

JOE NICK PATOSKI, (lower right) avid outdoorsman, conservationist and Texas music authority, has written extensively about his passion for the outdoors over nearly two dozen years, often in the pages of this magazine. He's contributed to all five special water issues of *TP&W* magazine, and two of his articles appear in this issue. He is currently at work on a comprehensive biography of Willie Nelson.

E. DAN KLEPPER, (lower left) writes and publishes stories on the outdoors, adventure sports, cultural history and the arts. His article on mountain biking Big Bend Ranch State Park, entitled *Solitario Solamente*, won the Gold award for travel writing from the International Regional Magazine Association in 2003. He has authored, under the pen name Edwin Daniels, the book *Wolf Walking*, which won a Texas Outdoor Writers Association Excellence in Craft Award. His latest book is *Spirit Walker ~ JD Challenger and His Art*. Klepper writes from his home in Marathon.

AT ISSUE

FROM THE PEN OF ROBERT L. COOK

I don't know why I worry so much about water. Some would say that that is my job. No, my job is to worry about fresh water for fish and wildlife and outdoor recreation. My job is easy. Fish and wildlife have evolved over millions of years with — and without — an abundance of water. They will survive. I fear that people will suffer long before wildlife in the event of a long term shortage of fresh water.

I worry that the future citizens of our state will not have enough fresh water, and that there will not be enough fresh water for agriculture and for industry so that the Great State of Texas can continue to prosper and thrive for many generations to come. I worry that we waste far too much water. I recently looked at how much water my family uses in our home per year on a "per capita" basis; 300 gallons of water per day, per person, is excessive, wasteful. We could and should use less — maybe as little as 120 gallons per day if we were careful, thoughtful. Each of us can make a positive difference in our future water supply and needs if we'll just try.

On the other hand, I am proud to report that many land managers in Texas are doing a great job of water conservation across the state. For example, on Lost Creek Ranch we have eliminated all grazing on the "creek pastures" and we do deferred-rotation grazing on the rest of the acreage for about 6-7 months of the year. We do prescribed burns when we can and we control noxious brush. Excess brush wastes lots of groundwater and is unproductive for wildlife or livestock. The impact has been amazing. The rainfall soaks into the ground now as opposed to rapidly running off and carrying lots of soil and sediment with it as it used to. The absorbed groundwater reappears as springs throughout the drainage. The fresh water from Lost Creek drains into the Colorado River, passes through the Highland Lakes system, and eventually makes its way to the bays and estuaries on the Texas Coast. That is, it does if I don't waste it on my lawn or in my shower in Austin. Thousands of landowners in Texas are doing a great job of habitat management in Texas on millions of acres of rangeland which, in turn, results in what I believe to be the most significant contribution to water conservation in Texas today. We can do even more; we must do more.

We can't "make more water," we are just in its path as it falls to the ground, flows by in our rivers and streams and maintains our seas. The natural cycle of rainfall, run-off, transpiration through vegetation, evaporation from our surface waters and oceans, irrigation of cropland, use in our cities and cycling back into the rivers from our water-treatment plants all puts the components of water, hydrogen and oxygen, back into the air where again it falls back to Earth as fresh, clean water for our use. The key is that we use it carefully, that we conserve all we can. We must manage the surface of the land to conserve and provide more fresh water for our use and consumption. Water is precious; we must use it wisely and safely as it comes by us each time. It will be back around ... but there will not be more just because we need more.

Thousands of landowners in Texas are doing a great job of habitat management in Texas on millions of acres of rangeland which, in turn, results in what I believe to be the most significant contribution to water conservation in Texas today.



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MAIL CALL

PICKS, PANS AND PROBES FROM OUR READERS

FOREWORD

I never intended to create a sheet-flow wetland in my backyard, but one day I forgot to turn off the hose. When I discovered the oversight, instead of shutting off the water immediately, I simply watched it for a while. It was oddly fascinating. As the water spread slowly across the yard, it flowed in unexpected ways — sometimes uphill — as it encountered piles of leaves, rocks and dog toys. The toad that lives under the house hopped out to take a look. In the corner of the yard, a grackle took a bath in a puddle. After I turned off the hose, the water slowly seeped into the ground. By the end of the next day, all evidence of the short-lived wetland was gone.

This accidental experiment offers insight into why it's so hard to garner support for protecting wetlands. How do you define, much less protect, a body of water that isn't always wet? At what point does a puddle in the middle of a field become a wetland? How do you get people excited about mud and mosquitoes and mush?

I think more people will get engaged when they understand the vital roles the various types of wetlands play in the environment. They serve as nurseries for dozens of species, they clean water, they recharge aquifers, and much more.

There is also remarkable beauty in wetlands, but few people are willing to slog through the mire to find it. So we've done the work for you. Specifically, Chief Photographer Earl Nottingham has traveled from Big Bend to the Panhandle to East Texas to the coast to bring you many of the wonderful photos in this issue. Keep your feet dry and enjoy his masterful work as you flip through the following pages.

The beautiful layouts you'll find in this issue — and every issue — are designed by our curmudgeonly but lovable Art Director, Mark Mahorsky. If I may do a little horn-tooting, for the first time in the magazine's 64-year history, Mark took top honors for **Best Overall Design** in this year's Western Publication Association's Maggie Awards. The magazine also won first place for **Best Magazine** in the category of Outdoor Sports, Boating & Recreation and **Special Theme Issue** for July's State of Springs. The WPA is a respected, 50-year-old association serving magazines west of the Mississippi River. Its members include hundreds of consumer magazines of every type imaginable, including *MacWorld*, *Sunset*, *Arizona Highways*, *American Way*, *Shape*, *Las Vegas Life*, *Desert Living*, *Mother Jones* and *Sierra*.

While we always appreciate the compliments we receive from readers and the support we receive from within the agency, there is something to be said for the compliments of strangers. The WPA is made up of magazine professionals who do the same type of work that we do, day-in and day-out. The awards are judged by our peers, who share a genuine desire to highlight the best work in the industry. Way to go, Mark, and keep up the great work.

Robert Macias

ROBERT MACIAS
EDITORIAL DIRECTOR

LETTERS

DECLARE WAR ON PLASTIC BAGS

Thank you for your article in the June issue regarding the environmental ills of plastic and paper bags ("Bag Those Bags").

We're proud to be winter Texans.

We spend five months each winter touring Texas, the state we love, and always have a wonderful time.

This article, however, prompted us to respond to a subject that we feel is very important to Texas as well as all states.

Traveling on back roads and state highways in our motorhome allows us to enjoy the diverse countryside. For the most part, we have not been disappointed, except in the western part of this great state. We saw

miles of fence lines nearly white with plastic bags. What a sad and disgraceful sight! We think everyone should consider what happens to those plastic and paper bags once they've served their purpose. We especially would like to see the stores come up with some other means of packing groceries and other purchases rather than in plastic bags that are only going to be discarded into the environment and create such an ugly sight for residents and tourists.

MARGIE AND CLIFF FEDDERLY
Cusick, Washington

MOVIN' TO MONTANA

You're raising the bar! *TP&W* seems to just get better and better each year. I hadn't seen the magazine for a



Texas Parks & Wildlife won Western Publication Association Maggie awards for **Best Overall Design**, **Best Magazine** and **Special Theme Issue**.

MAIL CALL

while (I heard you stopped sending it to other states as a money-saving measure), but we've started a subscription and have again begun receiving copies, starting with April 2006.

That issue was a knockout. So nicely edited, so intelligently designed. I don't dare let your magazines circulate within the department ("Dickson! Why aren't you doing something like this?!"), so I have to destroy them as soon as I finish reading and figuring out how I can steal design and editorial ideas to use in our magazine.

And who is this Larry D. Hodge, who writes as skillfully as he photographs? I might have to send our two grizzly bear biologists down to kidnap him and bring him to Montana.

TOM DICKSON, EDITOR
Montana Outdoors

WATCH FOR SPARROW SQUATTERS

On page 29 of the May issue article "Skytrek, Exploring the Wonders of Spring Bird Migration," you show a photograph of a purple martin house and, in the accompanying text, you explain the necessity of the traditional martin houses to insure the purple martins' reproductive success. Yet, you imply by omission that the nests visible in the martin house are actually purple martin nests. The six nests visible in the bottom two stories of the purple martin house are English sparrow nests, and those nests should be removed. The English house sparrows, along with the European starlings, are exotic invaders in the martin houses and need to be prevented from nesting in the martin houses. The nests in this photograph appear to be complete and undoubtedly have nesting sparrows in them. Purple martin house owners who are just starting out and are looking for information on healthy purple martin nest formation are very likely to believe that the nests are martin nests. This misinformation will only increase the numbers of the unwelcome species.

Your magazine is a wonderful source of accurate information for the nature enthusiast. Please let your readers know the importance of routinely cleaning out the nests of exotic invaders who take over purple martin houses. If these foreign nests are not removed, the purple martins will not nest in the houses designed for them. With the ongoing reduction of wood-

lands that provide the natural nest sites for purple martins, we need to provide as many healthy nest sites as possible.

KAREN BRENEMAN
Houston

EDITOR'S NOTE: Karen Breneman is the author of Gardening with Nature in Texas, and we appreciate this information about martins.

Experience San Angelo from a different point of view.

Wild times are waiting for you in San Angelo

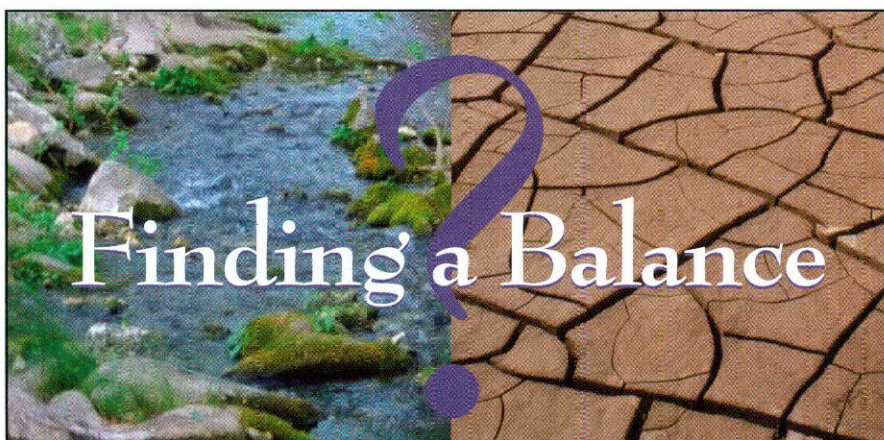


San Angelo combines the best of the great outdoors with the finest in West Texas charm and hospitality. Dive into the fun at one of our refreshing lakes. Or take in our wide open wilderness for hunting, horseback riding, biking, or just plain relaxing. Any way you look at it, San Angelo is an outdoorsman's dream come true.

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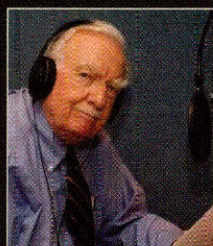
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VACATION READING

For years, I enjoyed your magazine at my neighborhood barber shop in Dallas. When the shop closed last year, it was time for me to subscribe, and I'm glad I did. Both the articles and the photographs in your magazine are consistently excellent (after earning a living behind the camera for 15 years, my standards are pretty high). Your May 2006 issue that included the article on bird migration was no exception. The issue arrived just in time for my wife and I to take it along on vacation to a very special bird nesting refuge: Rose Island, an 18-acre rock in the middle of Narragansett Bay, a mile off of Newport, Rhode Island.

Admittedly, the prime attraction for my wife and me was the historic lighthouse (pictured above) on the southwest point of Rose Island, where we lived as volunteer lighthouse keepers for a full week in April 2006. Since 1999, all of the island beyond the lighthouse grounds has been protected as a wildlife refuge, thanks to the ongoing efforts of the Rose Island Lighthouse Foundation. Not even the lighthouse keepers are allowed to enter the nesting areas between April 1 and August 15.

I thought you and your readers might enjoy the photo of the lighthouse. Please note that we flew the Texas flag with great pride every day of our visit.

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MAIL CALL

PHILOSOPHY OF HUNTING

I was prompted to write this long-overdue letter by the "At Issue" essay on hunting (and remote control hunting) written by the Texas Parks and Wildlife Department Executive Director Robert L. Cook which appeared in the May issue of the *Texas Parks & Wildlife* magazine. His essay should be required reading for hunters everywhere; it is a beautifully written philosophy.

Even though I'm a lifelong resident of Tennessee, I have been blessed for several years by the photographs and articles of the *TP&W* magazine thanks to a gift subscription from a devoted sister in New Braunfels. Month-by-month, the magazine reminds me of the shared traditions of Texans and Tennesseans, especially as they relate to a reverence for fields, streams, forests and wildlife and to a deeply ingrained love of the outdoors. Please accept my heart-felt thanks.

GEORGE H. CATE, JR.
Nashville, Tennessee

CORRECTION: We missed a key letter — a "u" — in the link for the Texas A & M University Press, which published the popular book Hummingbirds of Texas mentioned in the table of contents for our May issue. The correct link is: <http://www.tamu.edu/upress/BOOKS/2005/hackelford.htm>

Sound off for "Mail Call!"

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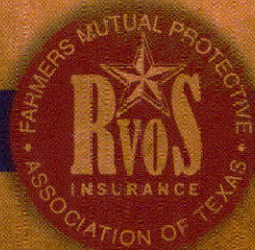
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SCOUT

NEWS AND VIEWS IN THE TEXAS OUTDOORS

IN WATER WE TRUST

Landowners can earn tax breaks and help the environment by depositing their water rights into a trust.

Even though it seems like a drop in the proverbial bucket, and may not be enough to meet the state's environmental flow needs, the 1,236 acre-feet of water in the Texas Water Trust represents a promising step in the right direction. In 1997, the Texas legislature created the trust as a repository to hold water rights dedicated to environmental needs, including instream flows, water quality, fish and wildlife habitat and freshwater inflows to bays and estuaries. In essence, the trust is a legal mechanism that allows water to remain in Texas rivers and streams for the benefit of the environment.

The Texas Parks and Wildlife Department holds the title of inaugural depositor to the Texas Water Trust. The true honor, however, belongs to C. R. "Kit" Bramblett, the Hudspeth County rancher who donated to TPWD two water rights on the Rio Grande. Simply put, Bramblett says, "I just wanted to see

some water left in the river." Bramblett asked TPWD to deposit the rights in the trust, and he hoped his actions would inspire others to protect instream flows.

Consider Texas State University inspired, as it has followed Kit Bramblett's lead and deposited 33,108 acre-feet of San Marcos River water rights in the Texas Water Trust. Andrew Sansom, executive director of the River Systems Institute at Texas State University, remarks that water plays a defining role at the university. "Having the headwaters of the San Marcos River on campus and having strong aquatic resource programs in the biology and geography departments make water a major part of the school's culture. The university's deposit in the trust represents a particularly meaningful and very real commitment to protecting water as a core value." Sansom personally believes that protection of river flows and freshwater inflows to bays and estuaries is the single most important natural resource issue facing Texas today.

Facing mounting competition for a finite resource, Texas

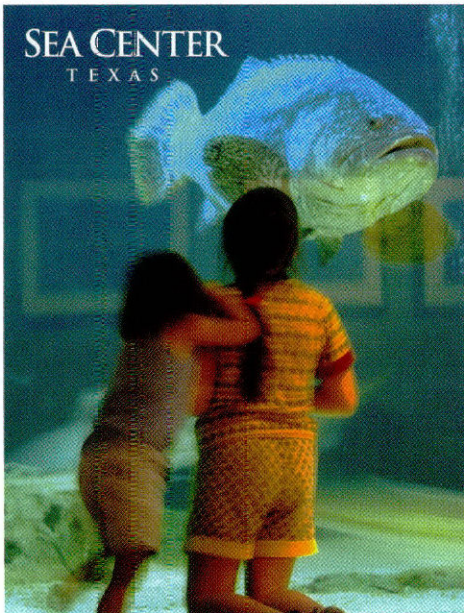
The Texas Water Trust can help preserve water for environmental needs, including preserving fish and wildlife habitat.



Something's Fishy!

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continues to search for ways to provide water for environmental needs. Only since 1985 has the state imposed a duty on surface water rights to provide protection for fish and wildlife. Texas governs water rights under the doctrine of prior appropriation, which can be summed up as "first in time is first in right." Senior water rights must be satisfied before junior rights; this makes older rights considerably more reliable and valuable than junior rights. One way to convert senior rights to environmental flow protection is through the use of the Texas Water Trust.

Administered by the Texas Water Development Board, the Texas Water Trust allows for the voluntary assignment of water rights to meet environmental needs but does not require the right holder to relinquish ownership. Water rights may be deposited for a term specified by contract or in perpetuity to protect rivers, bays and estuaries. While on deposit, rights retain their seniority and are protected from cancellation by the state.

The concept of voluntary private participation in conserving river flows is sparking interest throughout the state.

Several nonprofit organizations are now operating or developing private water trusts.

Founded in 2001, the nonprofit Guadalupe-Blanco River Trust promotes the conservation, stewardship and enjoyment of the land and water resources of the Guadalupe River watershed. In its first foray into instream flow protection, the trust took the creative approach of securing river flows through a water right lease. Pursuant to an agreement between the Guadalupe-Blanco River Authority and Thornton Family Investments, L.P., the river trust now serves as guardian for a five-year lease of 70 acre-feet of historic senior water rights on the San Marcos River. Todd Votteler, Guadalupe-Blanco River Trust executive director, says the organization is focused on attracting unused rights and creating a positive outcome for the environment and the property owner. "Similar to entering into land conservation easements, by donating water rights to a nonprofit trust, property owners can realize federal income or estate tax benefits as well as achieve environmental benefits."

In water-scarce far West Texas, the

newly formed Trans-Pecos Water Trust is dedicated to protecting the "Forgotten River," that stretch of the Rio Grande that winds from Fort Quitman to Amistad Reservoir. Low river flows are a fact of life in the Rio Grande Basin, but Board President Mike Davidson says the TPWT is dedicated to helping build a process to better determine the value of individual water rights and to seeking voluntary market-based solutions including but not limited to donation, lease, barter or outright purchase, to support instream flows. Davidson notes that river-based recreation can be an important economic factor in small rural communities near scenic navigable streams, and along with the wildlife viewing opportunities that a healthy river ecosystem offers, the long-term economic sustainability of the rural Big Bend region is inexorably bound to the relative health of the Rio Grande. Plus, says Davidson, when you work to protect instream flows, "You get the personal satisfaction of being a part of a basin-wide community of incredibly optimistic people who are working towards goals that may well take longer than our remaining lives to accomplish. It brings out the inner Don Quixote."

Believing that a local water trust would best serve the needs of its water-dependent community, the board of the Menard County Water Control and Improvement District No.1 has authorized District Manager Caroline Runge to form the San Saba River Trust. "For a small river like ours, the best way to achieve instream flow protection is through a private community-based organization run by trusted locals," Runge says. The nonprofit group will seek donation of water rights and funding to purchase water rights.

Whether through private or state trusts, dedicating water rights to protecting environmental flows gives Texans the opportunity to participate in conserving the fish and wildlife that depend upon healthy rivers, bays and estuaries.

★

— Colette Barron

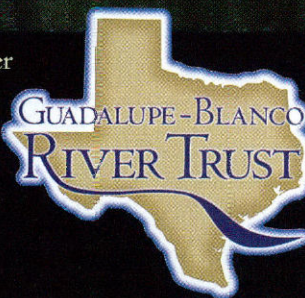
Conserving a Texas Treasure —The Guadalupe River...



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Recently, I received this letter from Brian Howe of Richmond, VA.

Sharpshooter:

A couple of weeks ago, my friend Dave and I were sitting in a duck blind. Now, this is a guy I've known practically my whole life. We've hunted duck, whitetail, elk, turkey and just about everything else in season for the last 20 years.

We're both pretty good marksmen and we love to compete with each other! We've always been even skill wise. But, this last time we went out, I noticed Dave was picking up objects a lot faster than I was. He was focusing on incoming targets and squeezing off shots faster and more precisely than ever. By the end of the day, Dave was cleaning several more birds than I was. This went on the entire weekend.

So, I finally asked him if he'd gotten laser surgery or contact lenses. I mean, his shooting accuracy had improved so much. It was incredible. He just laughed and said no. But, last November he had been on an elk hunting trip in Alberta, Canada, and one of the guides gave him a bottle of a supplement called Claroxan™. He told Dave that it would greatly improve his vision. In a few weeks, the guide explained, he would be able to pick up, focus, and lock in on moving objects faster than he ever dreamed of.

Anyway, now Dave boasts about having the secret edge, and I don't like it one bit! Have you heard of this Claroxan stuff?

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Wetland Warriors

Landowners, Ducks Unlimited and other conservation groups lead the charge for private wetlands restoration efforts.



The Texas Prairie Wetlands Project has helped preserve more than 33,000 acres.

Despite considerable wetlands loss nationwide during the last 50 years, Texans are working to protect a chunk of the state's historic wetlands, thanks in no small part to conservation incentives for private landowners.

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As land values continue to climb, particularly for development along the Texas coast, so does the need to ensure wetlands conservation. That is where groups such as Ducks Unlimited step in, leveraging fundraising dollars with matching state and federal grants to help private landowners justify maintaining wetlands on their property. More than 160 local DU chapters throughout Texas raise upwards of \$3.3 million annually, money that works for conservation from Canada to the coast. Since 1985, Texas' partnership with DU has conserved more than 200,000 acres of wetlands and waterfowl habitat in Saskatchewan. This province provides many of the ducks that winter in Texas.

Here in Texas, DU money is matched with state and federal grants to maximize the benefits for wetlands.

In 1991, DU, TPWD, the U.S. Fish and Wildlife Service and the Natural Resources Conservation Service created the Texas Prairie Wetlands Project, a project that covers a 28-county focus area along the coast. Since its inception, more than 33,565 acres of shallow, seasonal wetlands have been restored or enhanced at a cost of \$7.1 million. Landowners have completed upwards of 432 projects with 727 individually managed wetland units signed under a 10- to 15-year Wetlands Development Agreement with DU and TPWD.

Ducks Unlimited and TPWD part-

nered again in 2001 with the NRCS and the USFWS to initiate a similar venture in East Texas. The East Texas Wetlands Project targets a 46-county area in northeastern Texas. During the first three years of the project, more than 200 landowners have received technical guidance on wetlands conservation, resulting in 40 projects to restore about 2,500 acres of wetland and bottomland hardwood habitat. Another 15 projects are currently in the planning phase, and they will improve habitat on an additional 1,000 acres.

In addition to these initiatives, the 1990 Farm Bill established a federal Wetlands Reserve Program. That has become a popular, cost effective and ecologically successful voluntary incentive-based wetlands restoration program. WRP provides incentives to farmers and ranchers to stop cultivating areas that were once wetlands and return them to wetlands once again. About 50 wetland projects covering 16,000 acres in Texas have been enrolled in the program during the last three years.

Landowners interested in participating in these programs can get more information in the TPWD *Wetlands Assistance Guide for Landowners*, a comprehensive guide to federal, state and private programs offering technical and financial assistance to private wetland owners within the state of Texas. To receive a copy, send an e-mail to: <jennifer.key@tpwd.state.tx.us>.

Since more than 50 percent of wetlands have been lost in Texas, it's not likely we can completely restore these habitats, but landowners are realizing benefits in water quality and improved wildlife habitat. With continued DU and government support, landowner participation and education, these private wetlands programs have an opportunity to make a significant impact on the future of wildlife and plant communities in the Lone Star State. ★

—Steve Lightfoot

Lawful Loss

In the Houston/Galveston area, a housing boom coupled with weak legal protection has led to an alarming loss of wetlands.

Near the western shore of Galveston Bay, there once was a wetland-splashed expanse of coastal prairie. Wetlands here used to be protected under the federal Clean Water Act.

Today the area is becoming housing subdivisions with names like Mar Bella and Tuscan Lakes. Just these two projects comprise 1,404 acres, where people will live in more than 3,000 homes.

Wetlands are also lost to roads, industry, agriculture and other factors, but this example shows how changing interpretations of regulations and laws affect wetlands protection.

"Before the SWANCC decision, this area was about 3,000 acres of coastal prairie and wetlands, and now it's gone," says Andy Sipocz, a TPWD biologist and wetlands expert. "It had large areas of water on it that flowed into Galveston Bay, deep enough for large gar to swim into. We have 2004 aerial photos of undeveloped prairie there."

Sipocz is talking about the 2001 Supreme Court case "SWANCC vs. U.S. Army Corps of Engineers." This had the effect of removing protection for an estimated 40 percent of previously protected freshwater wetlands on the upper coast, according to the Corps Galveston district. (See also "Redefining Wetlands," July 2003).

Even without the SWANCC interpretation, coastal prairie loss to growth would still happen, but there would be a mitigation requirement to create, restore or protect wetlands.

The crux of the issue is defining which wetlands are considered connected to navigable waterways and are thus regulated under the Clean Water Act, and which are considered isolated and can be filled without a Corps permit. Many observers believe the Corps Galveston district interpreted the SWANCC decision in a way that resulted in less protection for overland "sheet flow" wetlands common on the Texas coast. "If the Galveston district's interpretation was in place in

Florida, most of the Everglades would be considered isolated and subject to filling," says Sipocz.

"The definition of wetlands did not change with the SWANCC decision, but the requirements for how we regulate them did," says Fred Anthamatten, a marine biologist and chief of policy analysis with the Galveston Corps district. "We still do regulate adjacent wetlands. And we can regulate isolated wetlands if there's a connection with interstate commerce. We've been criticized as one of the more conservative districts. We're actually one of the more middle-of-the-road approaches." Even so, no one denies the region is losing wetlands.

According to the Greater Houston Partnership, new housing starts in the Houston-Galveston-Brazoria area for 2003 and 2004 were the highest since 1983. Other data show a corresponding loss of wetlands. In June 2005, Texas Sea Grant issued a report on wetlands loss. It stated "The Lower Galveston Bay watershed lost at least 3.1 percent of its natural freshwater wetlands between 1992 and 2002. Most of the loss occurred in Harris County, which lost at least 13 percent of its natural freshwater wetlands in the same period." Researchers concluded "Rapid development in Galveston, Ft. Bend, and Brazoria Counties suggests losses on a par with Harris County in the next two to five years, and catastrophic losses for



Up to 40 percent of formerly protected wetlands are threatened by development.

the entire area in the next two decades."

Wetlands protection laws could get weaker across the rest of Texas and the nation. Early this year, the U.S. Supreme Court began hearing two cases in which Michigan developers are challenging the Clean Water Act. Some observers believe that more than half of the nation's streams and wetlands could no longer get Clean Water Act protection if the newly remade court sides with developers.

In one case, a developer wanted to sell a wetland for a shopping center and filled it without a permit. In the other, a condominium developer was denied a permit to fill a wetland.

The developers argue that Clean Water Act regulators have overreached by claiming jurisdiction over wetlands far from larger waterways where federal lawmakers have clear authority. ★

— Tom Harvey

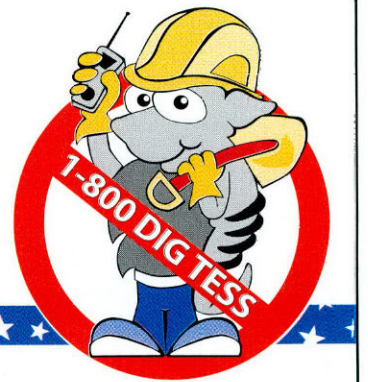
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BY THE NUMBERS / BY BRYAN FRAZIER

GOOSE ISLAND STATE PARK

HARD DATA AND FUN FACTS ABOUT YOUR STATE PARKS

1,620 feet —

the length of the lighted fishing pier that overlooks Goose Island State Park and extends out into the bay.

1,000 years —

the estimated age of the famous "Big Tree" located at Goose Island State Park.

300 —

the number of bird species that can be found in Goose Island State Park and are listed on the park's checklist. The park is also home to some of the best seasonal habitat for observing the famed and endangered whooping crane.

127 campsites

are available for rental inside Goose Island SP, 45 of which are located directly along the waterfront shoreline.

25 —

the number of acres of marshland that will be restored in a cooperative conservation partnership.

1 —

mile is the length of Goose Island shoreline stabilized by a new breakwater that created a 40-acre lagoon and enhanced seagrass habitat.

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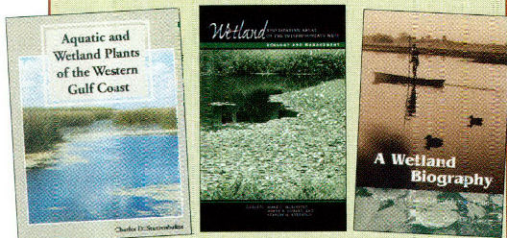
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TEXAS READER

BY CHARLES J. LOHRMANN

Wetlands Lit

How to learn more about the region's diverse ecosystems.



Wetlands are mysterious landscapes, but well-presented information can transform that mystery into understanding and appreciation. For the most essential background about Texas' coastal wetlands, turn to *Aquatic and Wetland Plants of the Western Gulf Coast* (477 pages, distributed by University of Texas Press, \$29.95, softcover). Even though it is printed in black-only, the extensive drawings and photographs, along with concise descriptive text, combine to form an encyclopedic guide to wetlands.

If you're drawn more to the wetlands that appear in the desert and mountain reaches of the West, look for a copy of *Wetland and Riparian Areas of the Intermountain West: Ecology and Management* (335 pages, University of Texas Press, \$39.95, hardcover). As its title states, this book offers insight into the intermountain region that covers parts of 11 western states. Even though Texas is not included in this region, the book presents legal issues, ecology, management approaches and restoration techniques that relate to West Texas. Its academic chapter titles come across like a textbook, but the content is, nonetheless, approachable.

For a fascinating — and probably unexpected — story of the true pirogue-poling, muskrat-skinning Cajuns who make a living in the “strange and exotic” region that stretches from Sabine Lake to Vermilion Bay, read *A Wetland Biography: Seasons on Louisiana's Chenier Plain* (286 pages, University of Texas Press, \$18.95 softcover). A rich mixture of folk history, ecology and biology, this book takes you trapping, fishing and hunting in the long-suffering and still-challenging environment that was hammered by the brutality of the first wave of Hurricane Rita's wrath. ☆

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A close-up portrait of a woman with long, wavy brown hair, wearing a light-colored straw cowboy hat with a silver band and a brown leather jacket over a blue denim shirt. She is smiling slightly and looking off-camera to the right. The background is a solid, bright yellow.

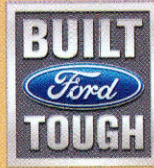
Cracked

three ribs

breaking the wildest horse on the ranch.

Took it like a man.

Better, actually.



BOLD MOVES

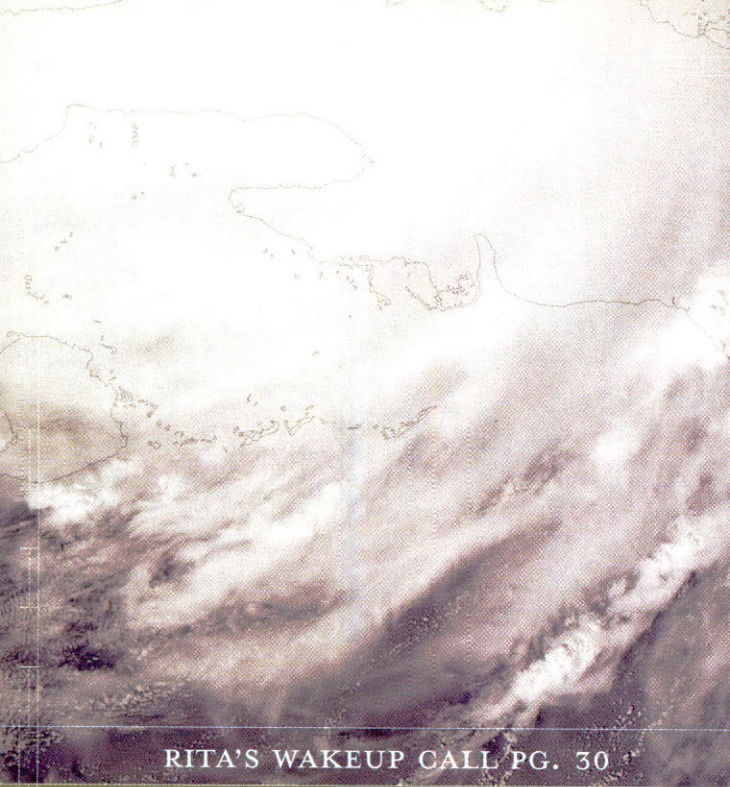
A stiffer frame equals a
smoother ride. Weird, huh?

Let's have a moment of silence for
"rides like a truck."

F-150

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RITA'S WAKEUP CALL PG. 30



PLAYAS IN PERIL PG. 44

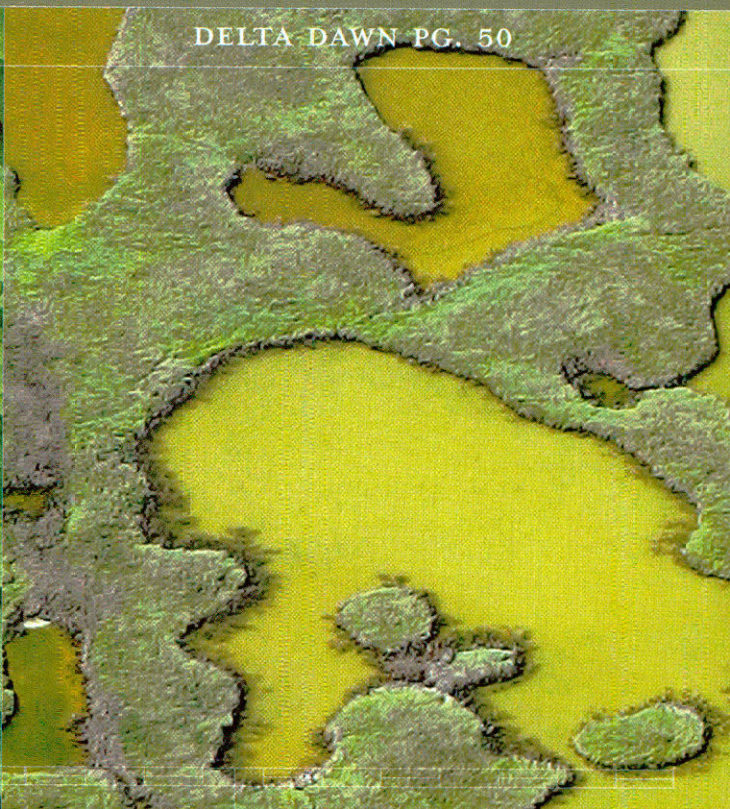
The State of Wetlands

Often maligned as worthless swampland, wetlands are actually an essential factor in the state's water equation.

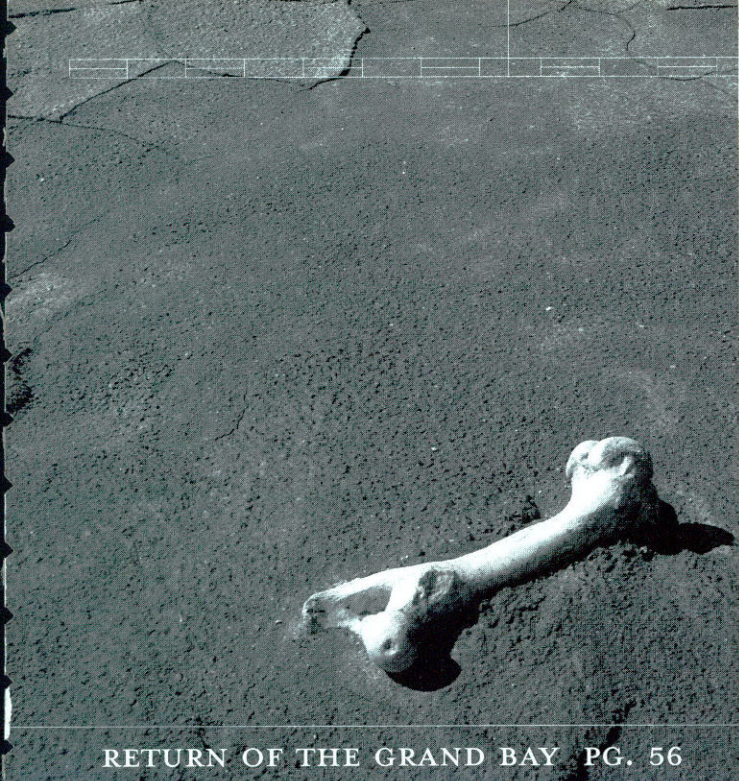
BY LARRY MCKINNEY



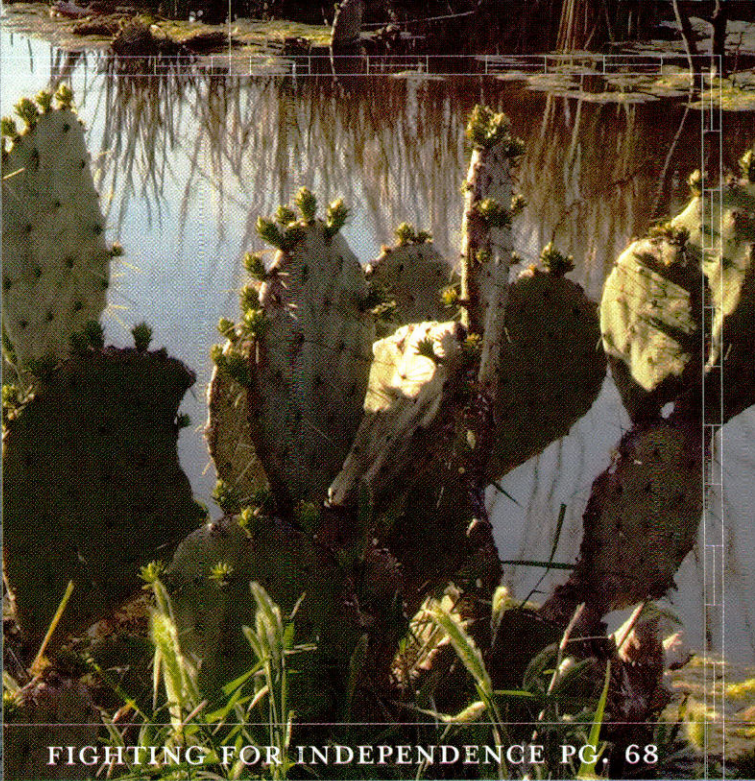
BADLAND BEAUTIES PG. 36



DELTA DAWN PG. 50



RETURN OF THE GRAND BAY PG. 56

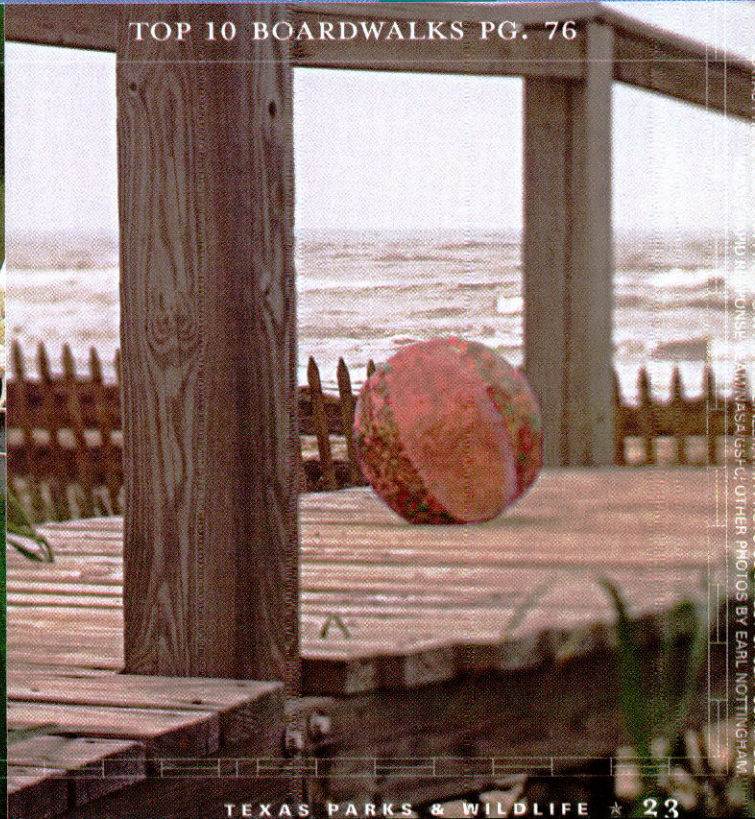


FIGHTING FOR INDEPENDENCE PG. 68

Wetlands are amazing places, biological treasure troves brimming with life. Unfortunately, most people know them only by the gross caricatures presented in TV and film. Movies such as *Swamp Thing* and *The Creature from the Black Lagoon* have portrayed wetlands as places where evil lurks and bizarre creatures emerge from the mud. And then there's the saying that has seeped into popular culture as a way of questioning someone's intelligence: "And if you believe that, I've got some swampland to sell you." I may not be able to single-handedly repair these image problems, but I can at least try to explain why wetlands are such a vital piece of the water puzzle in this state.



WASHING THE WATER PG. 62



TOP 10 BOARDWALKS PG. 76

Bogs, swamps, marshes, mires, fens, sloughs and *cieneegas* are just some of the names for these remarkably diverse and productive habitats that we collectively call "wetlands." Any place you go in Texas you can find wetlands. The deserts of West Texas are no exception. One that anyone can see, both above the surface and below through a special viewing port, is the desert *cienega* at Balmorhea State Park. It was created to show visitors what few people otherwise would have a chance to see — desert wetlands — which are mostly hidden in that vast and arid landscape. Historically, the knowledge of where to find them meant life or death for the traveler. While the stakes may not seem as high today, in fact, they're higher than they've ever been. The alarming pace at which we are losing our wetlands is a direct threat to us all. Fortunately, private landowners, government and nongovernmental conservation organizations increasingly share a common goal, each valuing these gems in their own way, but with a common aim of conservation. It is not an easy task, with competing demands for the water that sustains them and the lands they occupy.

Far across the state from Balmorhea, on the northernmost border of Texas and Louisiana, lies one of the truly spectacular wetlands in our state, Caddo Lake State Park. This maze of sloughs, bayous and cypress trees is a wetland such as many would imagine existed in the time of

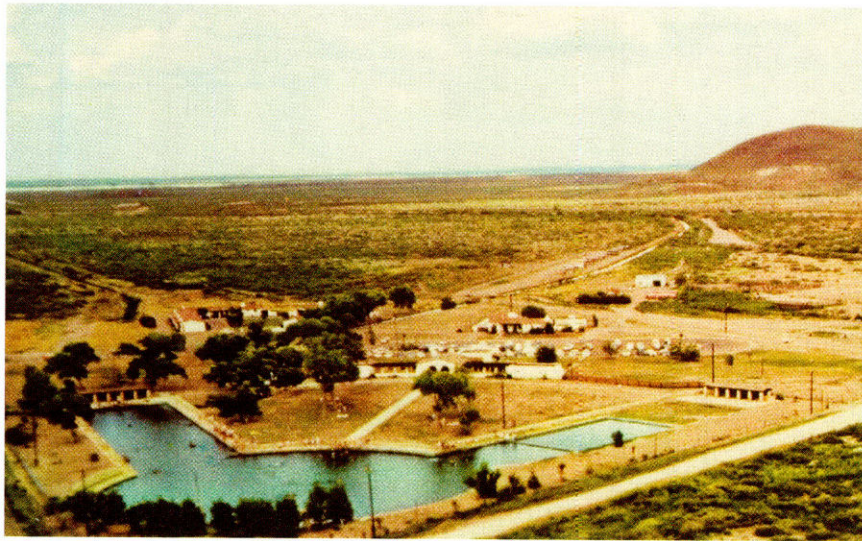
dinosaurs. Early morning and late evening are the times that best show its timeless beauty and mystery. The croaky call of a startled great blue heron, the rising song of frogs and the swirling ripple of a submerging alligator punctuate still and mirrored waters. To really appreciate it you have to climb into a canoe or onto a kayak and paddle the well-marked trails. And believe me, you want to stay on the trails, and you do not want to fall out of the boat!

The playa lakes of the Panhandle, the hardwood bottomlands of East Texas, the *resacas* of South Texas and the prairie pot-holes of the coastal plains are just some of the more recognized wetlands habitats that fill in between the extremes of deep East Texas and far West Texas. All have unique features, as expressed in their diversity of vegetation, but they all have a common characteristic as well: water. Okay, it is no great leap of intuition that wetlands require water. It is how that water is expressed, however, that dictates the form and function of any wetland. Because of that direct link, wetlands are the first landform to feel the diversion of water from the river and the estuary, the depletion of groundwater feeding the spring and the inundation of bottomlands for new reservoirs. We must assure that water for the environment is part of the water equation. Just as municipal, industrial and agricultural water needs must be considered as we allocate this limited resource to various uses, we must

never forget that our rivers, lakes, bays and the wetlands associated with them need water as well.

Every part of our state has one or more kind of wetland, and our system of state parks and wildlife management areas is often the most accessible means of seeing them and learning about them. The value of wetlands, or, more aptly, the lack of our ability to fully appreciate their value, is the crux of the problem. Nationwide and in Texas, we have lost 50 percent, or even more, of these valuable resources.

How valuable are wetlands? The deadly impact of Hurricane Katrina illustrates one of those values — flood control. Louisiana is a true wetland state, as some 28 percent of its land mass is defined as a wetland. Louisiana also has seen some of the greatest loss of wetlands over the years, a rate of 29 square miles a year. A number of experts have stated that the storm surge that inundated so much of southern Louisiana would have been much lower if historic wetlands had been in place. One estimate is that for every 2.7 miles of wetlands it must cross, a storm surge can be reduced by as much as two feet. How much damage would have been mitigated by a lower surge from Katrina, or Rita for that matter? Would the levees in New Orleans have failed? No one really knows, but there is no doubt that intact wetlands would have saved billions in damage and countless lives. (Continued on next page)



THE DESERT CIENEGA AT BALMORHEA STATE PARK WAS CREATED TO SHOW VISITORS WHAT FEW PEOPLE OTHERWISE HAVE A CHANCE TO SEE — DESERT WETLANDS — WHICH ARE MOSTLY HIDDEN IN THAT VAST AND ARID LANDSCAPE.



NATIONWIDE AND IN TEXAS, WE
HAVE LOST 50 PERCENT, OR EVEN
MORE, OF THESE VALUABLE
RESOURCES.

PHOTO BY EARL NOTTINGHAM



ON THE NORTHERNMOST BORDER
OF TEXAS AND LOUISIANA LIES
ONE OF THE TRULY SPECTACULAR
WETLANDS IN OUR STATE,
CADDO LAKE STATE PARK.



REDFISH, SPOTTED SEA TROUT, CRABS AND SHRIMP ARE JUST SOME OF THE SPECIES THAT DEPEND UPON COASTAL WETLANDS AT KEY STAGES OF THEIR LIFE CYCLE.

The values of wetlands are as numerous as the names by which we know them. In addition to flood control, wetlands also store and recycle nutrients; treat and recycle human waste; recharge groundwater; provide a buffer for salinity changes; control erosion; protect water quality; help stabilize ecosystems and climate and, act as a nursery habitat and refuge for countless birds and aquatic organisms. While many of these values may be a surprise, most of us recognize how important wetland habitats are to fish and wildlife. Redfish, spotted sea trout, crabs and shrimp are just some of the species that depend upon coastal wetlands at key stages of their life cycle. Waterfowl, wading birds and many shorebirds find refuge, nesting and feeding habitat in almost every type of wetland.

The economic impact of hunting, fishing and wildlife viewing has been estimated at \$10.9 billion per year in Texas. Wetlands and their ecological functions are key to sustaining these recreational values and the economic returns they represent. Such benefits are collectively recognized as “direct” and can most easily be measured as pounds of seafood produced or in terms of recreational expenditures by anglers or birdwatchers. Indirect values are another matter. Perhaps the greatest values of wetlands to the greatest number of us are the mostly unrecognized direct values of flood control and water treatment. Most of us are not aware that many of our wetlands are an integral part of every major city’s waste-

water treatment system.

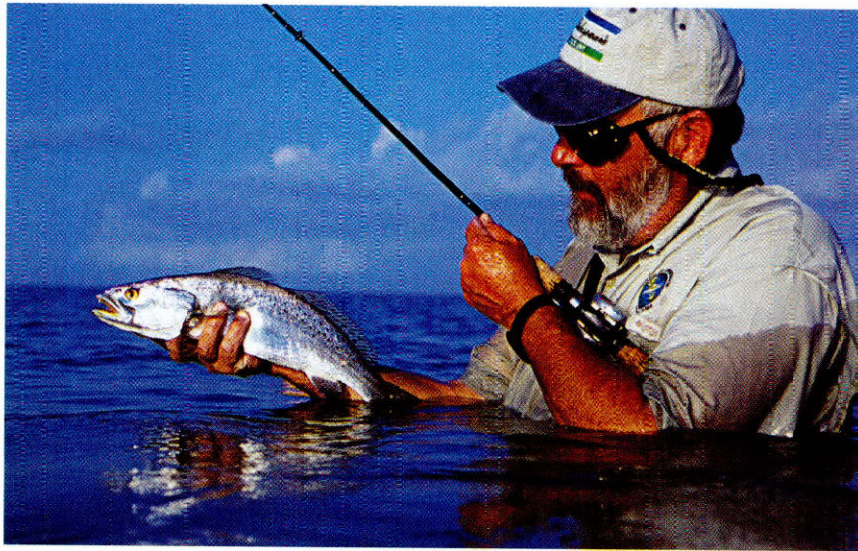
Functioning wetlands provide much of the tertiary treatment, that final and necessary step in cleaning up water quality. That step is necessary before the water can be reused by others downstream or before we can eat the seafood our wastewater discharges eventually wash over. Wetlands, healthy and functioning, serve that role. Natural processing saves us millions of dollars annually in treatment costs. Wetlands are the reason many of our rivers and much of our coastline have not been closed to fishing, swimming and recreational use. The artificial wetlands in the Richland Creek Wildlife Management Area exemplify this function as nowhere else in Texas, or maybe anywhere, period. Here wetlands have been created by diverting Trinity River water into the area and through constructed wetlands to create waterfowl habitat while naturally treating that water to meet municipal water needs as it comes out the other end. It has saved the cost of constructing an additional reservoir and created recreational opportunities — everyone wins.

Indirect values of wetlands are not so easily defined but may be of even greater importance. How important is it to save wetlands for the future? Most of us have a strong desire to make sure that future generations of Texans have at least some of what we have come to enjoy. Wetlands are some of our most threatened habitats. As a society we will have to make some difficult

calls in the future, and how we value wetlands in the context of other uses for them will be important. If we cannot express that value, termed “bequest value” by economists, in a meaningful way we can expect significant losses to continue.

Another form of indirect value is related to maintaining future options. It is always a wise course to keep options open as long as possible, especially when it is difficult or impossible to reverse your decision. Once you destroy many types of wetlands there is no way to restore them. Bequest values and options values are the indirect values so difficult, perhaps impossible, to quantify when assessing wetlands in the light of their conversion to other uses. The one thing we do know is that when they are gone, they are priceless.

Some have tried to define both direct and indirect wetland values in economic terms as a means of better understanding and appreciating them. The collective term “ecosystem services” has been used to summarize these values. One set of estimates calculated that value at \$1,200 to \$5,000 per acre, considerably more than some of the best farmland. I am sure that number raises some eyebrows. The reason is that most of us can visualize how the value of an acre of farmland would benefit us if we owned it. That is not the case when the benefits are something as hazy as ecosystem services. We all benefit from these services in both direct and indirect ways, common benefits to society as a whole.



THE ECONOMIC IMPACT OF HUNTING, FISHING AND WILDLIFE VIEWING HAS BEEN ESTIMATED AT \$10.9 BILLION PER YEAR IN TEXAS.

A commons in the old English sense was a piece of property, usually a pasture, that was held or owned by all in the community and that could be used by any and all. The commons provided a valuable service to the whole, but because it belonged to no one, and everyone, commons were often abused. It was such a frequent outcome that a parable arose around it and came to be known as the “tragedy of the commons.” As implied in the allegory, those things that we hold in common most often suffer in contrast to those that we hold individually. Wetlands are our modern commons, and we seem to be repeating the past in our

treatment of them.

The Texas commons now equals about 7 million acres of wetlands. We once had some 16 million acres. The hardwood bottomlands of East Texas, nearly all of which are associated with the major river systems of that region, comprise 84 percent (5,973,000 acres) of that total and coastal marsh about nine percent. The remainder is distributed between all of the remaining wetland types. In reaching our current population and level of economic development, we have destroyed some 56 percent of our original wetland commons. We will double our present population in fewer

than 30 years. We simply cannot absorb the ecological and economic consequences of treating our wetlands as we have done in the past. We have consumed half of our wetland resources to reach our current population. We cannot use up the remaining half as we double the number of people in Texas. It is the tragedy of the commons writ large and across our entire state.

Fortunately, we do not have to go down that path, and many are working to avert it. The rate of loss has slowed somewhat over the last several years but continues at a rate of around 58,500 acres per year nationally. The good news is that the current rate of

BRIEF HISTORY OF U.S. WETLANDS

1650 1750 1900 1970s

TEN YEARS AGO, Ted Williams wrote a story for *Audubon* magazine, “What Good is a Wetland?” He described the change from society’s myths that wetlands are dark, festering swamps, that they are breeding grounds for disease-bearing mosquitoes, pests and disease, and that we would be better off if they were all sucked dry.

When Europeans colonized the U.S., the land teemed with wildlife and wilderness, including vast expanses of prairie potholes, coastal marsh and bottomland hardwood forests — all forms of wetlands. The lower 48 had more than 221 million acres of wetlands, with an additional 230 million in Alaska and Hawaii. While many reflect

on the loss of wilderness, beauty, biodiversity, habitat and ecological functions wetlands provide, they were not always so revered. Fears of disease, pests and fearsome swamp beasts inspired a rush to drain, fill and suck them dry.

In the **18th century**, William Byrd called the “Dismal Swamp” in Virginia and North Carolina “a horrible

desert [where] the foul damps ascend without ceasing, corrupt the air and render it unfit for respiration.” The U.S. Supreme Court dubbed wetlands the cause of malarial and malignant fevers in the **20th century** and said, “The police power is never more legitimately exercised than in removing such nuisances.” The Swamp Lands Acts

gave 65 million acres of federal land to states with the caveat that they drain them.

The heyday of environmentalism in the **1970s** saw the passage of the Clean Water Act, the Clean Air Act and the Endangered Species Act, and helped shift views of swamps, bogs, sloughs and marshes from dank, musty places

demanding drainage to wetlands with inherent functional value for enhancing water quality and providing wildlife habitat.

Many attribute the societal sea change to Rachel Carson’s book, *Silent Spring*, widely heralded as the impetus behind these laws. The book foresaw a silent spring, when no bird or frog or cicada



CHALLENGES REMAIN, AND TIME IS SHORT FOR ALL OF US TRULY TO COME TO REALIZE THE VALUE OF OUR TEXAS WETLANDS.

wetlands loss is almost five times slower than it was 30 years ago. Wetlands restoration of at least some types of wetlands, like coastal salt marshes, is relatively easily accomplished now. Over the last 11 years, TPWD and an impressive array of state and federal resource agencies, nongovernmental conservation organizations, businesses and individuals have partnered to restore more than 11,000 acres of wetlands, much of it in Galveston Bay, where past loss has been dramatic. TPWD, the United States Fish and Wildlife Service, the Natural Resources Conservation Service (U.S. Dept. of Agriculture) and

Ducks Unlimited have underwritten the Texas Prairie Wetlands Project to assist private landowners in wetlands conservation. More than 27,000 acres of wetlands have been restored and technical assistance provided on more than 400,000 additional acres. There are many such restoration opportunities, and two good sources for more information about them are your local TPWD biologist and the TPWD Web site: <www.tpwd.state.tx.us/>. If you really want to get your hands dirty, you can do that as well. The Galveston Bay Foundation sponsors an event called Marsh Mania, in which you can go out and actually help

restore wetlands by planting marsh plants in a restoration site.

Challenges remain, and time is short for all of us truly to come to realize the value of our Texas wetlands. We all have a stake in their conservation. The ecological and economic health of Texas depends upon it. While we have lost much, what remains continues to serve us well. Our goal should be to save what we have and restore what we can. We have the knowledge, skills and tools to accomplish that end. We are certainly capable of doing so, and if successful, we can leave a wonderful gift for those who come after us. ★

1972

1977

1990s

2006

would sing, if the nation continued in the same direction. Congress enacted the Clean Water Act of 1972 to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." Defining the nation's waters has proven a bit trickier. Did it or did it not include wetlands? The law charged the Army Corps of

Engineers with regulation and permitting. The Corps opted to regulate only traditionally navigable waterways, but a federal court ordered them to follow "Congressional Intent." In response, in 1977 the Corps explicitly included, "isolated wetlands and lakes, intermittent streams, prairie potholes, and other waters that are not

part of a tributary system to interstate waters or to navigable waters of the United States, the degradation or destruction of which could affect interstate commerce." According to the EPA, "The definition promulgated in 1977 is substantially the same as the one in effect today." In practice, a tangled mire of court cases and con-

tradictory regulations coming out of different Corps Districts with no clear national guidance has led to a sort of Wild West for wetlands. Why did the Clean Water Act even address wetlands? Two reasons. Hydrologically, through surface runoff or other connections, wetlands connect to other waterways. And the

scientific data are indisputable: Wetlands clean water. A wetland can take rainwater runoff coming from major metropolitan areas and, within a matter of days, neutralize chemicals and nutrients through microbial processes. Wetlands clean water so well that a handful of innovators figured out how to

harness their power by engineering them for specific purposes. Constructed wetlands have been used to detoxify effluent from paper mills, mines, refineries, urban storm runoff, sewage and municipal gray water — to name a few (see also "Washing the Water," page 62). ★
— Wendee Holtcamp

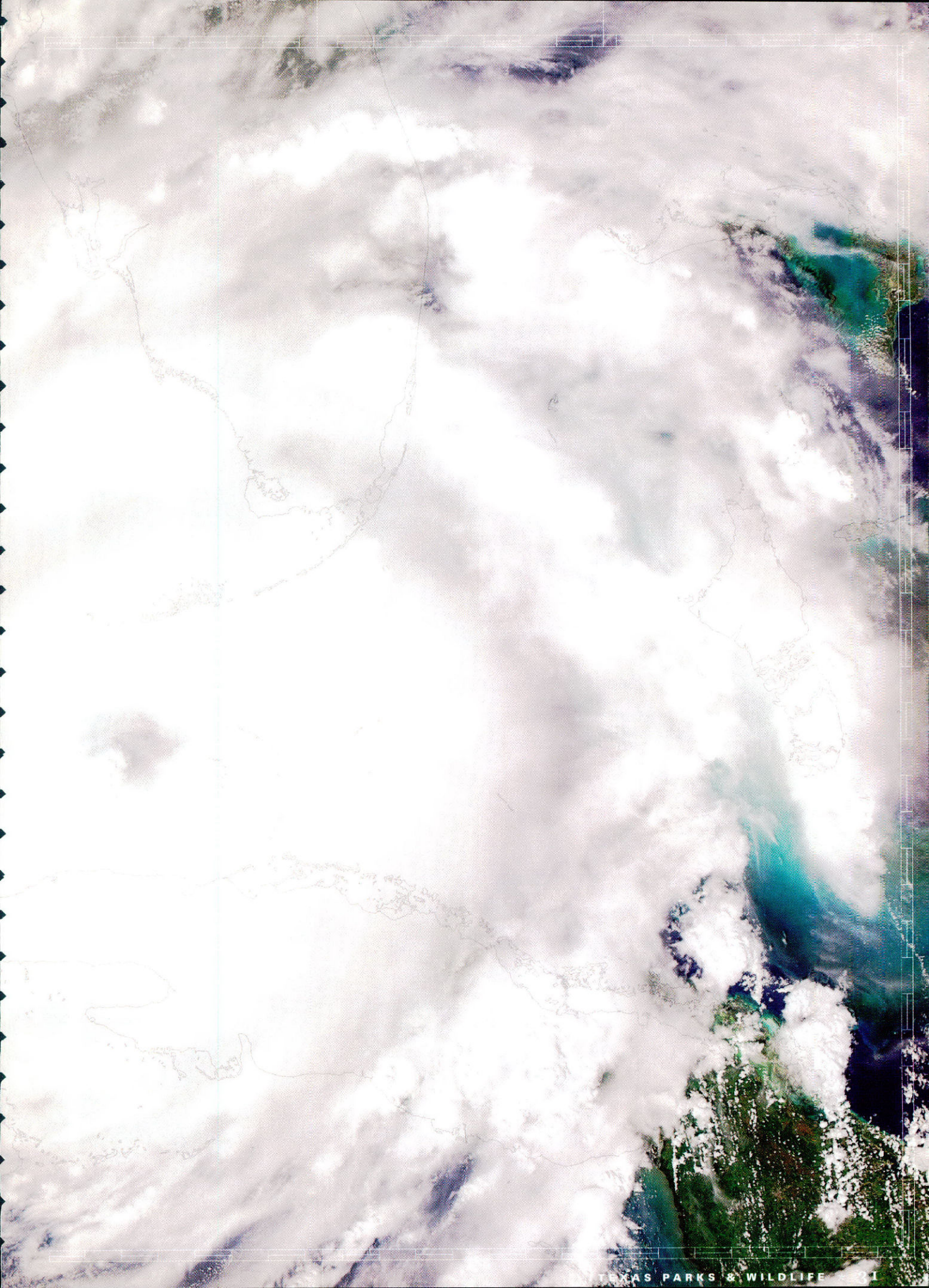
An aerial satellite-style photograph of a massive hurricane, Hurricane Rita, over the Gulf of Mexico. The storm's eye is visible on the right side, surrounded by dense, swirling clouds. The coastline of Texas is visible at the bottom left, showing the Gulf of Mexico and the coastline. The overall color palette is dominated by dark blues, greys, and whites from the clouds, with a touch of green and brown from the land.

Rita's Wakeup Call

*While the hurricane carved
a path of destruction, it also
helped shine a spotlight on
a more insidious problem —
human impact on wetlands.*

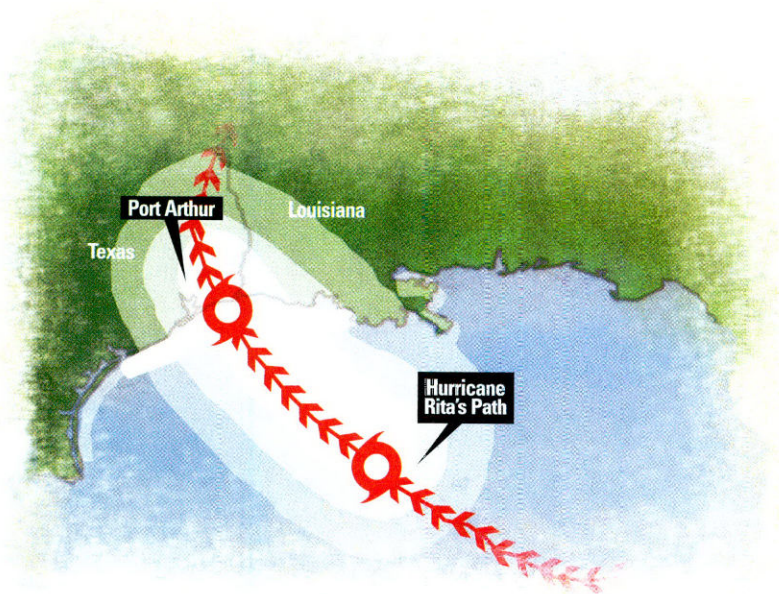
BY JOE NICK PATOSKI

HURRICANE RITA,
THE FOURTH MOST INTENSE
ATLANTIC HURRICANE EVER
RECORDED, BLASTED INTO TEXAS
ON SEPTEMBER 24, 2005. THE
STORM CAUSED \$10 BILLION IN
DAMAGE ON THE GULF COAST.





Six months after the fact, Hurricane Rita still weighed heavy on the minds of everyone, including the four biologists gathered around a table in the offices of the J.D. Murphree Wildlife Management Area on the outskirts of Port Arthur. Most of the storm debris had been cleaned up, save for snapped trees and twisted sheets of metal shimmering in a meadow. But a lot of cleanup work remained.



So Jim Sutherlin, the Upper Coast Wetlands Ecosystems Project leader for the Texas Parks and Wildlife Department, called in three wildlife biologists, Andrew Peters, Tucker Slack and Amos Cooper, to strategize about their presentation to the National Fish and Wildlife Foundation. The foundation was awarding matching grants for cleanup after hurricanes Katrina and Rita, and the men around the table wanted to steer some money to the upper coast state wildlife management areas they were charged with overseeing — the J.D. Murphree WMA, the Lower Neches WMA and the Tony Houseman WMA in Orange County, and the Atkinson Island and Candy Abshier WMAs on Galveston Bay.

The wish list to repair terraces, wave fences, levees and sills compromised by Rita totaled a cool \$1 million. Hustling

funds is a major aspect of hurricane cleanup, one quickly learns while sitting at the table. For better or worse, Hurricane Rita transformed all the upper coast wildlife management areas into laboratories. No one is exactly sure what the impact was, or what it will be, although the biologists have a pretty good idea what needs to be done. But without money, not much can be accomplished. Two other revelations come with listening to the men plan their presentation. One, there's a lot more to wetlands management than cleaning up after a hurricane. Second, considering that all four men at the table are educated to know the biological impact of the ongoing destruction of the wetlands they are charged with

into the sea in both Louisiana and Texas, as we fuss and fight about other matters.

In many respects, Hurricane Rita let Southeast Texas off easy. With sustained winds of 124 mph for four hours and gusts up to 170 mph in Port Arthur, Rita blew ashore a few miles east of Port Arthur and the state line as a Category 3 hurricane on September 24, 2005. Houses and commercial structures lost roofs, trees snapped and were uprooted, and all sorts of stuff was either blown down or blown away. More than \$2 billion in damage was done on the Texas side of the line.

Texas' coastal wetlands suffered moderate damage from erosion and saltwater intrusion, mainly because the marsh was fairly healthy and the plant community in

been so fortunate. The storm surge east of the hurricane's eye flooded dozens of communities and erased one coastal village entirely off the map. Several decades' worth of erosion was done in a single day. According to one U.S. Geological Survey estimate, 100 square miles of Louisiana marsh became open water after Rita.

"We were extremely fortunate to be hit square by the hurricane and not on the eastern side of the eye," Jim Sutherlin says. "That tidal surge rolled up marshes [in Louisiana] like a rug. Holly Beach is gone."

Farther inland in southeast Texas, Rita left behind a wide swath of fallen timber, 400,000 acres of pine and hardwoods damaged or destroyed, according to the



TEXAS' COASTAL WETLANDS SUFFERED MODERATE DAMAGE FROM EROSION AND SALTWATER INTRUSION, MAINLY BECAUSE THE MARSH WAS FAIRLY HEALTHY AND THE PLANT COMMUNITY IN GOOD SHAPE BEFORE RITA WENT IN.

stewarding, it takes a hardnosed cuss to tackle the task. Small wonder all the vehicles on the premises had bumper stickers that read "No Wetlands, No Wildlife."

Wetlands are neither pretty nor inviting, unless you happen to be a biologist, a duck hunter, a fisherman, a birder or just real different. Wetlands are squishy and buggy and emit foul smells and are inhabited by alligators, snakes and who knows what else. They register zero impact as a political cause, although Hurricane Katrina certainly raised awareness of how more wetlands instead of concrete could have prevented the New Orleans levees from breaking. Instead, coastal wetlands are crumbling

good shape before Rita went in. High winds from the north pushed up to four feet of water into some marshes and caused major die-offs and more erosion, which are familiar conditions on the upper Texas coast. "We get blackwater conditions with floods," Sutherlin explained. "There's a whole lot of dying going on. Alligators get a smorgasbord. Water stands on the prairie, turns to black tea, plants die and fish are killed."

"We had fish kills all the way up to the I-10 bridge," Andrew Peters says. "It stunk bad." Erosion, seemingly a permanent condition on the upper coast, simply accelerated.

Southwestern Louisiana should have

Texas Forest Service, causing losses estimated at nearly \$1 billion. Much of that timber has been left as is because it is too inaccessible to log out. The remaining deadwood portends something even more ominous. "We expect one of the biggest blooms of bugs we've ever seen in our lifetime," Sutherlin surmises. "Whether we see an increase in birds showing up to feast on those bugs is something we don't know yet. The woodpecker numbers might come up. Or maybe they won't. The bloom may be real pretty beetles that don't bother anything or it might be termites. Will it be this spring, or a couple years down the road? We shall see."

By the time all the hurricane stories had been told, it was clear that Hurricane Rita's biggest impact as far as wetlands go had been to pour salt into an old wound, making more stressful an already stressed situation. Compared to the long-term effects the development of land and the canalization of water were having on wetlands, Rita was a minor irritant.

"The threat to wetlands in Texas and Louisiana comes from changes we're making on land and water surfaces," Sutherlin says. "We're suffering considerable land loss and secondary loss from hydrological changes. Some areas already suffering from erosion were opened up. Windblown flats got bigger."

The waterways engineered to facilitate

"The Sabine waterway is an even bigger piece of the puzzle," he says of the shipping channel that cuts through the Lower Neches WMA. In some cases, the waterways allow saltwater intrusion into freshwater marshes, and in other cases, the waterways prevent freshwater flow into salt water. Both situations impact soil and the plant community. "The largest piece of contiguous loss of wetlands in Texas is in Orange County, and it's associated with the Sabine-Neches Waterway," Sutherlin says.

"We recognize we need to stabilize the banks. The Texas Parks and Wildlife Department owns seven and a half miles of canal banks. All that should be rocked in."

Other factors are at work. The coastal wetlands of the upper coast are part of the

while Louisiana officials are working on ways to slow, stop or reverse the loss, Texas is still in denial. Despite wetlands' role as a sponge and filter for the dominant life forces on the coast, their decline, regarded as politically insignificant, continues unabated. "We have the same issues here in Orange and Jefferson counties as they do in Louisiana," Sutherlin says. "But they're not recognized except by folks who study and work around wetlands and hunting and fishing interests. Texas is 15 years behind Louisiana in what wetlands mean politically. Direct coastal erosion, wetland loss through subsidence and saltwater intrusion, sea level rise — it all goes back to carbon and water. Those wetlands issues are here with or without hurri-



"THE THREAT TO WETLANDS IN TEXAS AND LOUISIANA COMES FROM CHANGES WE'RE MAKING ON LAND AND WA

shipping are perhaps the biggest culprits. The Gulf Intracoastal Waterway (GIWW), an inland channel cut through marshes and wetlands along the coasts of both Texas and Louisiana for barge traffic, bisects the J.D. Murphree WMA, which at 24,250 acres is the largest state wildlife management area on the upper coast. The waterway was designed with a surface width of 150 feet, a depth of 12 feet, and an easement of 75 feet on both sides. Slow but steady erosion from wave action has expanded that easement anywhere from 540 feet to 740 feet from Sabine Pass to Galveston Bay. "We need to recognize the threat from the change of hydrology and stabilize the canal banks," says Sutherlin.

Chenier Plain, which sprawls from the heart of Cajun Country in southwest Louisiana to near the eastern shore of Galveston Bay. The part of the plain in Texas is fragmenting as land once used for rice farming, which relied on wetlands, has been developed or converted to cattle ranching, which promotes draining of wetlands. No laws exist in Texas to protect wetlands much less regulate development near or on them, nor is there any public demand to do so.

The good news is wetlands loss in Texas hardly compares to Louisiana, which is the fastest-disappearing land mass on earth, amounting to about 29 square miles a year over the past 50 years. The bad news is,

canes."

Texas does have a coastal erosion program for the protection of highways and developments, but not one for open space.

"We've got a lot of long-term issues about wetlands health and wetlands sustainability," Sutherlin said. "Rita was a wakeup call. But if Rita hit here like she did in Louisiana, we wouldn't be meeting here having this discussion."

Amos Cooper hitched a trailered john boat to a pickup to drive Tucker Slack and me for a look-see at storm damage. On the road to Sabine Pass, debris from the storm still piled up against the base of the tree line west of the highway.

We launched the boat and headed down

ALL PHOTOS ON THE SPREAD © JIM OLIVE

the GIWW. At the intersection of the big canal and another small waterway cut to the north, Taylor's Bayou outfall, Slack showed the erosive effects. "This little point here went out another 15 feet before Rita. It would've happened eventually," he said, pointing to the bank erosion caused by wave action when barges and even small boats passed by. "But the storm did it all at once."

Levees were constructed with dredge spoil along the banks of the waterway in 1958 as a means of slowing erosion. Maintenance has been an issue ever since. "These levees are breached to the point there's a separate ditch forming behind them," Amos Cooper said. "It won't be here next year. It'll be a shallow

lion we could spend it. What money we do have, we try to spend it where it counts."

"This is where we saw a lot of disturbances," Slack said as we motored up Magnolia Cut to two concrete water control devices on opposite banks. "The land has been undercut. The bank washed out from under it so that the integrity of the levee has been compromised. It limits how you can hold water. These have to be replaced. The levees need to be redressed with mats to protect the banks from the wave action." The cost: \$115,000 per device. Ka-ching!

Back at headquarters, Mike Rezsutek, the wetlands ecologist in charge of wetlands restoration for the upper coast, offered a glint of optimism when he

the elevation in what used to be wetlands with dredge material, and flood it into open water. In the Atachafalaya basin in Louisiana, they're breaching levees to bring in sediment.

"We did that at Bessie Heights in the Lower Neches WMA in 2003 when 690,000 cubic yards of dredge material were put into the marsh restoration. Since our restoration began at Bessie Heights, you wouldn't believe the number of people trolling for redfish back and forth in front of the levees. It's estimated that 6 to 7 million cubic yards of material are needed to get the marsh completely back. But it's a start."

I left Port Arthur satisfied that Rita might have put the hurt on the upper



SURFACES. WE'RE SUFFERING CONSIDERABLE LAND LOSS AND SECONDARY LOSS FROM HYDROLOGICAL CHANGES."

shoal." And what's left of the marsh will become even saltier.

Cooper crossed the canal to the south bank, where we inspected a concrete slab with rollers that small boats could use to go up and over the small levee and access Salt Bayou Marsh. The slab and rollers are solid. The soil underneath the slab had washed away. "We lose two acres of Salt Bayou a year," Slack said. "This year, with Rita, we lost four acres."

Back in the boat, Cooper pointed to levees covered with rocks. "The feds [at the neighboring McFaddin National Wildlife Refuge] have rocks on both sides [of the channel]," he said. "We don't have the money to do that. If we had \$20 mil-

detailed the creation of the 90-acre Tom Jackson Restoration Wetland in the Lower Neches WMA by the Army Corps of Engineers. The Corps created this beneficial use project as part of maintenance dredging of the Sabine-Neches waterway (something like 10,000 acres have been lost due to the waterway). It was a sure sign that humans can be a positive force for wetlands. "Our wetlands are declining, and we know how fast," Rezsutek said. "Unless corrective measures are taken, we will continue to lose wetlands."

Rezsutek knows what has to be done. "The first thing we should be doing is stop the loss. The second is to remove the stresses. Otherwise, you have to increase

coast, but the wetlands worked pretty much like they were supposed to. The hurt my fellow humans are putting on wetlands is something else. The hard-nosed Texas Parks and Wildlife Department personnel I met may not be enough to turn back the tide of wetlands destruction. It's the other folks who "get" wetlands, like hunters, anglers, birders and outdoors enthusiasts, who hold the key to saving and restoring this important resource. If these wetlands advocates can help spread the word to the rest of the population about the economic and ecological value of wetlands, there's reason to have hope, even after a tempestuous gal named Rita came to visit. ☆



Badland

PHOTO BY EARL NOTTINGHAM



Beauties

Rare flora and fauna hang on for dear life in the hidden wetlands of West Texas.

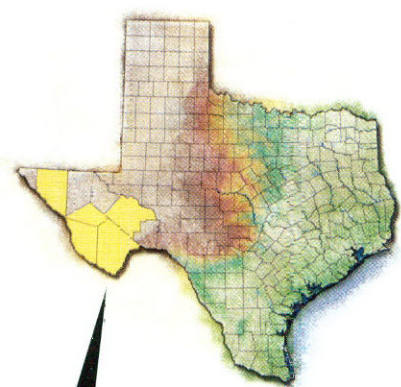
BY E. DAN KLEPPER

THE TRANS-PECOS FEATURES A VARIETY OF WETLAND ENVIRONMENTS DUE TO THE EXTREME ELEVATIONS IN THE REGION — FROM LOW DESERT TO HIGH MOUNTAINS — INCLUDING PLAYAS, CIENEGAS, EPHEMERAL STREAMS, MARSHES, WET DEPRESSIONS AND VERNAL POOLS.

PHOTO © WANNAN HEINZEL



It isn't difficult to understand why some ancient desert cultures appropriated the snake as their symbol for both lightning and water. Lightning, like the snake, strikes fast and deadly, yet its arrival in a desert also signals rain — a factor that often determines life or death in an arid world. The early Papago (now known as Tohono O'odham) of the southwestern desert placed their faith in the *corúas*, or serpent gods, which protected the desert's water. Every water source had its own *corúa* replete with killer fangs to deter abuse. But should the serpent die, claimed the Papago, its protectorate would evaporate.



The Trans-Pecos wetlands inhabit a region comprised of several vast counties, including (but not limited to) Hudspeth, Presidio, Brewster, Jeff Davis and Pecos

Texas' own arid land, the vast swath of Chihuahuan Desert that embraces the western elbow of the state known as the Trans-Pecos, has harbored its share of serpents, lightning and a good deal of water as well. The cataclysm that formed the West Texas geography turned seabeds, coral reefs and volcanic eruptions into eroding mountain ranges, deep canyons and broad grass-covered basins. For thousands of years this topography conserved the paucity of rainfall that fell upon it. The land captured the rain within layers of mulch that filled the grassy basins where water percolated slowly down to replenish the water table and revitalize springs. Rainwater collected in reservoirs of canyon *tinajas* and settled into the pockets of the desert's subterranean. It saturated flat gravel beds along the desert's surface and spread across the arid skin in green wetlands before it disappeared back into the ground.

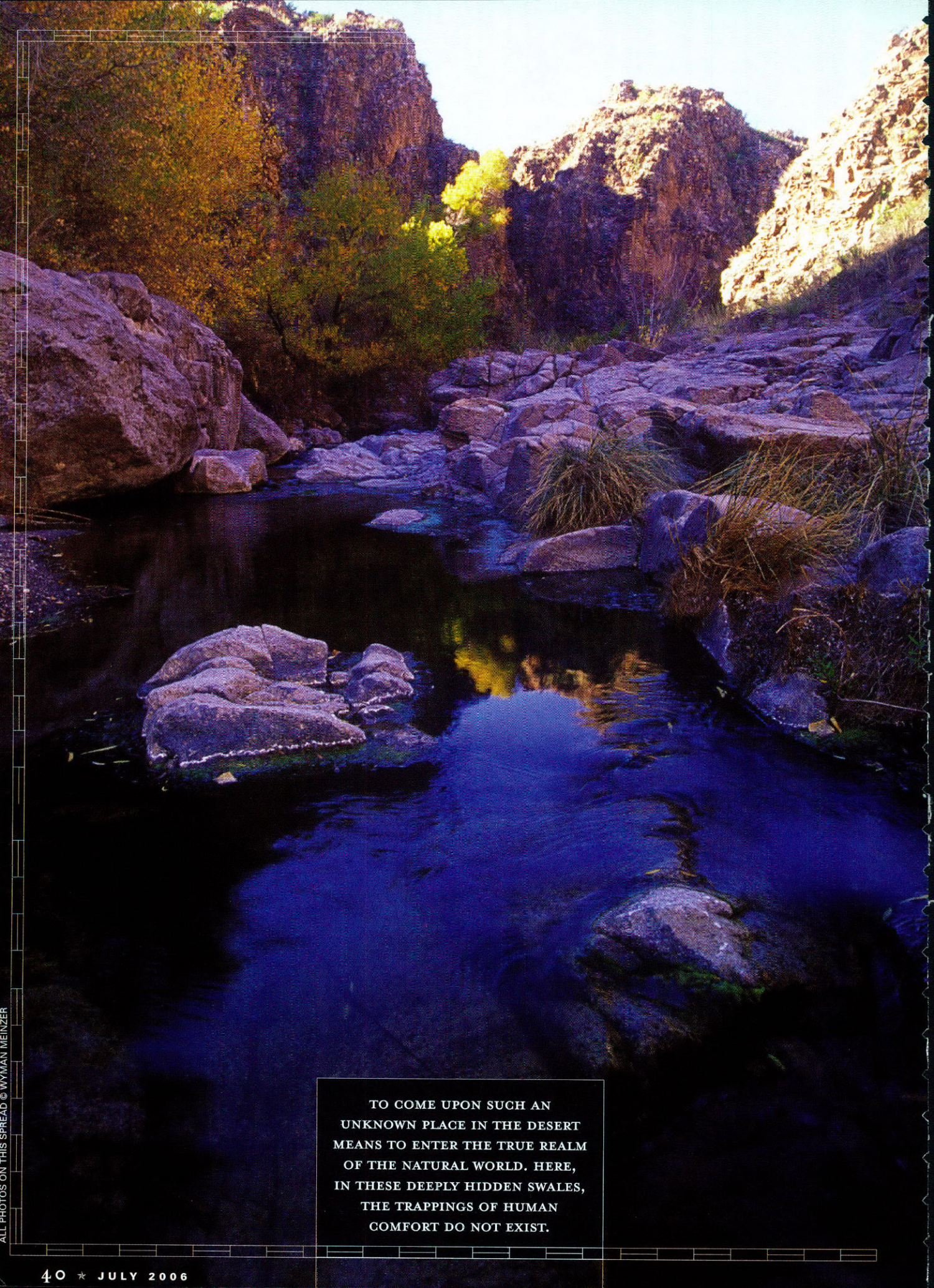
The Trans-Pecos features a variety of

wetland environments due to the extreme elevations in the region — from low desert to high mountains — including playas, cienegas, ephemeral streams, marshes, wet depressions and vernal pools. Perhaps the most unique is the hanging garden, which occurs along the seeps and springs of desert canyon walls. These microhabitats form without a significant amount of soil and can be found along cracks and pockets in the rock face where disturbance from flooding is minimal. Seep-line and wet-wall gardens, protected from sun and wind by canyon shadow, can support algae, bacteria and delicate yet drought-tolerant vegetation such as the venus-hair fern.

The venus-hair, *Adiantum capillus-veneris* (*capillus* refers to hair and *veneris* to Venus), is the only maidenhair fern species to occur in the Trans-Pecos and can often be found in abundance along hanging garden habitats. Considered medicinal for centuries, used primarily for hair and scalp prob-



THE CATAclySM THAT FORMED
THE WEST TEXAS GEOGRAPHY
TURNED SEABEDS, CORAL REEFS
AND VOLCANIC ERUPTIONS INTO
ERODING MOUNTAIN RANGES,
DEEP CANYONS AND BROAD
GRASS-COVERED BASINS.



ALL PHOTOS ON THIS SPREAD © WYMAN MEINZER

TO COME UPON SUCH AN
UNKNOWN PLACE IN THE DESERT
MEANS TO ENTER THE TRUE REALM
OF THE NATURAL WORLD. HERE,
IN THESE DEEPLY HIDDEN SWALES,
THE TRAPPINGS OF HUMAN
COMFORT DO NOT EXIST.

lems, the venushair is instantly recognizable for its diamond-shaped pinnules that comprise its fronds. The fern also is remarkable for its ability to thrive, like all wet-wall species, on a meager yet constant source of water. In fact, almost all of the state's western wetlands are dependent on groundwater that infiltrates subsurface permeable layers and then arises through seeps and springs.

These West Texas wetlands and their attendant springs and streams are ancient places, often demarcated by stone metates and hieroglyphs left by ancient people. They have always been integral to the survival of humans who have chosen to move through this arid country to hunt, gather, grow crops and build communities. Many wetlands and springs in the region have

regard to human presence or absence. Until now.

The Trans-Pecos wetlands inhabit a region comprised of several vast counties, including (but not limited to) Hudspeth, Presidio, Brewster, Jeff Davis and Pecos, some so large, in fact, that their square mileage exceeds that of entire states. This is big, open country where the geography is defined in sections more often than in acres and where year-round water sources, including springs and seeps and their marshy wetland habitats, are highly valued and constantly scrutinized. Many of these springs and wetlands were utilized for millennia by nomadic populations and, in historic times, by travelers on trade routes as well as ranchers and the military. Spring and wetland references can be found in an

Spanish explorers in the late 1500s. The Spaniards observed the conservative irrigation techniques practiced by Jumanos Indians farming along the exploration route. These irrigation practices represented a remarkable feat for an agrarian community living in such an arid region. And as late as the 1920s, the flats around the county's Dell City created an ideal wetlands environment, an expansive area covered in water that, along with the region's springs, had served the needs of humans and wildlife for centuries. But modern and unfettered irrigation rendered the flats dry in just a matter of years. In fact, out of the 25 major wet environments scattered throughout Hudspeth County that were documented by the late Gunnar Brune in his comprehensive 1981 book, *Springs of Texas*,



THESE WEST TEXAS WETLANDS AND THEIR ATTENDANT SPRINGS AND STREAMS ARE ANCIENT PLACES, OFTEN DEMARCATED BY STONE METATES (ABOVE LEFT) AND HIEROGLYPHS (ABOVE RIGHT) LEFT BY ANCIENT PEOPLE.


been documented by the progression of maps created since Spanish exploration began. Other desert wetlands have remained nameless and are often accessible to humans only with great effort. To come upon such an unknown place in the desert means to enter the true realm of the natural world. Here, in these deeply hidden swales, the trappings of human comfort do not exist. The succor of life rises and falls upon the whim of shadows and heat and intermittent rain. The realities of wildness and its harsh parameters dominate life, allowing a glimpse of the primordial state of early humans. The transitory pulse of nature can be felt most profoundly in these wild places, where the rhythms of time beat and flow without

archive of documentation including journals, correspondence, government reports and diaries. In addition, geologists and hydrologists have studied and measured hundreds of West Texas wetlands and springs over the last 75 years. Their changing conditions, whether flush or dry, have been the measure for all springs and wetlands across the western countryside both recognized and unknown. As a result, beginning in the mid-19th century, wet environments throughout the region have been monitored and documented with some regularity, and the results of this monitoring provide a record of alarming decline.

The wetlands and springs of Hudspeth County in West Texas were first noted by

Volume 1, all have either declined significantly or disappeared altogether.

Wetlands once dominated the Rio Grande floodplains of Hudspeth and neighboring Presidio County, which were fed by an array of draining arroyos and canyons along the international border. Many of these wetland sources have poetic names such as Arroyo de Los Barrancos (Stream of the Precipices), Arroyo del Fraile (Stream of the Friar) and Arroyo El Benigno as in Stream of the Benign One. But most all of their resulting wetlands have given way to agriculture or erosion from overgrazing, irrigation and the invasion of detrimental species such as saltcedar. However, agriculture is now threatened as well. The once-thriving



THE HISTORY OF THE
REGION'S MYRIAD WETLANDS,
SPRINGS AND ATTENDANT SPECIES
SUGGESTS THAT THE TRANS-
PECOS WATER WORLD HAS
ARRIVED AT ITS TIPPING POINT.

business of cantaloupe, honeydew and watermelon production in Presidio County is now struggling due to the degradation of water sources.

Presidio's sister county, Brewster, is the largest in the state, with 6,169 square miles that include Big Bend National Park. The history of the many springs and attendant wetland species of Brewster County is well documented due to the efforts of biologists and historians associated with the county's Sul Ross State University. Included in this archive is the ethnobotany of the *Equisetum laevigatum*, a moisture-loving fern distinguished by the particles of silica occurring in its stiff, rattling stems. The plant was used for scrubbing pots and dishes during the colonial and frontier periods, thus its common name — the scouring rush. It was also used in medicine, for weaving mats and to produce a yellow dye.



region of central Trans-Pecos that reaches above 8,000 feet in elevation. Wetlands and springs in these upper reaches show minimal human disturbance compared to other regions of the West. Yet documentation also indicates a decline in the number and size of both wetlands and springs. These cool, high desert swales are home to many endemic species, including the Demaree rose, found only along the seeps and springs of the county's Wild Rose Pass. Another romantic wet-environment species, the wood fern *Dryopteris filix-mas*, can be found along the region's bluffs and high-altitude glades. This fern's spores were once thought magical and powerful enough to render the possessor invisible.

But down off the higher elevations, the county has suffered significant wet-habitat losses. In fact, one major surface water source has simply vanished: the county



ty fell significantly, and Comanche Springs, as well as many of the springs and wetlands throughout the region, dried up in less than 10 years.

Remarkably, one of Texas' most endangered wetland environments is also a hold-out in Pecos County. The Diamond Y Spring, and its system of smaller springs and surrounding streams, is one of the rarest and last remaining desert wetlands of its kind in the state. Diamond Y Spring Preserve, now in the hands of the Nature Conservancy, is a desert marshland called a *ciénega*. Diamond Y Spring provides critical habitat for the federally endangered Pecos gambusia as well as for the Leon Springs pupfish, and it is considered the last remaining natural habitat for the pupfish. The preserve also protects habitat for the federally threatened puzzle sunflower, also called the Pecos sunflower, a beautiful



THE DIAMOND Y SPRING PRESERVE, ABOVE LEFT, IS ONE OF THE LAST REMAINING CIENEGAS IN THE STATE. THE SPRING IS THE LAST REMAINING NATURAL HABITAT FOR THE LEON SPRINGS PUPFISH, ABOVE CENTER. THE PRESERVE ALSO PROTECTS THE THREATENED PECOS SUNFLOWER, ABOVE RIGHT.

But after having provisioned human needs for more than 15,000 years, Brewster County wetlands, their associated species and any corresponding spring discharge have decreased noticeably within the last half-century. In fact, some desert wet-environment species may already be lost. A 1941 publication from the Texas Academy of Science on the fish of the Big Bend region reports that specimens of the little maravillas red shiner were already endangered by 1938. The new subspecies was identified, described and counted along wetland and spring-fed pools south of Marathon, and at the time, they were considered the only known members of *Notropis lutrensis blairi*. Twenty-five years later the maravillas red shiner was extinct.

To the north and west lie Jeff Davis County and the Davis Mountains, a rugged

seat's own Fort Davis Spring, which stopped its flow in the 1930s due to the influx of water wells.

Unlike the hidden corners of Jeff Davis County, Pecos County to the east has not been so lucky. The often-repeated story about the drying up of its Comanche Springs provides a dark lesson in the fragility of a wet environment, the troubling state of water laws and the finite nature of a water supply. Comanche Springs, once a source for 1,900 liters of water per second, was hailed in the early part of the 20th century as an "Inspiration for Irrigation" and, indeed, it was. Comanche Springs supplied water for the city of Fort Stockton and surrounding farms for decades. Beginning with a dramatic increase in irrigation pumping in 1946, the groundwater levels in the coun-

bloomer with a ramrod stalk and large, blousy flowers. The survival of these species depends on the continued health of Diamond Y's springs, pools, marshes and moist soils. It's a critical habitat that occupies a small stretch of three tenuous miles.

The history of the region's myriad wetlands, springs and attendant species suggests that the Trans-Pecos water world has arrived at its tipping point. Texans, proud of their outdoor heritage, continue to look to the Trans-Pecos as their last natural frontier. But unlike the hardy frontier spirit, West Texas wetland habitats are sensitive to change and quick to reach a critical stage when faced with adversity. Without a change in thinking about the importance of wetlands, they will disappear within a few years, leaving behind only memories of fragile treasures in a harsh land. ★

Playas i

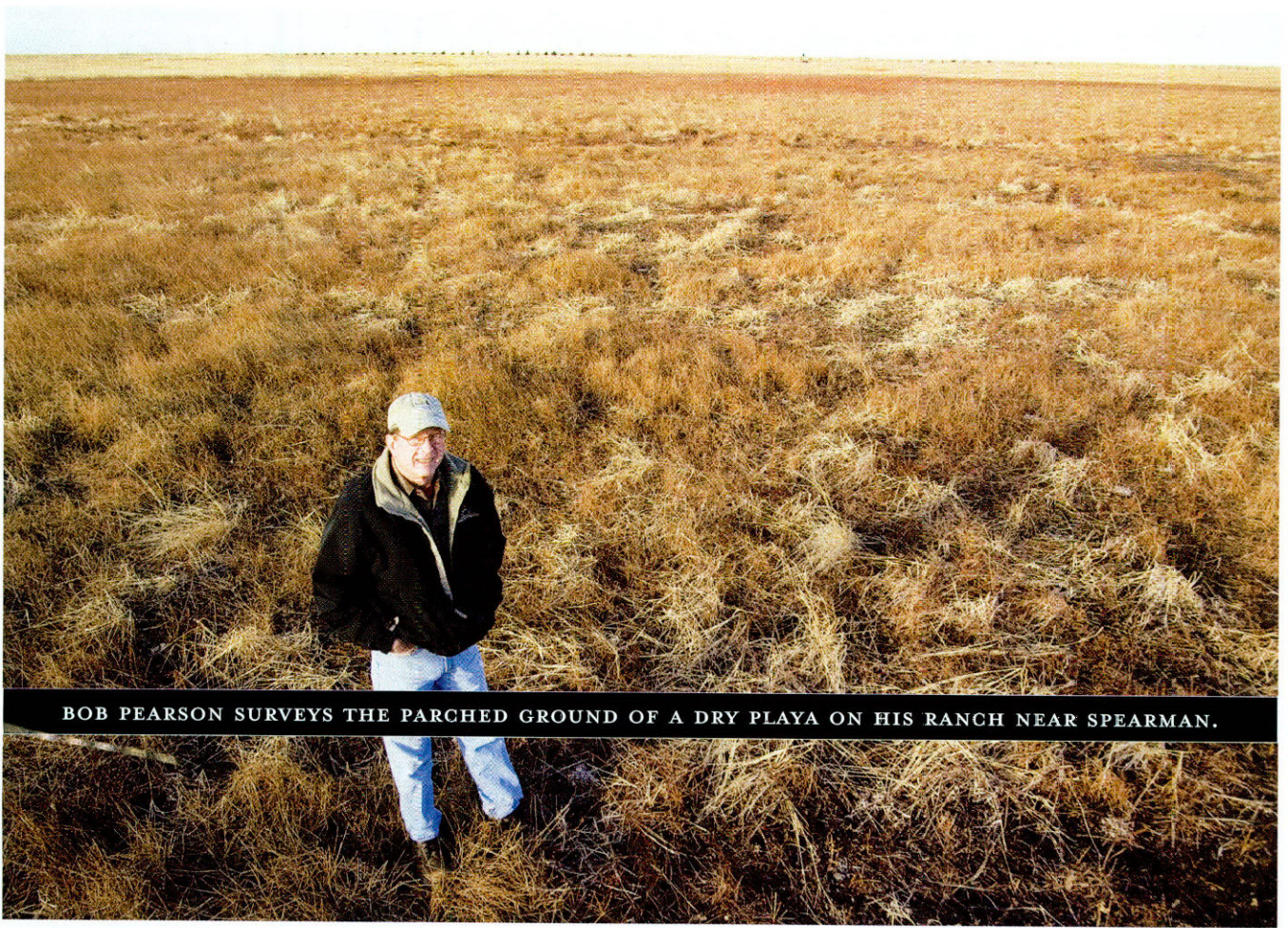
Shallow Panhandle lakes serve multiple functions, from acting as a rest stop for



n Peril

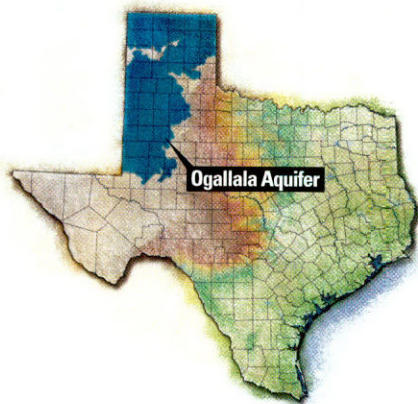
lucks to recharging the Ogallala Aquifer. ~ BY RUSSELL A. GRAVES

DRY PLAYA WITH RUMEX PLANTS.
THIRTY-THREE PERCENT OF
ALL PLAYAS HAVE BEEN ALTERED,
INCLUDING 69 PERCENT OF
THOSE LARGER THAN 10 ACRES.



BOB PEARSON SURVEYS THE PARCHED GROUND OF A DRY PLAYA ON HIS RANCH NEAR SPEARMAN.

It's late January in the far north Texas Panhandle, and like the rest of Texas this year, it's dry. Here, it's been nearly 120 days since the last measurable rainfall, and dust wafts from the land with even the slightest puff of wind. The ground is parched, yet Spearman rancher Bob Pearson and I are in search of Panhandle wetlands.



Creeping along in Pearson's truck, we ease past a wagon trail whose deep, grass-covered ruts cut an old road that leads from the Canadian River bottom north across the shortgrass plain. Soon we are at the edge of a 60-acre sunken depression. The broad, round spot is a *playa* (pronounced PLY-yuh) lake, and it is one of an estimated 19,000 shallow water basins that make up a huge complex of wetlands that cover the northern Panhandle down through the Southern Plains to around Lubbock. Although the lake is dry now, the thick and dormant vegetation hints of a wetter time in the recent past.

Around the ancient lake, I don't see much in the way of traditional agricultural manipulations, like row-cropping or terracing. Pearson, along with his brother and ranching partner, Doc, are past winners of the Texas Parks and Wildlife Department's

Lone Star Land Steward award. They both enjoy the fact that their family ranch is largely unchanged by man's influence.

"This land has been in my family since the 1940s," explains Pearson. "My dad got this ranch from the family who originally homesteaded the place back in the 1880s. Since I can remember, my dad loved the playa lakes on this ranch, and he was careful to never plow around the lakes for fear they would silt." Pearson, now in his late 50s, plans to continue managing the ranch in the same way his dad did. "My dad was a conservationist before anyone knew what the word meant. He instilled an ethic in me to take care of this ranch and take care of the lakes."

Even now, when the lake is bone dry, Pearson still finds beauty in the wetland. "When the playa is wet, all kinds of waterfowl and birds flock in here," he says.

"When it's dry, wildlife still uses the lake. I won't be surprised if we see ..." He pauses and points to the east. In the grass, 50 yards away, I see the unmistakable form of deer antlers sticking up through the dried smartweed. In the taller weeds around the lake's margin, I see a couple of gray bodies slipping through the weeds. "There are always mule deer hanging out in these lake bottoms. They'll bed in the high weeds and feed on some of the plants that grow in the wet soil." In the course of an hour, I see jackrabbits, mule deer, a few whitetails, quail and numerous songbirds around the 60-acre playa. All are animals not typically associated with wetlands, but ones that benefit from the shallow basins nonetheless.

For centuries, the wet-dry cycles of the high plains wetlands benefited wildlife and plant life alike. Since the Clovis period of 11,500 years ago, ancient people benefited from the lakes as well. Artifacts discovered in an ancient Roberts County playa (just a few miles southeast of here, near Miami) include spears and scrapers found in proximity to elephant bones. People of the Folsom period (10,900 – 10,000 years ago) supplemented their bison diet with various aquatic animals and ducks they captured from playas.

The term *playa* is Spanish in origin and literally means beach. Perhaps Francisco Coronado coined the term when he crossed the plains in search of the fabled Quivira — the lost city of gold. Pedro de Castañeda traveled with Coronado on the expedition and made note of the playas in the mid-1500s. "Occasionally there were found some ponds, round like plates, a stone's throw wider or larger," he wrote. "Some contained fresh water, others salt."

Throughout recorded history, the playas, which are the main water source on the plains, drew American Indians and 19th-century settlers. Comanche, and later hide hunters, knew that bison drank from the playas and often hunted them at the water holes. In fact, one of the theories that attempt to explain the origins of the playas suggests that bison wallowing in the mud over time caused the depressions. Still known as "buffalo wallows" by many contemporary plains residents, playas were actually formed by decaying organic matter that formed carbonic acid and dissolved the caliche soil layer. Once the caliche layer dissolved, various materials

such as rock and organic matter permeated the soil and eventually formed a layer of clay in the bottom of the lakes that, when wet, is impermeable.

As more settlers moved into the Panhandle, farms and ranches sprang up around the playas. Over time, however, many playas were partially filled in or entirely eliminated as the area evolved into the agricultural breadbasket of Texas. Bill Johnson, a TPWD wetlands biologist based in Canyon, says that most playa degradation came from agricultural practices such as irrigation ditching and close-proximity plowing. Although the rate of destructive practices has slowed considerably, Johnson estimates that at least half of the playas that originally existed in Texas have been severely damaged or destroyed.

"Although they represent only two percent of the landscape in the Southern High Plains, playas are key to both floral and faunal diversity," explains Johnson. "They are the primary wetland feature in a very arid landscape — without functioning

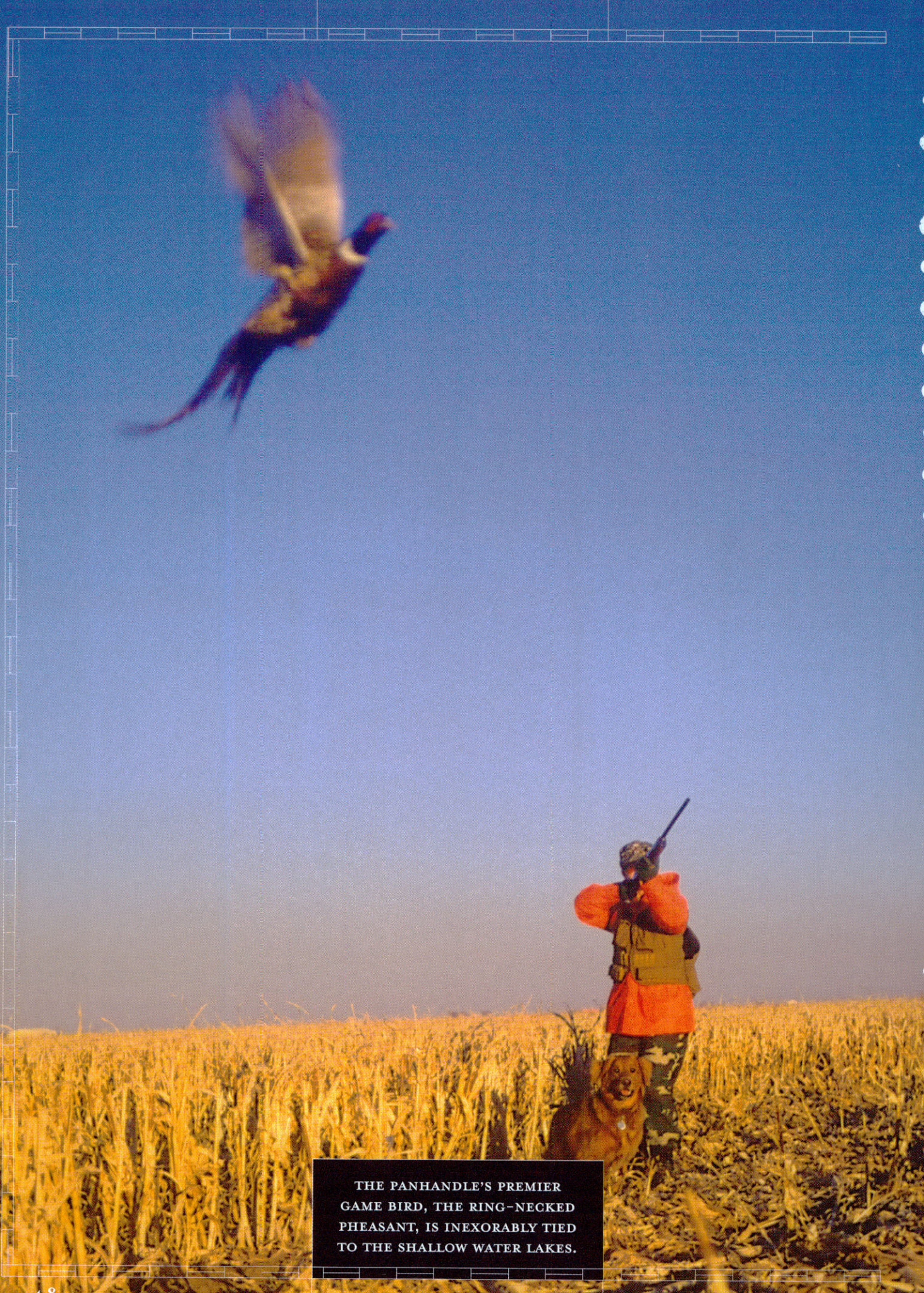
playas, both plant and animal diversity in the Texas High Plains would be very low." Johnson says that, during the peak of the winter, as many as half a million ducks are on the lakes in wet years. During the fall and spring migrations, that number increases substantially. "The numbers of ducks, geese, cranes and shorebirds that use playas during migration periods and winter can be quite impressive. Without functioning playas, it's not a stretch to say that waterfowl numbers would be affected on a continental level."

However, waterfowl and shorebirds aren't the only avian species that utilize playas. The Panhandle's premier game bird, the ring-necked pheasant, is inexorably tied to the shallow water lakes. According to Texas Tech University researchers, pheasants spend as much as 90 percent of their time around playa lakes during the nonbreeding season. Without playas, pheasant numbers and, ultimately, the local hunting economies would suffer. Towns like Hart and



IN THE COURSE OF AN HOUR, I SEE JACKRABBITS, MULE DEER, A FEW WHITETAILS, QUAIL AND NUMEROUS SONGBIRDS AROUND THE 60-ACRE PLAYA.





THE PANHANDLE'S PREMIER GAME BIRD, THE RING-NECKED PHEASANT, IS INEXORABLY TIED TO THE SHALLOW WATER LAKES.

Nazareth host huge groups of pheasant hunters annually, and their presence is essential to maintaining a vigorous local hunting economy even when the broader agricultural economy is marginal.

As important as playas are to the plants and animals above ground, they are absolutely essential as sources of recharge for the vast underground Ogallala Aquifer. For every gallon of water the lakes hold on top of the plains, countless millions of gallons of precious water lie just beneath the surface in the aquifer. Johnson explains that one of the big dangers that threaten to degrade the wetlands is sedimentation. Soil loosened by plowing and intense livestock traffic around a playa's margin can wash into the lakes with rainfall. Excess sedimentation affects the playa's ability to soak up water and reduces the amount of recharge to the aquifer that lies beneath.

"Maintaining wide, healthy grassland buffers adjacent to playa lakes is the best way to protect them from sedimentation. Many U. S. Department of Agriculture farm bill programs, such as the Conservation Reserve Program, can provide cost-share to plant or restore grassland buffers around playa lakes. The Texas Parks and Wildlife Department's role in playa restoration projects is to work closely with federal and state agencies and, most importantly, private landowners. Landowners are the key to playa lake functionality because 99 percent of playas lie on private land," explains Johnson.

Daryl Birkenfeld, director of the Nazareth, Texas-based Ogallala Commons—a group dedicated to protecting the region's land and water resources—underscores playa lakes' role as the lifeline for the aquifer. "The largest concentration of playa lakes in the entire world happens to occur across the top of the Ogallala Aquifer. Playas are naturally tethered to the Ogallala; when playas are in a dry cycle, their clay-covered basins form large cracks. When a significant amount of rain falls in a short period of time, the cracks in the soil allow recharge of the aquifer during the first 24-48 hours of the rainfall event." After the initial deluge, the cracks close and seal the bottom from further percolation. Even though the recharge period is brief, the lakes' contribution to the aquifer is significant. In fact, a significant rainfall on the plains proper may only contribute

a tenth of an inch of water to the aquifer level while a single playa lake can contribute three to six inches of water from the same downpour. Ultimately, playa lakes are the only significant source of recharge for the Ogallala Aquifer.

That's why sedimentation is such a danger to the wetlands. When sedimentation fills a lake, the depth is reduced and the

ference to playa lakes by landowners, could lead to the loss of the wetland complex and irreparable damage to the lakes and the aquifer over the next 20 years.

"Clearly, without functioning playas, it will be impossible for us to preserve the Ogallala Aquifer over the long term when we are withdrawing a foot or more from the water table every year," warns



THE NUMBERS OF DUCKS, GEESE, CRANES AND SHOREBIRDS THAT USE PLAYAS DURING MIGRATION PERIODS AND WINTER CAN BE QUITE IMPRESSIVE.



water spreads over a broader area and evaporation accelerates. More detrimental, however, is when the sedimentation fills the cracks in the playa's clay bottom, thus shutting off recharge. Since no state or federal legislation protects playa lakes, Birkenfeld is afraid that the intense draw-down of the Ogallala Aquifer and indif-

Birkenfeld. "In much of the central Southern Plains, where the concentration of playas is as high as one per square mile, if these playas are conserved and remain functioning, then recharge from healthy playas could play a major role in stabilizing the Ogallala Aquifer and help to preserve it for generations." ☆



Delta



*The young Colorado River delta is a lush breeding ground
for finfish, shrimp, crab — and controversy.*

BY WENDEE HOLTCAMP

Dawn

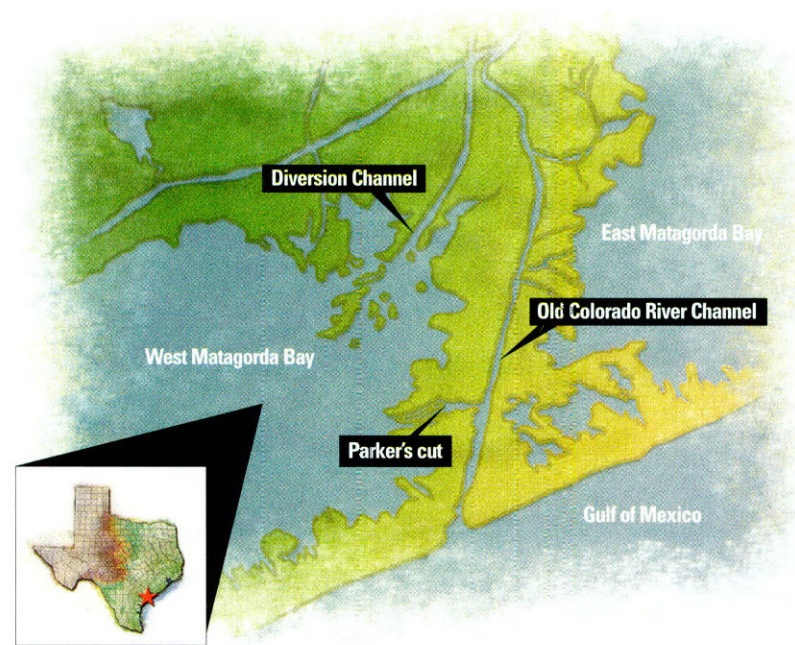
“THIS IS PROBABLY ONE OF THE MOST DYNAMIC AREAS ON THE TEXAS COAST,” SAYS TPWD COASTAL FISHERIES BIOLOGIST BILL BALBOA. “IT HAS CREATED ACRES AND ACRES OF MARSH HABITAT.”

The water's surface bubbles like a slowly boiling witch's brew. Each pop and bubble is an oxygen-hungry menhaden breaking the water's surface, struggling to breathe. Hundreds of them. "This is bad," TPWD coastal fisheries biologist Bill Balboa says to me, as we motor down the old Colorado River channel on the 22-foot outboard motor boat he takes out weekly to sample fish and other aquatic critters throughout Matagorda Bay. Balboa has led TPWD's Matagorda Bay ecosystem research for the past eight years. He has a laid-back approach to life, but he takes his job very seriously. And the gurgling water has him seriously concerned.

"This looks like a fish kill."

I've joined Balboa to witness the formation of a 15-year-old delta at the mouth of the Colorado River. River deltas are historically lush fertile lands, floodplains, river valleys — think world history class and the fertile Mesopotamian valley. Our plan is a grand exploration of the cuts and channels, dams and locks of this modified area of the Texas coast where the Colorado enters Matagorda Bay, and to view the newly forming tidal marsh, where elegant shorebirds feed on small delicacies hiding in the cordgrass. We're here to discuss the history of the region and how an environmental enhancement project — the Colorado River diversion — attempts to return Matagorda Bay to a more natural state. We didn't expect to witness the precursor to a fish kill.

For the sake of commerce, flood control and fisheries, humankind has wrangled with the mouth of the Colorado for more than 100 years, diverting it here and there, dredging it, dynamiting its logjams, relocating it. The river tells a colorful history, and today's fish kill can only begin to be understood in light of it.



Before 1900, the Colorado River used to flow into Matagorda Bay, which was not separated into an east and west bay as it is today. In the 1800s, a huge logjam, or log "raft," formed at the mouth and extended nearly 50 miles upriver. The logjam was so thick that trees grew on it. During those

years, heavy rains often flooded the seaside towns of Wharton City and Matagorda. In an attempt to remedy the flooding, a channel was dredged through the logjam. The dredging lasted from 1925 to 1929. Finally, the log raft was dynamited apart in 1929, and a major flood the same year flushed all

FOR COMMERCE, FLOOD CONTROL AND FISHERIES, HUMANKIND HAS WRANGLLED WITH THE MOUTH OF THE COLORADO FOR MORE THAN 100 YEARS, DIVERTING IT HERE AND THERE, DREDGING IT, DYNAMITING ITS LOGJAMS.



the remaining log debris downstream.

Clearing the logjam changed the bay. The river started to bring loads of sediment downstream and accelerated the formation of tidal fringe marsh at an astounding rate of 500 acres per year. The marsh quickly spread halfway across the bay.

But the flooding still came. This time, the rapid build-up of sediment in the middle of Matagorda Bay was blamed, so local entities decided they would just divert the river directly into the Gulf, bypassing the bay. In 1934, a channel was dredged and the mud spoil was placed on both sides, forming the present land bridge between East and West Matagorda Bay.

Balboa and I are motoring down this old Colorado River channel, where the menhaden are jumping for air. This would still be the main channel were it not for a 1990 Corps of Engineers project that re-diverted the Colorado yet again — this time into West Matagorda Bay. Scientists had started recognizing the incredibly important role of “freshwater inflow,” or the fresh water coming down a river into a bay, in sustaining its living organisms. In the late 1980s, several interest groups, including biologists, anglers and commercial fisheries, agreed that diverting the river back where it belonged would increase the bay’s biological productivity. Opponents at the time pointed out potential negative impact on seagrasses and oyster reefs.

With the support of TPWD, National Marine Fisheries Service and U.S. Fish & Wildlife Service, the Corps completed the diversion of the Colorado back into West Matagorda Bay by 1992, and an earthen dam plug closed off the old from the new channel. The Corps also plugged off Parker’s Cut (aka Tiger Island) which had previously allowed boat and fish traffic between West Matagorda Bay and the old river channel. Leaving it open would have brought salt water back into the bay and hence be counterproductive to the project’s goals. This tiny earthen plug has led to a mounting controversy over fish kills, water circulation and the state of the bay.

We head back up the river channel, past the closed Parker’s Cut to the Gulf Intracoastal Waterway, where the Corps of Engineers regulates barge traffic through a series of locks. These massive gates open and close off flow from the Colorado River to let barges pass. The lockmaster gives us a go-ahead. We negotiate past a pungent-



SCIENTISTS HAD STARTED RECOGNIZING THE INCREDIBLY IMPORTANT ROLE OF “FRESHWATER INFLOW,” OR THE FRESH WATER COMING DOWN A RIVER INTO A BAY, IN SUSTAINING ITS LIVING ORGANISMS.



Delia Dawn
TOP PHOTO © JIM OLIVE / STOCKYARD; BOTTOM PHOTO BY EARL NOTTINGHAM



A.



B.

A. Fingerling speckled trout; B. Green porcelain crab; C. Eastern oysters found along the Texas coast; D. White shrimp.



C.



D.

ONE NEEDS ONLY LOOK AT ADAPTATIONS OF THE ORGANISMS TO UNDERSTAND THAT THE BAY HAS LONG BEEN A PLACE WHERE CHAOS AND CHANGE RULE ...THE BEST-ADAPTED FAUNA ARE MOBILE: SWIMMERS, CRAWLERS AND BURROWERS.

smelling barge carrying toxic benzene, then head around the bend and down the new diversion channel, making our way to the mouth of the actively forming delta.

In addition to bringing fresh water, the river carries soil and debris scoured from land it runs through, particularly during flood flows, and dumps this sediment at its mouth. Dead trees make the delta treacherous for boat traffic, but they trap sediment to provide structure where marsh grass can grow. Clumps of smooth cordgrass grow in the mucky marsh mud, extending into the horizon, their stiff

green blades emerging from the salty water.

Roseate spoonbills sift crustaceans from the water with their flattened spoon-like bills, their elegant pink feathers like jewels against the pale blue sky. White ibises stand scattered throughout the delta. These estuaries are renowned nursery habitat for young finfish, shrimp and crabs.

Many people do not realize that the muddy sediment a river carries downstream contains nutrients, including nitrogen and silica, which tiny phytoplankton (plant-like animals) that form the base of the entire bay food web, need to survive. Diatoms are an

abundant silica-shelled phytoplankton that shrimp, crabs, and juvenile fish feed upon. A sandpiper runs to and fro, picking critters out of the mud. "This is probably one of the most dynamic areas on the Texas coast," says Balboa. "It has created acres and acres of marsh habitat." A U.S. Fish & Wildlife Service study documented that more than 300 acres of marsh have formed since the delta's inception.

Some locals love the diversion project, while others think it's caused harm, and there's nothing like a fish kill to get people riled up. Al Garrison has been a fishing

guide for 25 years, serves as Executive Director of the Matagorda Bay Foundation, and recently retained attorney Jim Blackburn to convince the Corps of Engineers to open Parker's Cut, or another channel, to increase circulation to the east end of West Matagorda Bay. Garrison says he is totally opposed to the diversion project. "I've seen absolutely no benefit for the environment, fisheries or production of the bay," says Garrison. "The last meeting I attended with LCRA [Lower Colorado River Authority], they showed that the productivity of [the] bay has gone way down — oysters, shrimp, crabs and fish." Garrison would not acknowledge that any new marsh has been created or its role in the production of finfish, crabs, or shrimp, but he said there are certain times of year when this end of the bay is good for fishing. "They can present a situation that's good for fish and bad for shrimp, or if it's good for fish, it's bad for crabs or oysters," says Garrison. "They're trying to play God and they can't do it."

LCRA's job is to carve up the fresh water allocation pie that must nourish bays, people, agriculture, cities and industry. Every week, Balboa and his crew drag trawl nets, bag seines and gill nets throughout the bay to analyze species presence and abundance. LCRA used this data to examine productivity of nine species — redfish, flounder, oysters, blue crab, white and brown shrimp, black drum, menhaden and mullet. Over a 20-year period, redfish and oysters have shown increases, while the others have shown gradual declines. However, as LCRA's John Wedig points out, "We've had an exceptionally wet 10 to 12 years," and rainy conditions decrease salinity. "It's really too early to tell the long-term trends."

The water quantity coming down all Texas rivers is threatened as future reservoirs are constructed and companies and river authorities sell water to water-poor cities like San Antonio. State agencies, nonprofits and politicians are currently wrangling to determine how much water people, cities, agriculture, fish and wildlife need to survive in a state where the population keeps increasing. Bays need a certain amount of freshwater inflow to maintain healthy commercial and recreational fisheries. The problem lies in determining exactly how much freshwater estuaries need, and how reduced flow in rivers will

affect that equation.

"There are so many factors that make bays what they are. It's very difficult to show cause and effect," says Balboa. LCRA is using catch rates for productivity and correlating freshwater inflow to these data, but Balboa explains, "No one can say that a gallon of water equals this much in terms of estuarine productivity." He also stresses that the data can only assess overall bay production rather than pinpoint a particular area, such as at the new delta.

"I agree with Bill's statement that bay productivity/ecology is a very complex issue," says Wedig. "That's just one of the reasons LCRA is currently conducting what we believe is the most thorough study to date of the bay's health. This study measures not just critter abundance, but also includes habitat, nutrients, primary productivity and macro-benthics."

Species in bay ecosystems have evolved to deal with pulses in salinity, and no salinity level is optimal for all species. "People say extremes are bad, or the salinity should be maintained at a certain level, but bays evolved around chaotic events including flood and drought," says Balboa. One needs only look at adaptations of the organisms to understand that the bay has long been a place where chaos and change rule. According to the classic text, *Shore Ecology of the Gulf of Mexico*, the best-adapted bay fauna are mobile: swimmers, crawlers and burrowers.

The irony of how people react to changing bay conditions does not escape Balboa, "If we get a flood and it kills the reef, automatically it's a bad thing. But when the reefs are producing market-sized oysters it's because of the fresh water." Oysters are highly sensitive to salinity, and when fresh water floods in, they die. But even if an entire reef is wiped out, free-swimming larvae recolonize the oyster shell substrate when salinities increase. It's all part of the dynamic cycle of estuary life.

Blackburn differs from his client, Garrison, on the overall benefit of the new delta, applauding it as an environmentally beneficial project, but says something needs to be done to restore circulation to the old Colorado River channel to prevent fish kills. The fish kills did not occur before, but five have occurred since its completion. "If you open up Parker's Cut, I don't know if you'll solve the circulation problem, but you'll provide a pathway for


fish to get out of the channel," says Blackburn. "I don't think Parker's Cut is the only fix that would be appropriate, but some channel needs to be cut."

In the 15 years since the diversion, the area has seen two major floods and two major droughts. "Because of the boom or bust nature of our inflows, it's going to change where people fish," says Balboa. "A lot of people are not happy about the diversion because they used Parker's Cut for access. They're angry because they lost business."

Some locals love what the diversion project has done for Matagorda Bay. "I've fished that thing all my life. It's the greatest thing that happened to that bay," says Raymond Cox, a veteran fishing guide. "You've got a river bringing silt down that's replenishing that bay. It's making more wetlands for the plankton that feed everything in the bay. It made the greatest fishing hole I've seen anywhere in the world. If you open it [Parker's Cut] up, you're going to kill what you built."

We head out into the open bay and drag a trawl net behind the boat to see what we can catch. We haul up various and sundry creatures, including cabbagehead jellyfish, gafftopsail catfish, lookdown (a Gulf fish), moon fish, white shrimp, brown shrimp, bay anchovy, spotted sea trout, a smooth pufferfish and sauerkraut grass — a colonial bryozoan. The mix of creatures in our catch indicates a fairly high salinity — normal for this bay. Most of these organisms breed in the Gulf, and their eggs or juveniles drift back into the bay, where they feed and grow, many seeking shelter in the coastal marsh. We dump the creatures overboard and head back.

The day after our grand Matagorda Bay river delta exploration, thousands of dead menhaden wash ashore at the mouth of the old river channel. These commercially important fish enter the channel in mass aggregations seeking deep, still water. Balboa agrees the closing of Parker's Cut and the diversion channel have caused increased fish kills, but thinks that if a channel should be opened, it should be in East Bay, not around the new delta. A lot of money and effort went into the project, and no one really knows what any modification would do. "This isn't a project that will yield results overnight," Balboa concludes, "it was supposed to yield results over a long time." ★



STILL HALE AND HEARTY
IN HIS 80s, FRANK YTURRIA IS
MORE THAN PLEASED TO STAND
WITNESS AS THE BAHIA GRANDE
BEGINS ITS REBIRTH.

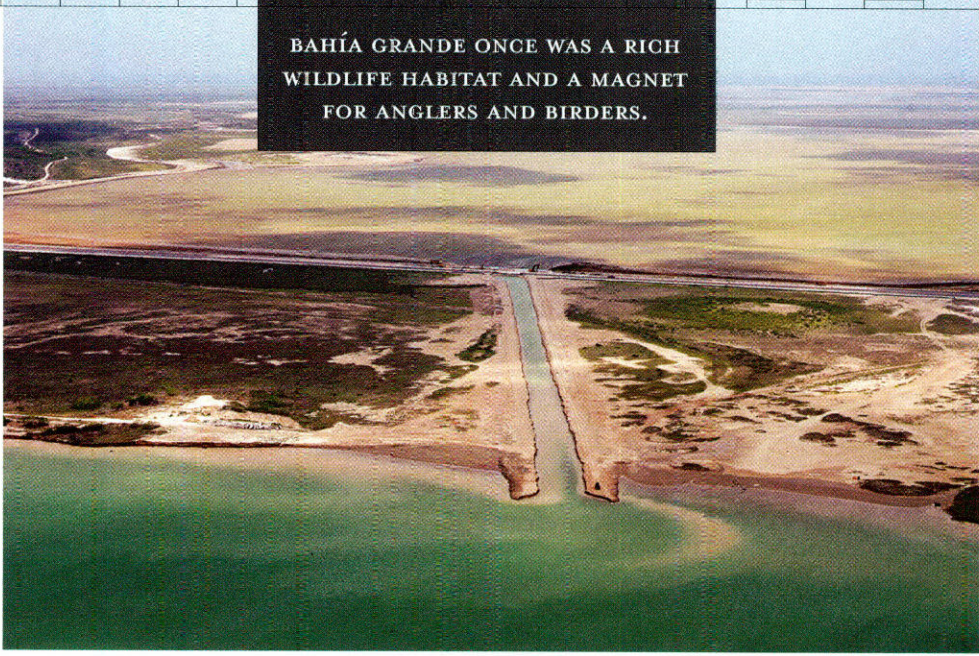


Return of the Grand Bay

Community support plays a key role in the largest wetland restoration project in U.S. history.

BY KAREN HASTINGS

BAHÍA GRANDE ONCE WAS A RICH WILDLIFE HABITAT AND A MAGNET FOR ANGLERS AND BIRDERS.



Water travels through the new channel, left, from the Brownsville Ship Channel to Bahía Grande.

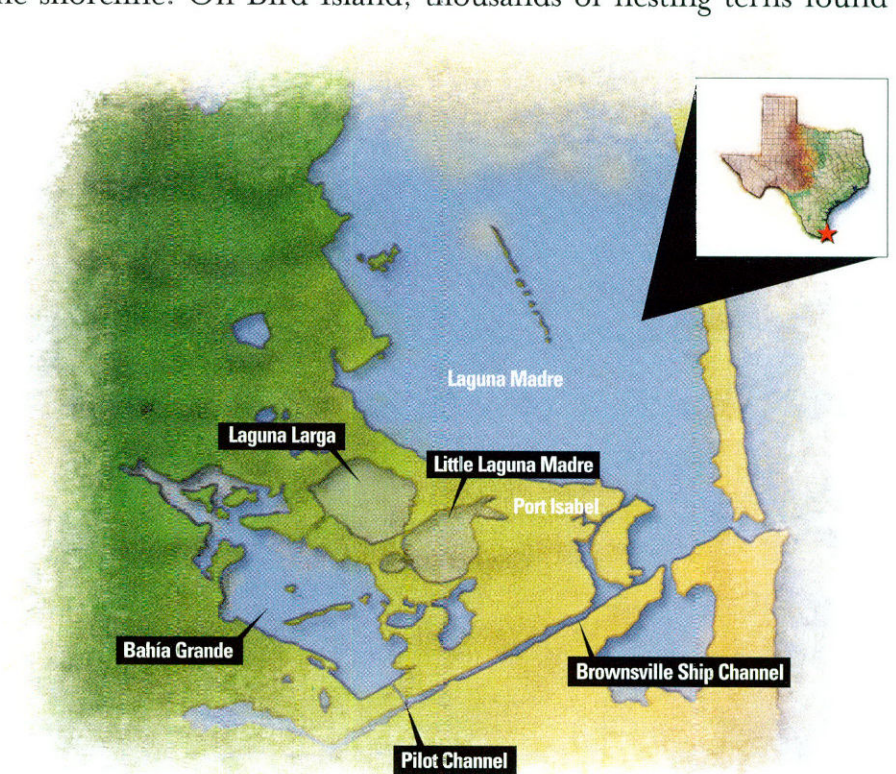
South Texas rancher Frank Yturria remembers picnics along the shores of Bahía Grande as a boy. The crabs and shrimp were so numerous, you barely had to get your feet wet to scoop them up with a net. Flocks of migrating redhead ducks floated on the shallow, salty water, while egrets and other wading birds stalked the shoreline. On Bird Island, thousands of nesting terns found refuge from predators.

“When I first looked at it as a kid,” he says, “it looked like an ocean to me.”

Yturria is one of few in the Lower Rio Grande Valley who remembers the “Grand Bay” the way it used to be. Cut off from the Gulf of Mexico in the 1930s by construction of the Port of Brownsville ship channel, this tidewater basin at the tip of Texas was a dustbowl for seven decades, devoid of most life. Dust storms plagued the area and the result for Laguna Madre communities was more asthma attacks, clogged air conditioners and annoying layers of grit.

Still hale and hearty in his 80s, Frank Yturria is more than pleased to stand witness as the Bahía Grande begins its rebirth, in what is being called the largest wetland restoration project in United States history. “Oh yes—I drive out there and stop and just gaze,” he says. “I never thought I’d live to see this day.”

On a windy morning in July, about a year ago, water started flowing along a pilot channel that has reconnected Bahía Grande’s vast mudflats to the life-giving Gulf of Mexico. Acre after acre of what had been barren and dry land now reflects the sky in a vast, waist-deep expanse of hypersaline water. If funding for a much wider permanent channel can be secured, then Bahía Grande has the opportunity to



become what it once was: a watery nursery for finfish and shellfish, a rich habitat for animal and plant life, a magnet for recreational fishermen and birdwatchers.

But even as the dust settles for communities like Port Isabel and Laguna Heights, and life returns slowly to the waters, shore and sky over Bahía Grande, the fate of this

massive project is still uncertain. Opening a pilot channel was an important step—but only one—in an ambitious plan to re-flood the entire 10,000 acres of Bahía Grande, Laguna Larga and Little Laguna Madre, the three bays that dominate the 21,762-acre Bahía Grande complex.

With the arrival of the triple digit tem-

THIS PAGE PHOTOS AND OPPOSITE PAGE ABOVE PHOTO BY EARL NOTTINGHAM

peratures typical of South Texas summers, scientists warn of water stagnation, fish kills and even an unwelcome encore of the dust problem. Without a permanent, abundant source of water to keep the Bahía Grande healthy, it may never live up to its full potential.

Standing at the pilot channel, overlooking a scenic expanse of sparkling water, the manager of what is now a federal refuge worries the public may lose interest.

“One of my fears is that people will look at this and think it is restored,” says John Wallace, who manages Bahía Grande as part of the Laguna Atascosa National Wildlife Refuge. “It’s not fully restored. Not yet.”

According to newspaper archives and other records, calls to re-flood the Bahía Grande began only a few years after Brownsville celebrated the opening of its deep-water port in 1936. It was a boon to the border city’s economy, but its construction came long before the advent of “environmental impact studies.”

Spoil from the dredging of a 17-mile trench from Brownsville to the Gulf of Mexico cut off the Bahía Grande from tidal flows. Later, construction of Highway 48, which parallels the ship channel for several miles, sealed Bahía Grande’s fate in concrete and asphalt. Except during sporadic rainfall, thousands of acres of productive estuary for shrimp, crabs, redfish and spotted sea trout dried up and blew away. Nearby lomas, little hills once covered in thorn brush, were suffocated into stunted gray humps by layers of salty clay.

Eventually, a film company would come to see the area as a perfect stand-in for a Moroccan desert, and New York waste haulers would try unsuccessfully to use it as

a sludge disposal site. In letters to their congressmen, children from Port Isabel wrote about cancelled recess, allergies and other illnesses. “I think you should put back the water because other people are breathing in (the dust) and they are getting sick,” wrote one student.

The long campaign to resurrect Bahía Grande gained momentum in the 1990s, when state law was changed so that minerals beneath property submerged by man-made means remained with property owners, rather than reverting to the state. The Yturria and Garcia families then sold their land for conservation, and 21,000 acres eventually were acquired by the U.S. Fish



and Wildlife Service. The pilot channel opened with fanfare on July 16, 2005.

Supporters describe the restoration effort like an old-fashioned barn-building, a project that reunited the often-fractured South Texas community like no other. Conservation groups and shrimpers, educators and the tourist industry, ranchers and bankers, bird-watchers and sport fishermen, city, county, state and federal bureaucracies — all have pulled together to bring Bahía Grande back to life.

“Some, you might say, are on the ‘tree-

hugger’ side of the equation and others are on the ‘hook-and-bullet’ side. But they all have the same goal and understanding of how important it is to restore those wetlands for wildlife,” says Wallace. “It really is a community project and the community deserves the credit.”

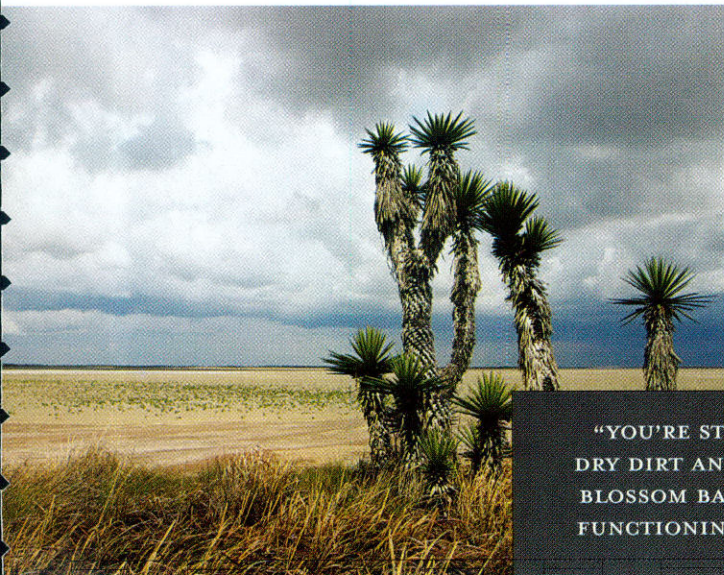
In an old Coast Guard station on South Padre Island, environmental sciences student Clint Roberts uses pliers and an oven mitt to transfer a small porcelain crucible, holding what looks like fine gray sand, into a glowing kiln.

Roberts and lab partner Jose Aguilar are analyzing core samples recently taken from the submerged sediments of Bahía Grande. By alternately cooking, sifting and re-weighing each sample, they hope to discover important characteristics and components of the sediments around the bay.

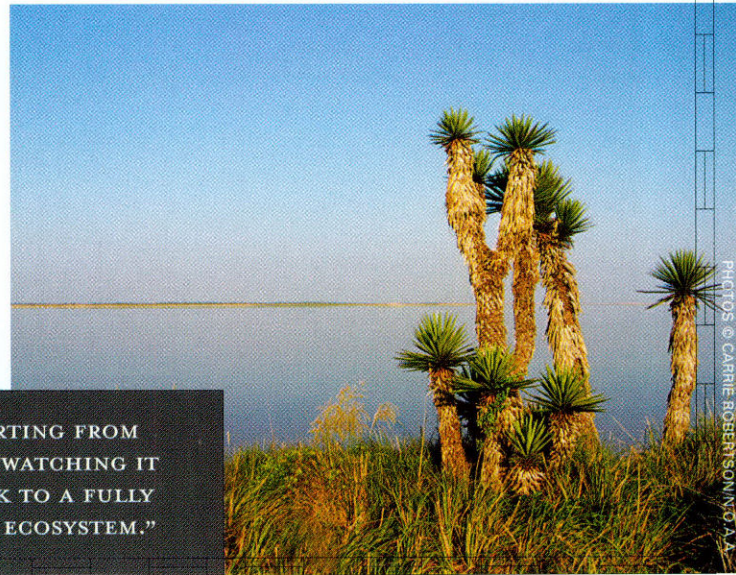
“The sediments are the place where life is happening,” says Elizabeth Heise, the University of Texas at Brownsville professor who supervises the lab. “The plants put their roots into the sediments and many of the organisms live in the mud. It’s important to understand the sediments in order to understand the biology.”

Actually, Roberts and Aguilar were practicing, perfecting a lab protocol, for the day when they begin working on what they call “the gold” — samples of Bahía Grande sediments collected before last year’s flooding, stored inside sections of PVC pipe in the lab’s freezer. Eventually, says Heise, comparison with post-flooding samples could be used to chart and predict the bay’s restoration.

In the meantime, Roberts and Aguilar are just thrilled to be working on a project of this size, at its very beginning. “You can’t



“YOU’RE STARTING FROM DRY DIRT AND WATCHING IT BLOSSOM BACK TO A FULLY FUNCTIONING ECOSYSTEM.”



BAHÍA GRANDE NEEDS A
PERMANENT, ABUNDANT
SOURCE OF WATER TO LIVE UP
TO ITS FULL POTENTIAL.



get this kind of experience anywhere," says Roberts. "I get goose bumps just talking about it."

Their scientific enthusiasm is widely shared. Hydrologists, ecologists, sedimentologists and zoologists are all over Bahía Grande, paddling in kayaks and four-wheeling along the shoreline, toting bag seines and gill nets, taking water, soil, plant and fish samples.

"I have pulled more vehicles out of the mud out there than I care to remember," says Heise, who keeps two boards, two shovels and two towropes in her truck.

"This type of a project you get only once in a lifetime," says aquatic ecologist Hudson DeYoe, a professor at the University of Texas-Pan American in Edinburg. "You're starting from dry dirt and watching it blossom back to what we hope will be a fully functioning ecosystem. It could transform that area if it really gets on the right track."

There have been encouraging signs. Within a month of the channel opening, seagrasses appeared, although they didn't last long in the bay's super-salty water.

According to DeYoe, seagrasses are crucial because they stabilize sediments and help keep the water clear, provide habitat for wildlife, and jump-start the complex food chain that eventually attracts fish and birds. Right now, DeYoe's students are trying experimental plantings of shoal grass in

various locations, to determine how, when and where to plant.

"I know a lot of people don't care about the seagrass, but they care about the fish and birds, and the fish and birds depend on the seagrass," says DeYoe. "It will transform the system magically into something truly amazing, if we can get the seagrasses."

Meanwhile, at a UT-Brownsville greenhouse and in another greenhouse at Bahía Grande, students and volunteers tend thousands of black mangrove, gulf cord



grass, sea ox-eye daisy and other native plants that will be used to help stabilize the shoreline and seabed. Five elementary and junior high schools are planning to grow black mangrove and spartina grass in new 8- by-16-foot propagation ponds.

"What we're doing is propagating the native plants that we want to grow and we're going to put them out there to jump-start the native plant process," says Heise, who helps supervise the greenhouses. "We don't

want the non-natives to take over and we don't want the soil (lining the interior canals) to run back into the bay. We want to (replant) the lomas and fight the erosion."

Biologists also report that marine worms — an important early development in Bahía Grande's rebirth — started appearing in Bahía Grande mud as early as September, less than two months after the pilot channel opened.

"In our December samples, we're finding the same range of invertebrates, but they're much, much bigger. They have been able to thrive and grow in the environment," says UT-Brownsville zoologist David Hicks.

Fish, shrimp and crabs also have "wandered in," says Hicks.

"Surprisingly there are quite a few birds, like snowy egrets, reddish egrets, roseate spoonbills, gulls, osprey," he reports. "They wouldn't be there unless there was something to feed on. The birds hang around the intake channel as the fish are flushed in with the tide, and they just pick them off."

But with summer closing in, there are reasons for concern as well.

Every two weeks, Hicks and his students change out, clean and calibrate three water quality monitoring stations located in Bahía Grande. These hydrolabs measure water depth, salinity, dissolved oxygen, pH and water temperature. Run on a marine

"IF EVERYBODY CONTINUES THE COURSE AND SEES THIS THING THROUGH, I THINK IT CAN'T HELP BUT BE A SUCCESSFUL PROJECT."



battery and solar panel, they transmit data to researchers at Texas A&M—Corpus Christi, who post it on the Internet. A fourth meteorological station on land measures wind speed, wind direction, barometric pressure and air temperature.

Data so far show high salinity even during the cool South Texas winter. In late February, for example, salinity measured close to 70 parts per thousand, more than twice as salty as the Gulf of Mexico.

"The pilot channel with the culverts will never exchange enough water," says Hicks. "What that sets up is more evaporation than water coming in. The water just gets saltier and saltier and saltier. And in the summer, it will also heat up really fast. Hot, salty water does not hold oxygen."

This "very stressful environment" could lead to a stagnant mess, he warns. "Looks like the fish are going to float."

Improving that environment requires a careful understanding of fresh and salt water flows into and out of the bay system, and that's the work of hydrologist and UT-Brownsville Professor Jude Benavides and his students.

"Hydrology pretty much drives everything," says Benavides, who is working with his students on computer models to identify how water circulates in the system, and what Bahía Grande needs to sustain its full range of flora and fauna. "It is a wetland, and if you don't nail the hydrology, you

have the potential for miscalculations."

Surface water runoff, rainfall and the effects of man-made channels all figure into the calculation, Benavides says. Already, two additional channels connecting the larger Bahía Grande to the smaller Laguna Larga and Little Laguna Madre are under construction, with the help of various private and governmental partners. There are also plans to open a second channel connecting the system to tidal water, and one to the north aimed at adding fresh water.



Top priority, however, is construction of a 2,300-foot permanent channel, a major construction project that will be ten times wider and three times deeper than the existing pilot channel. "If everybody continues the course and sees this thing through, I think it can't help but be a successful project," says zoologist Hicks. "It could be a model project for restoration projects worldwide, and we'll learn a lot along the way."

Bahía Grande partners have met both here and in Washington in recent months to find corporate and governmental sources for the main channel's estimated price tag of \$700,000 to \$1.4 million. "That," says Wallace, "is the question everybody is trying to answer right now."

BOUNCING ALONG RUTTED SENDEROS in an SUV, it's easy to visualize a fully restored Bahía Grande. Wallace points out the lush vegetation along Loma del Ballo, near the southern edge of the complex, where allthorn, mesquite, prickly pear and cenizo combine in a dense thicket of low brush, perfect for the endangered ocelot already found on nearby refuge land. Someday, as rain leaches accumulated salt from the other degraded lomas of Bahía Grande, they too could be reborn as productive upland habitat.

"When the dust stops blowing," says Wallace, "you will start to see gradual, subtle changes begin. Who knows? Ten, fifteen, twenty years from now, you could support a population of ocelots out here."

While the Grand Bay that Frank Yturria remembers from his youth may never be fully resurrected, the Bahía Grande project shows that the combination of community support and good science can turn seemingly impossible dreams into realistic and achievable goals. ★



Washing *the* Water

*Wetlands at Richland Creek Wildlife Management Area
act as a huge water filter, removing pollutants the natural way.*

BY WENDEE HOLTCAMP
PHOTOGRAPHY BY EARL NOTTINGHAM



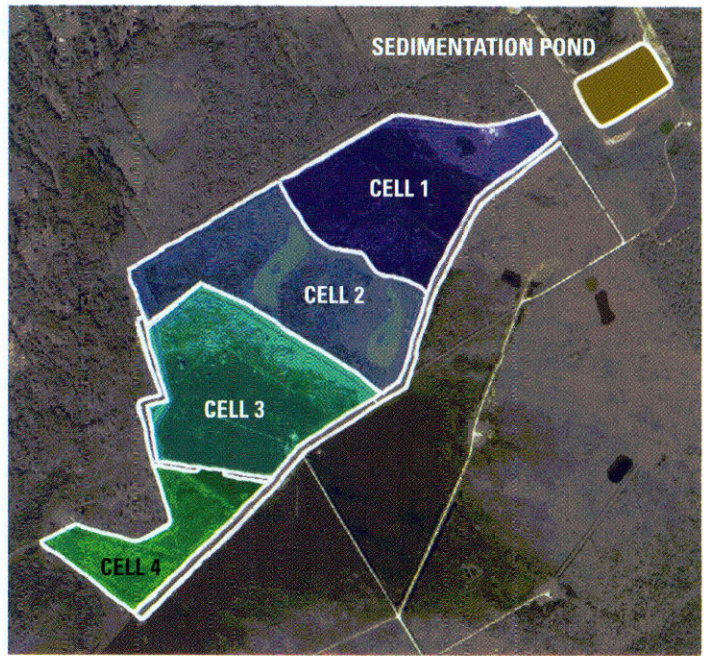
IN THE WORLD OF CONSTRUCTED
WETLANDS, THIS REPRESENTS THE
FIRST OF ITS KIND — A GIGANTIC
WATER RECYCLING PROJECT. AND
243 ACRES IS JUST THE BEGINNING.



"IT REALLY IS SATISFYING TO SEE KIDS LOOK ON IN WONDER AT A SCHOOL OF FISH SWIMMING IN CRYSTAL CLEAR WATER AS IT LEAVES THE SYSTEM," SAYS DARREL ANDREWS.



TRWD water quality manager Darrel Andrews

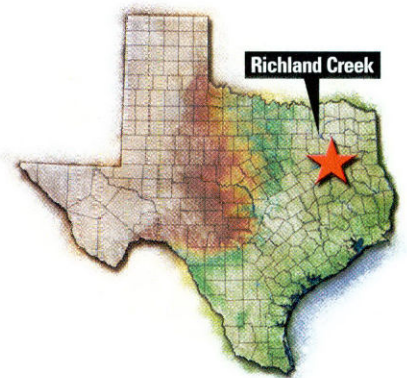


As soon as I step in the shallow wetland, my boot gets stuck in thick mud and I lose my balance. “Oh my gosh! I’m gonna fall!” I say to Darrel Andrews, with the Tarrant Regional Water District (TRWD). I fall backwards, my jacket drenched. I’m cold and wet, but it was my idea to slog through the marsh, so I’m not about to quit before we look around. “Don’t laugh!” I say, as two TPWD biologists — Jeff Gunnels and Hayden Haucke — watch amusedly from the bank.

“Oh, we wouldn’t,” Gunnels says. “At least not while you’re still around!” He hands me a walking stick. “You don’t want to go in without one of these.”

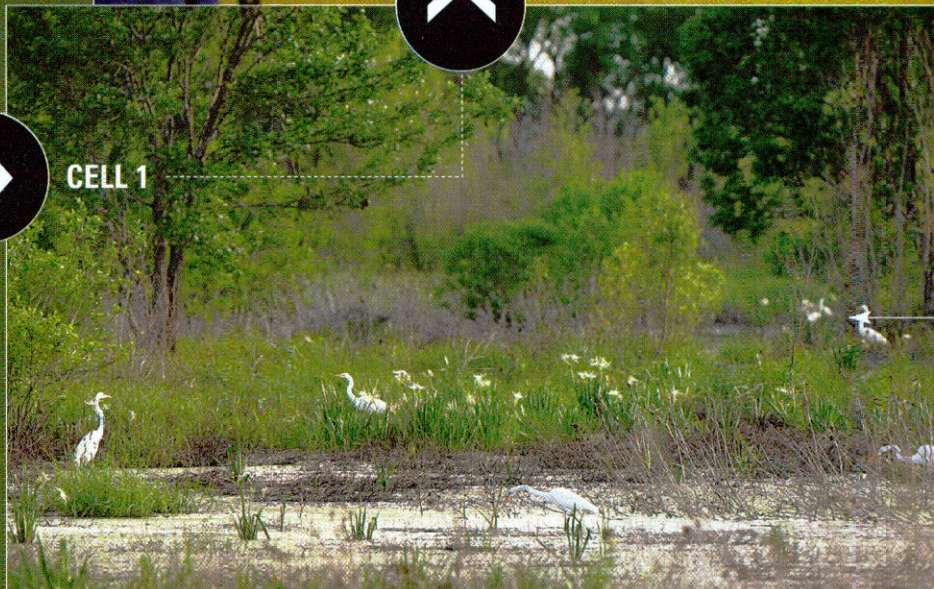
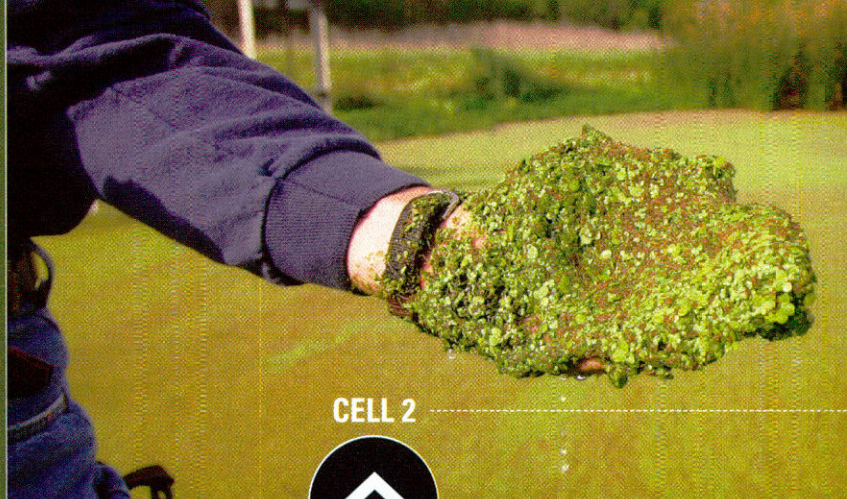
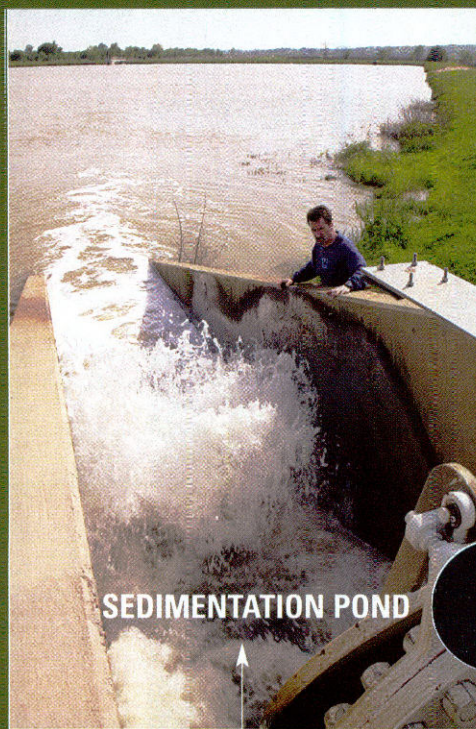
As we trudge through the water, I am entranced by the tiny green duckweed and reddish fernlike azolla floating on the water’s surface, roots dangling into the water. They thrive in the nutrient-rich wetland along with other native vegetation — sedge, bulrush, smartweed, burhead, wild millet. “It’s like a smorgasbord for wildlife,” says Haucke.

This is not your ordinary wetland. The 243-acre “moist soil impoundment” is not a natural wetland, but one imagined by consulting engineer Alan Plummer, planned and paid for by TRWD and formed as a wildlife Shangri-la through the guidance of Gunnels and Haucke, who work on this project at Richland Creek Wildlife Management Area, 80 miles



southeast of Dallas/Fort Worth. In the world of constructed wetlands, this represents the first of its kind — a gigantic water recycling project. And 243 acres is just the beginning.

If you didn’t know better, you might think the shallow ponds — or any wetland for that matter — represent wasted land. There is no aquaculture production. No



The wetland system's flow begins at the Trinity River pump station. The water then flows a little more than a mile through a 42-inch pipeline and enters the sedimentation basin (above), where the bulk of the suspended sediment in the river water falls out. This step keeps sediment build-up to a minimum in the wetland cells.

livestock graze on this once-fallow field. Plenty of birds come here: ducks and geese, majestic wading birds, migratory shorebirds and raptors. Frogs lay their eggs and tadpoles metamorphose within the waters. Mammals — raccoons, opossums, bobcat — quench their thirst or seek a crayfish meal. Aquatic invertebrates live, breathe and help decompose vegetation in the wetland. But what does all this mean for humans?

Beyond their role as wildlife habitats, wetlands are also lean, green, water-cleaning machines. Wetlands remove pollutants and suspended sediment — and they do it quickly, cheaply and efficiently. The popularity of constructed wetlands has skyrocketed in tandem with a body of scientific data documenting their effectiveness.

Constructed wetlands have been around for decades. But Texas has dibs on the first water recycling wetland in the nation, the Richland Creek WMA wetland, which will eventually span a whopping 2,000 acres and augment the city of Fort Worth's

drinking water supply via the Richland-Chambers Reservoir.

This award-winning wetland has been heralded as a model for developing public water supply without creating additional reservoirs. I think of it as a giant, shallow impoundment built on a fallow field instead of a river, with a constant input of water from the Trinity River. Water flows through its finely engineered cells — shallow ponds with interior levees that force the water to follow a serpentine path. A thriving native wetland ecosystem maximizes the project's water-cleaning power.

"We need to make sure that the water coming out of the wetland is at least as good as the water flowing into the reservoir from its tributaries," says Andrews. "The sampling that has been done ... indicates that these wetland systems are capable of meeting that goal." TRWD tests weekly for suspended solids, pH, dissolved oxygen, phosphorus and nitrogen-based compounds. Annually, they also test for a long list of chemicals in soil, vegetation

and water: atrazine, organochlorine and organophosphorus pesticides, PCBs, heavy metals, among others. No law mandates these tests; TRWD conducts them proactively.

"This water entity chose to find an environmentally sensitive solution to water supplies," says Gunnels.

After more than 10 years of testing, it's ready to go live. In late 2007, the final step will be made, connecting the "polished" product to Richland-Chambers Reservoir, which provides drinking water for Tarrant County residents. The water will go through additional processing by municipalities before being delivered to homes.

As effective as wetlands are at cleaning water, they are not miraculous. Toxic chemicals in runoff from agriculture and urban lawns can concentrate in wetland vegetation and sediment. During the past three years, the Richland Creek WMA wetland removed 99 percent of suspended solids, 63 percent of total nitrogen and 54 percent of total phosphorus. However, wet-



After the water leaves the sedimentation basin it flows into the system of wetland cells. The water normally flows from wetland cell 1 into 2 to 3 to 4. There are times when the flow must be altered, but in general, it is sequential.

Water then leaves wetland cell 4 and enters Alligator Creek where it begins a journey of several miles, down to the point where it will be diverted out of the creek channel and pumped over the dam, into the reservoir. This final pump station is not in place yet. The pump station, as well as two new cells, will be constructed as part of an expansion now underway.

land plants contained mercury, lead and arsenic in the pilot scale project. Studies indicate that biofilms on the vegetation — microorganisms that form a slimy film — likely removed the metals, since water and sediment levels were normal.

To reduce such pollutants in an ecosystem, their use must be reduced. A common misconception is that chemical pollution in this region comes largely from agriculture. “Believe it or not, most pesticides or insecticides are not coming from agricultural lands,” says Gunnels. “Farmers run pretty tight operations. They apply what is absolutely necessary. But homeowners go out and, instead of following the recommended rate for ant poison or herbicide, they think ‘if a little is good, a lot is better.’” TRWD and TPWD will continue to monitor chemical accumulation in the sediment to protect wildlife and ecosystem integrity.

Birdwatchers are catching on to the avian hotspot. In spring, TPWD conducts moist soil drawdowns, which allow vegetation to germinate, creating food for wildlife. Acres

of mudflats attract migrating shorebirds, such as yellowlegs, sandpipers, stilts and avocets. In summer, white ibis, herons, egrets and roseate spoonbills frequent the site. More than 5,000 ducks visited last fall — gadwall, shovelers, pintail and teal — and would erupt in great clouds.

Some people criticize the project because the wetlands are artificial, says Gunnels. He retorts, “We know they are artificial wetlands. We want them to simulate natural wetlands as closely as possible. But it is better than the alternative — no wetlands.”

Haucke agrees. This project helps delay — and hopefully prevent — the destruction of some of Texas’ last remaining bottomland hardwood forests, of which about 35 percent of Texas’ original acreage remains. “It’s a win-win situation,” says Haucke. The project pushes the need for additional supply into the future.


There is no simple formula that relates wetland loss to loss of water quality. Constructed wetlands provide exceptional alternatives, but these can’t replace protect-

ing our remaining natural wetlands, particularly with the uncertain future for the Clean Water Act. We need both.

Until the Supreme Court rules again or state laws change, the responsibility for water quality may depend on entities like TRWD willing to bear responsibility for a larger piece of the commons.

Before we started exploring the wetland — where I so elegantly fell in — Andrews topped a bottle with murky Trinity River water. At the last cell, the water’s final destination before it will head towards the reservoir, he fills another bottle with ... crystal clear water.

Andrews wows school kids the same way. “When they see water that resembles hot chocolate and is full of floating debris, we hear a lot of ‘ewww’ or ‘nasty’ or ‘gross,’” says Andrews. “It really is satisfying to see those same kids a couple of hours later look on in wonder at a school of fish swimming in crystal clear water as it leaves the system. It’s at that point when you know they really ‘get’ what this project is all about.” ★

A photograph of a desert wetland. In the foreground, there is a beaver dam made of logs and branches, with green cattails growing from it. To the right, a prickly pear cactus is visible. The middle ground shows a calm body of water reflecting the sky and the surrounding vegetation. The background features rolling hills under a bright sky. The overall scene is a mix of natural and man-made elements.

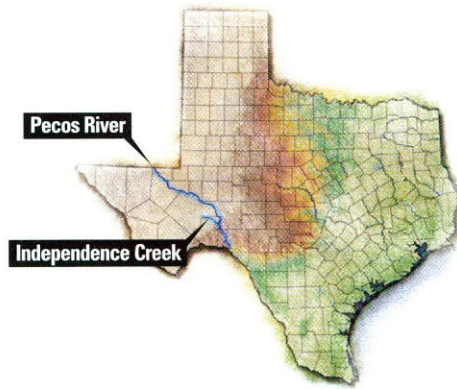
BEAVERS MOVED IN A COUPLE
OF YEARS AGO, AND THEIR DAMS
HELPED CREATE THIS UNIQUE
WETLAND — WHERE CATTAILS
COEXIST WITH PRICKLY PEAR.

Fighting for Independence

*The Nature Conservancy, along with a few determined individuals,
struggled for years to save this one-of-a-kind desert wetland.*

BY JOE NICK PATOSKI
PHOTOGRAPHY BY EARL NOTTINGHAM





HOW TO MAKE YOUR OWN DESERT WETLAND IN FIVE EASY STEPS:

ONE

Be a visionary conservationist.

TWO

Identify the most important springs in West Texas, the ones that feed the lower Pecos River, giving it a translucent aquamarine tint.

THREE

Wait a while, and when some of the land around the springs goes on the market, help the Texas Nature Conservancy buy it, then decide to make your loan a donation to create a preserve, and agree to give it all back to the conservancy upon your death.

FOUR

Wait a while longer and observe how 14 inches of rain in 8 hours can scour the creek and tear out the brushy riparian corridor around it.

FIVE

Notice a pair of beaver move in. Instead of shooting them, sit back and watch their dam-building frenzy.

**EIGHTEEN MONTHS LATER,
VOILA! A FULL-TILT DESERT WETLAND.**



Actually, it took a whole lot longer and was a lot more complicated. But that's more or less how Robert McCurdy came to be the steward of Independence Creek Preserve. The aquatic micro-environment — consisting of springs, a nearly eight-mile creek and wetlands — in the desolate flat-top canyonlands of southwest Texas is so unique, it could not be replicated if lost.

Located in the transitional zone between the Edwards Plateau and the Chihuahuan Desert, Independence Creek has been a popular watering hole for quite a while actually. Humans have been living around the springs and the creek as far back as 12,000 years ago, evidenced by artifacts, Paleo Indian dwellings, ceremonial cave shelters and middens found on the preserve.

For the past 140 years, the springs and creek supported cattle, sheep and goat ranching operations. The most prominent was the Chandler Ranch, mainly because it was located at the confluence of Independence Creek and the Pecos River and always had water, a precious commodity in the desert scrub. For 40 years in the mid-20th century, the Chandler was a resort destination with manicured grounds and a nine-hole golf course. The ranch's history is well told in the book *On Independence Creek: The Story of a Texas Ranch* by Charlena Chandler (Texas Tech University Press), who grew up on the ranch.

In 1991, ranch owner Joe Chandler contacted the Nature Conservancy. He knew his ranch was special — he'd been welcoming biologists to study the land for decades — and he was getting up in years. He told the Conservancy he wanted a conservation easement on the ranch. The Conservancy had targeted the Devils River/Rio Grande/Pecos River complex as a watershed worth saving, and Independence Creek was the major tributary of the Pecos. A deal was struck. The Nature Conservancy placed such a high value on the site that it purchased a 702-acre conservation easement from the Chandlers. The terms included reverting the gold course to prairie and allowing access through the Chandler land for Conservancy personnel and researchers.

Seven years later, the Nature Conservancy became an Independence Creek landowner when the organization bought the Bailey Ranch adjacent to the Chandler Ranch. The Bailey was known habitat for the



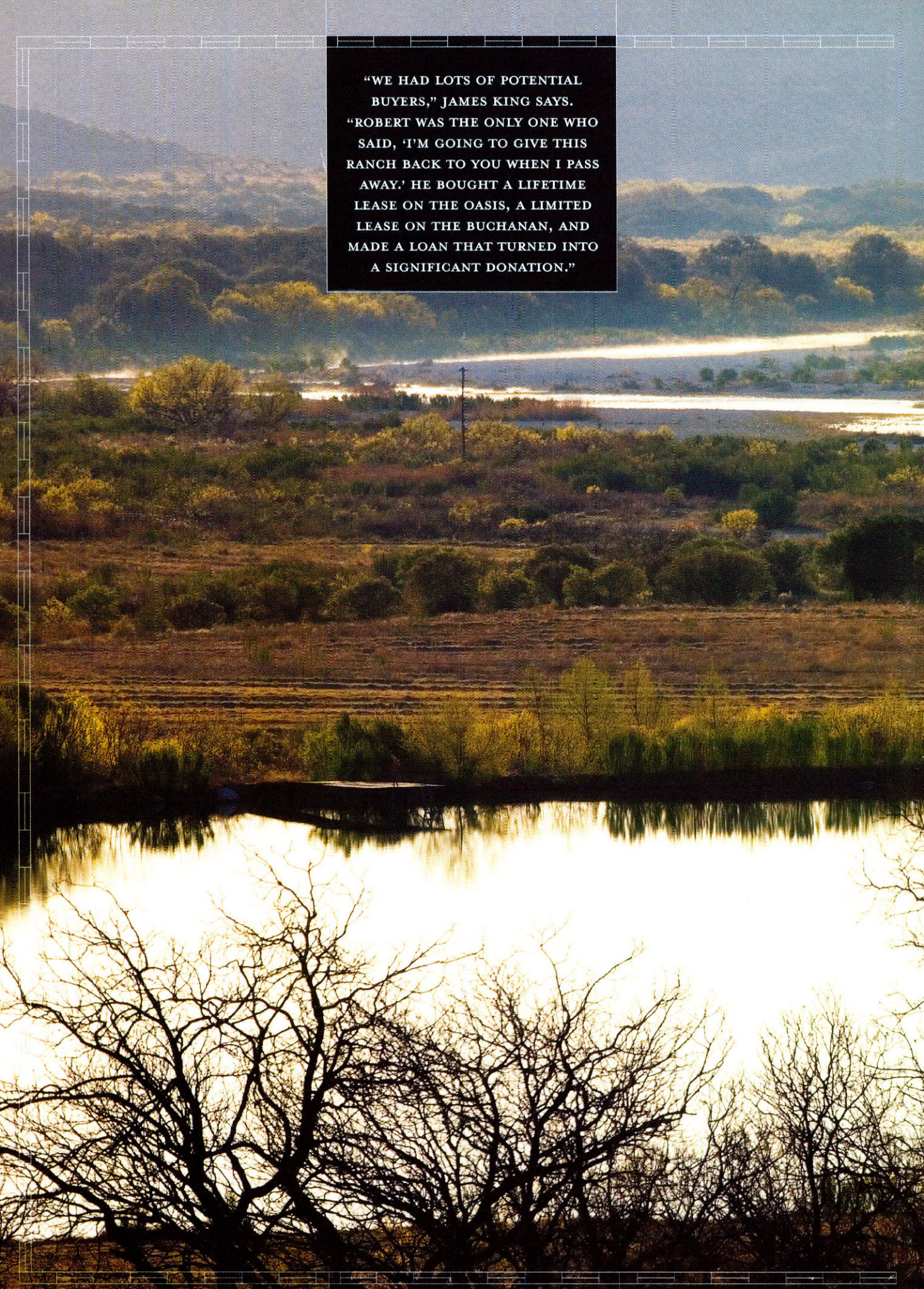
MCCURDY IS HARDLY YOUR GARDEN VARIETY CONSERVATIONIST. A TALL, DARK-HAIRED GENTLEMAN WITH RUGGED FEATURES, HE GREW UP NEAR THE RIVER BOTTOMS OF THE WEST FORK OF THE TRINITY RIVER IN FORT WORTH.

endangered black-capped vireo and included one mile of the Pecos River. In 2000, the Conservancy acquired the Oasis Ranch and three more miles of creek from the Bill Roden family of Midland, and the neighboring Canon Ranch the following year. In four years, the Nature Conservancy purchased 19,740 acres of land in and around Independence Creek for the express purpose of keeping it natural.

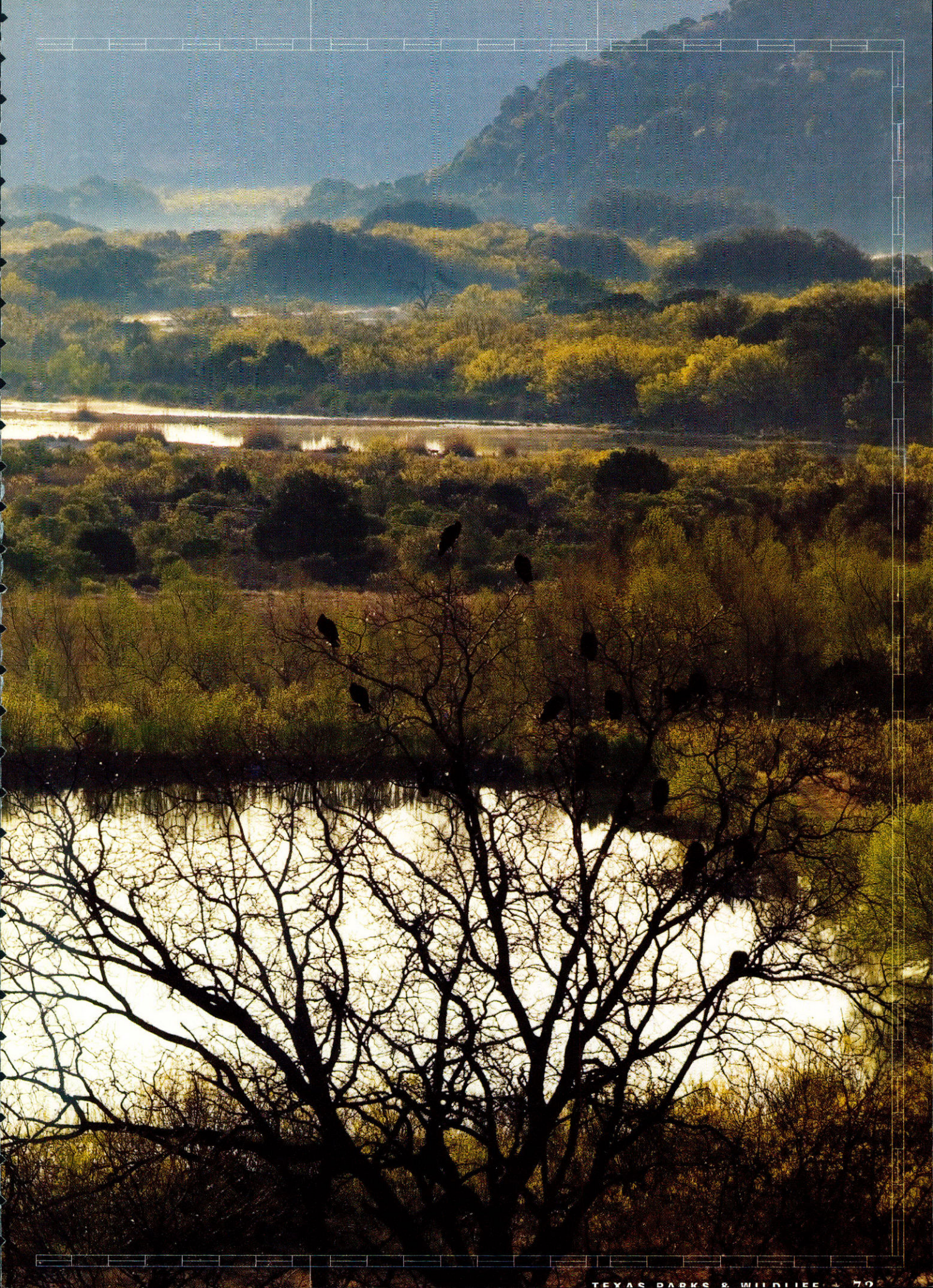
In most cases, the Nature Conservancy of Texas would have sought buyers for the ranches willing to put most of the land in conservation easements where the owner promises to leave the land as is, rather than develop it, and pay lower taxes on the "devalued" land. But the more the Conservancy learned about Independence Creek, the more it became clear this was no

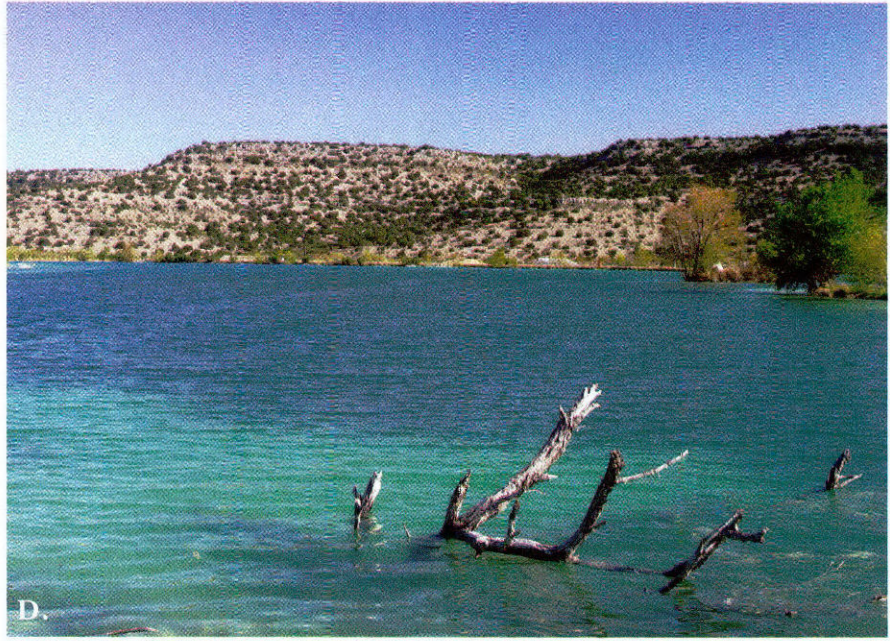
ordinary piece of real estate. "Our science committee was very concerned about how you sell this to a buyer and make sure the easement protects the water resource," says James King, the West Texas program manager for the Nature Conservancy of Texas. "We didn't realize how exceptional it was. Larry McKinney, the director of the TPWD coastal fisheries division, called it the most important piece of water in West Texas."

That's where Robert McCurdy stepped in. He proposed a lifetime conservation lease with recreational rights to the Oasis Ranch. "We had lots of potential buyers," King says. "Robert was the only one who said, 'I'm going to give this ranch back to you when I pass away.' He bought a lifetime lease on the Oasis, a limited lease on the Canon, and made a loan that turned into



“WE HAD LOTS OF POTENTIAL BUYERS,” JAMES KING SAYS. “ROBERT WAS THE ONLY ONE WHO SAID, ‘I’M GOING TO GIVE THIS RANCH BACK TO YOU WHEN I PASS AWAY.’ HE BOUGHT A LIFETIME LEASE ON THE OASIS, A LIMITED LEASE ON THE BUCHANAN, AND MADE A LOAN THAT TURNED INTO A SIGNIFICANT DONATION.”





A. and B.: The spring water that feeds Independence Creek and the Lower Pecos. **C., D. and E.:** The future of these impoundments, which have offered fishing and recreation, has not been decided. Note the dead trees hauled into the lake (in photo **D.**) to create habitat for fish. **F.:** The ranch is the westernmost habitat for the black-capped vireo.



a significant donation. Most people we work with on easements donate some of their net worth. Robert gave most of his."

McCurdy is hardly your garden variety conservationist. A tall, dark-haired gentleman with rugged features, he grew up near the river bottoms of the West Fork of the Trinity River in Fort Worth. He learned how tough a conservation fight can be in the 1970s, when he successfully beat back the Nantucket Island Board of Selectmen's designs on neighboring Esther Island, which remains roadless. He opened the Austin Angler, the first retail shop specializing in fly fishing in Texas. Throughout the 1980s, he headed the Clear Clean Colorado River Association, a citizen group that fought the city of Austin's practice of dumping partially treated sewage into the Colorado River (and past his home on Hill's Prairie east of Bastrop) and initiated a public schools program for monitoring water quality.

Independence Creek isn't his first dance with the Nature Conservancy. He donated over 400 acres of land on the north shore of Caddo Lake in northeast Texas in 1990, which ultimately led to the Conservancy and the Texas Parks and Wildlife Department purchasing 7,000 acres for a state wildlife management area on the lake.

McCurdy's happy with the Independence Creek arrangement. He gets the main ranch house on the Oasis, built in the 1890s, and access to hunt the wetlands for ducks and fish the creek and the ponds. "They told me this place was carpeted with ducks," McCurdy says, nodding with a wink towards James King as 50 mallards took off behind him. "I said 'that better be true'." He also gets great advice. Not for nothing is Independence Creek a wetlands laboratory. Field researchers are frequent guests at the 21-bed bunkhouse. "One of the perks I get from this is less ignorance," McCurdy says. "I get to hang out with scientists."

They have educated McCurdy well. He is quick with the facts. The springs are upwelling with hydrostatic pressure from the Edwards-Trinity Aquifer. About 20,000 gallons per minute (44.6 cubic feet per second) of pure, pristine spring water rise to the surface along the first three miles of Independence Creek. The gravity springs effectively double the flow of the Pecos River, and run cool (71 degrees F), swift and clear, cutting total suspended solids in half. The creek is home to two

locally abundant, but threatened, aquatic species — the proserpine shiner and the headwaters catfish, found only along the Devils, the Rio Grande and the Pecos rivers. The ranch's waters also harbor the Rio Grande cichlid, the only native cichlid found in the United States. The area also harbors the westernmost megapopulation of vireo and an extensive array of neotropical migrants, waterfowl and shorebirds. Both belted and ringed kingfisher are found at Independence Creek.

On a drive around the Oasis, the bird spotting started before seat belts were buckled. A vermilion flycatcher was flitting in the trees near the bunkhouse, flashing red. Greenwing teal, pintail and cinnamon teal were seen on the lower lake. A flock of wild turkey rushed from under the huge canopy of an oak tree near the creek. Overhead, a kestrel soared.

While we rode around, project manager Jason Wrinkle, another Fort Worth area native and McCurdy's sometime foil, pointed out mitigation projects in progress. Irrigated fields of oats and alfalfa were being converted into a native grass seed farm for use on the ranch, for Conservancy partners and for neighboring ranches. Ninety miles of fencing have been removed. Power lines were rerouted. Exotics are being removed from the ponds. The deer herd has been thinned out to near carrying capacity. "When we first came out here, the kidneywood was worn to the nub with very short stems," Wrinkle explains. "Since that's a favorite browsing source for deer, we knew there were too many deer on the land." The ratio has been knocked down to one per 18 acres.

There are plenty of "stay tuned" deals, as McCurdy refers to unanswered questions, such as why they were finding vireos all along the creek, never more than 100 yards from the water, but nowhere else. Wrinkle calls them "be patient" propositions. "Things happen *sooooo* slow around here," he draws with a smile.

They haven't figured out what to do with the walled-in bank by the main springs, two lakes that were impounded, one in the 1930s and the other in the 1980s, or the dam and irrigation channels. McCurdy pointed out the dead trees that have been dragged into the shallows of the lower lake. "Robert's building fish habitat single-handedly," Wrinkle says of McCurdy's determination to add organic material to

the lakes. The purity of the springs flowing into the lakes leaves them sterile. "It's not a drainage, so nothing fertile is coming in," McCurdy says. Dead trees are a start.

For all the projects discussed, no one anticipated the beaver, whose presence has accelerated wetlands restoration dramatically. "In two seasons of doing this, we've had just about every species of duck from the Central Flyway to the Mountain Flyway," McCurdy says. "Two hundred years ago, this part of Terrell County was beautiful prairie land. Prairie dogs and prairie chickens were everywhere. One of the best things we can do with the water that we're blessed with is bring back the wetlands. We've lost so many prairie potholes, cienegas and springs. We can do a lot of good with this."

Before first light the next morning, McCurdy had us huddled in waders at the edge of a marsh, where cattail coexist with prickly pear, to watch the morning liftoff. As the darkness gradually faded, the wildlife stirred. In the palest of light, we could make out two beaver or nutria weaving their way through the water into a pile of sticks. "See that fringe of sticks?" McCurdy whispered. "That's beaver levee work right there."

As the light improved, the liftoff began. Widgeon, gadwall, and mallard lifted off in flights of threes, fives and tens. Teal and coot joined in. Jason pointed out a snipe that landed at our feet. As the light improved, we spotted a zone-tailed hawk circling above. "OK, it's a good morning," McCurdy declared.

"It's mind-blowing here on the edge of the Chihuahuan Desert to see wetlands created by these frontier beaver," he said. He wasn't kidding. I saw the trunk of a live oak 10 inches in diameter felled with a very clean cut. These beaver would chew up anything. The beaver arrived after the big flood of July 2004. "It rained 14 inches in 8 hours in this watershed and changed everything," Jason Wrinkle said. "The [riparian] corridor had been heavily vegetated to the point you couldn't see the water unless you were right up next to it. The flood scoured the whole thing. That's how it's supposed to be — exposed rock banks." The clearing looked like an opportunity to the beaver moving in, and the humans who owned the land welcomed them. A year and a half later, a desert wetland is in the making. ★

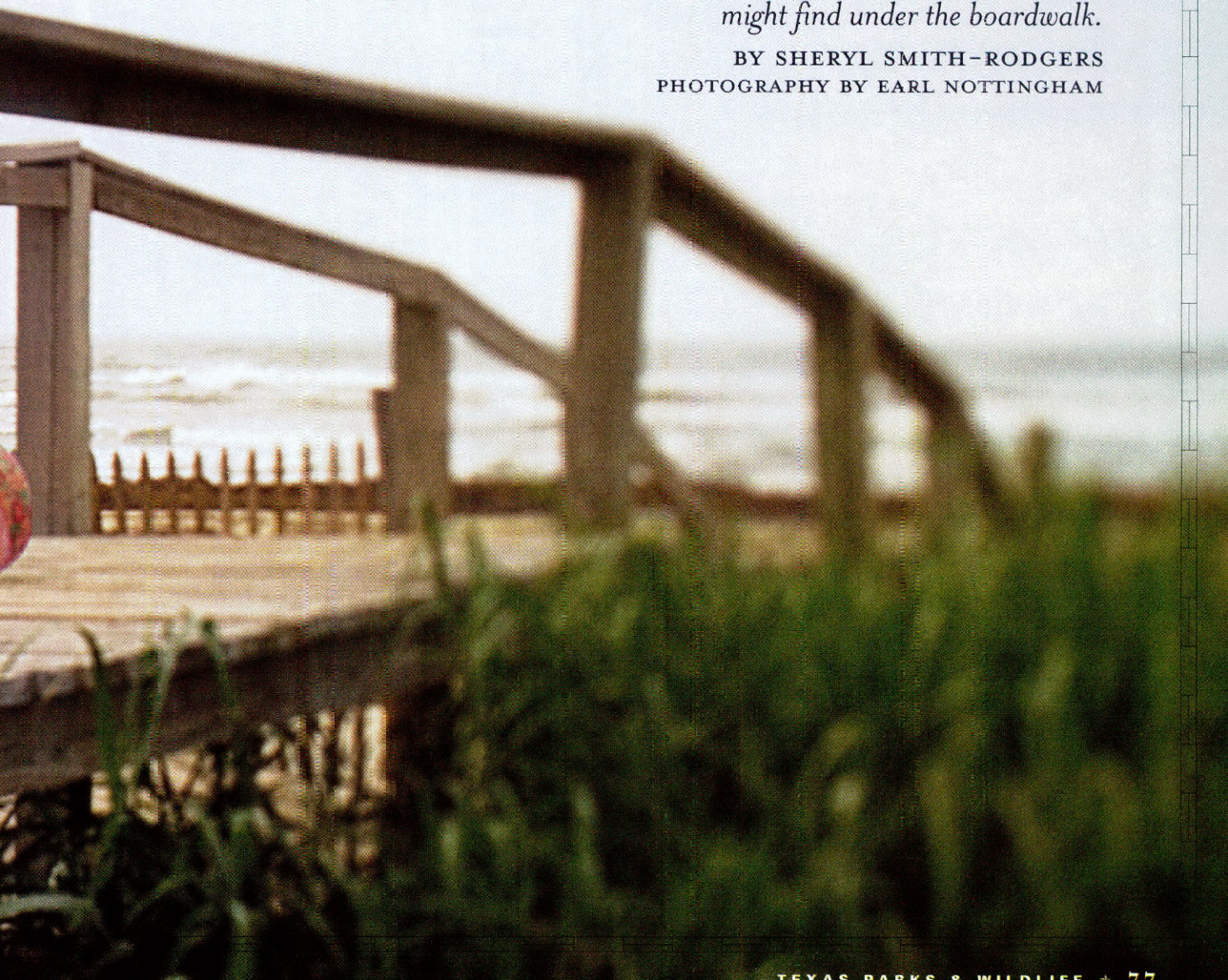
Top 10 Boardwalk

IT'S THE BEST WAY TO GET TO THE BEACH, AND IT'S THE BEST WAY TO ENJOY THE UNIQUE VEGETATION AND SPOT THE WILDLIFE UNIQUE TO THIS LANDSCAPE.

walks

From exotic birds to carnivorous plants, you never know what you might find under the boardwalk.

BY SHERYL SMITH-RODGERS
PHOTOGRAPHY BY EARL NOTTINGHAM



Wetlands sustain an astonishing diversity of plant and animal life. So much untold beauty and drama lies within the mysterious marshes and obscure swamplands of Texas. To experience and witness the ever-changing cycles of life that unfold within these fragile environments, you'd have to don waders and rubber boots, then slog your way through the mire. Not only would you get grungy fast, but your tromping through the water would further damage an already imperiled habitat. ¶ Thanks to manmade boardwalks, you can experience wetlands firsthand without getting soggy. Across the state, a number of "sidewalks over water" have been erected to provide an easier and gentler method of viewing the diverse species of birds, animals and plants that inhabit our marshes, swamps and bayous. ¶ Amazingly, Texas boasts a number of boardwalks, including one as far west as Big Bend National Park. Read on, and you'll learn about 10 sites across the state that host great boardwalks. As a bonus, there's an "honorable mention" list of a few more boardwalk sites you'll want to check out, too.



Leonabelle Turnbull Birding Center, Paradise Pond, Wetland Park, Port Aransas

LEG DEEP IN MURKY WATER, A TRICOLORED HERON stands perfectly still, its eyes sharply focused on something moving within the marsh's shallow depths. Oblivious to the small crowd that's gathered on the nearby boardwalk, the slender-necked, gray-feathered bird moves ever so slightly, then darts its long yellow bill into the water.

"He got a minnow!" exclaims an onlooker. "A pretty good sized one, too!"

At the Leonabelle Turnbull Birding Center in Aransas Pass, you'll get an up-close look at life in a wetland from a wooden boardwalk that extends past a jungle of cattails and into a large body of brackish water. Birders armed with binoculars gravitate to an elevated observation deck (located midway down the boardwalk) that offers panoramic views of the marsh.

As you stroll down the boardwalk, red-winged blackbirds call out raucously from their hiding places amid the cattails. In the water, turtle heads pop up here and there while a sociable group of cormorants sun themselves on a triangle-shaped roost fashioned from wooden boards.

Around the marsh's edges, brown pelicans, great egrets and roseate spoonbills hunt for meals. Two American alligators — nicknamed Boots and Bags — also claim the marsh as home. At the end of the boardwalk, a bevy of noisy black-bellied whistling-ducks, northern shovelers and dowitchers feed and feud in the shallow water.

Less than a half-mile away from the birding center, you can slip into a heavily wooded wetland habitat via another wooden boardwalk at Paradise Pond. Three outboxes offer views of the freshwater pond, where an abundance of birds, including great blue herons, warblers and other songbirds, feed and nest.

Within a short drive, you'll find the 361 Wetland Overlook, a short boardwalk and gazebo that overlook tidal flats, home to many water birds and cranes.

(361) 749-4158; <www.portaparks.com>



Big Thicket National Preserve

YOU'LL FIND THE BIGGEST NUMBER OF BOARDWALKS AT — where else? — the Big Thicket National Preserve. More than 75 boardwalks of varying lengths can be found within the preserve's 97,000-plus acres in East Texas, where three biologically rich ecosystems — hardwood forests, coastal plains and midwest prairies — converge. In all, the preserve has eight trails totaling more than 45 miles. The Kirby Nature Trail System and its 15 boardwalks meander through a mixture of hardwoods and pines, then bald cypress swamps, while the Turkey Creek Trail and its 43 boardwalks cross through sandhill pine uplands, mixed forests and flood plains. Don't miss the Pitcher Plant Trail, which features an observation deck with benches for optimum viewing of the preserve's fascinating enclave of carnivorous pitcher plants.

(409) 951-6725; <www.nps.gov/bith>



Laguna Madre Nature Trail, South Padre Island Birding and Nature Center, South Padre Island

THE DYNAMIC HANDIWORK OF WIND AND WAVES can be seen at the South Padre Island Birding and Nature Center, one of nine sites that are part of the World Birding Center network in South Texas. Here, a 1,500-foot-long boardwalk cuts through tall marsh grass and links four acres of wetlands to the Laguna Madre shore. From two observation blinds, you can watch birds, fish, turtles, crabs, dragonflies and maybe even an alligator. Along the boardwalk, informative panels tell about the dune systems and birds that frequent South Padre Island, the first stopover for migratory species making the cross-Gulf trip from Southern Mexico and northern Central America.

(800) 767-2373 or (956) 761-3005;
<www.worldbirdingcenter.org/sites/spi/>
and <www.sopadre.com>

Galveston Island State Park, Galveston

WALK ALONG ONE OF 14 BOARDWALKS HERE that lead to the beach, and you'll likely spot some small, mysterious holes dug into the dunes. Land-loving ghost crabs — named for their light coloring and swift little legs — inhabit those sandy burrows. Among the dunes, you may also see cottontail rabbits, mice, coyotes and diamondback rattlesnakes. Approximately 4.5 miles of trails that include two boardwalks wind through the park's wetlands. Watch for blue crabs, herons, egrets, roseate spoonbills, mullets and other wildlife. (409) 737-1222; <www.tpwd.state.tx.us/spdest/findadest/parks/galveston/>





Formosa Wetlands Walkway, Lighthouse Beach and Bird Sanctuary, Port Lavaca

SUNRISE BREAKS GENTLY OVER LAVACA BAY and across Lighthouse Beach, casting a warm amber light on the Formosa Wetlands Walkway. The elevated boardwalk, constructed of recycled plastic, stretches for some 2,200 feet over coastal wetlands and a tidal exchange basin. From the Alcoa Bird Tower and an elevated gazebo along the walkway, you can watch the many birds, crabs, fish, snakes and other animals that inhabit the area. Beautiful roseate spoonbills often perch along the walkway. (361) 552-1234; <www.portlavaca.org/beach/lhbeach.html>

Anahuac National Wildlife Refuge, Anahuac

COME SUMMER AT ANAHUAC NATIONAL WILDLIFE REFUGE, long-legged black-necked stilts and colorful purple gallinules build nests around Shoveler Pond, a large freshwater marsh. Shielded by tall stands of cane and cattails, a wide, 750-foot-long boardwalk gives a water-level view of resident birds and wildlife, including great blue herons, snowy egrets, white-faced ibis, marsh wrens and mottled ducks. You may also glimpse American alligators sunning themselves on banks.

The refuge has no drinking water, so bring your own.

(409) 267-3337; <www.fws.gov/southwest/refuges/texas/anahuac/>





Armand Bayou Nature Center, Houston

MORE THAN 370 SPECIES OF BIRDS, MAMMALS, REPTILES AND AMPHIBIANS inhabit the 2,500 acres of Armand Bayou Nature Center, one of the nation's largest urban wilderness preserves. The refuge protects remnants of the region's original ecosystems — estuarine bayou, riparian forest and tall grass prairie. A 600-foot-long boardwalk leads past a raptor exhibit (which houses two rehabilitated red-tailed hawks that are unable to survive on their own), through a hardwood forest and over a pond. Along the walkway, you'll see an abundance of birds, turtles, armadillos, snakes and white-tailed deer.

(281) 474-2551; <www.abnc.org>



Cibolo Nature Center, Boerne

THIS 100-ACRE PRESERVE PROTECTS FOUR ECOSYSTEMS found in the Texas Hill Country — riparian forest, oak savannah, tall grass prairie and spring-fed marsh. A 4-mile trail system includes a quarter-mile boardwalk that crosses a marsh. Children especially love to sprawl on their stomachs and peer into the water below. Crayfish, leopard frogs, great blue herons and spring peepers feed and hide among the cardinal flowers, wild rice and buttonbushes. (830) 249-4616; <www.cibolo.org>



Rio Grande Village Nature Trail, Big Bend National Park

EVEN DESERTS HAVE WETLANDS. At Big Bend National Park, the Rio Grande Village Nature Trail takes visitors on a three-quarter-mile loop that crosses a two-acre beaver pond via a wide boardwalk (no handrails). Fed by a warm freshwater spring and surrounded by mountains, the pond hosts the world's only population of endangered Big Bend mosquitofish (*Gambusia gaigei*). Along the water's edge, thick stands of willows and honey mesquite attract green kingfishers, American bitterns, common black-hawks, roadrunners, warblers and shore birds. (432) 477-2251; <www.nps.gov/bibe>

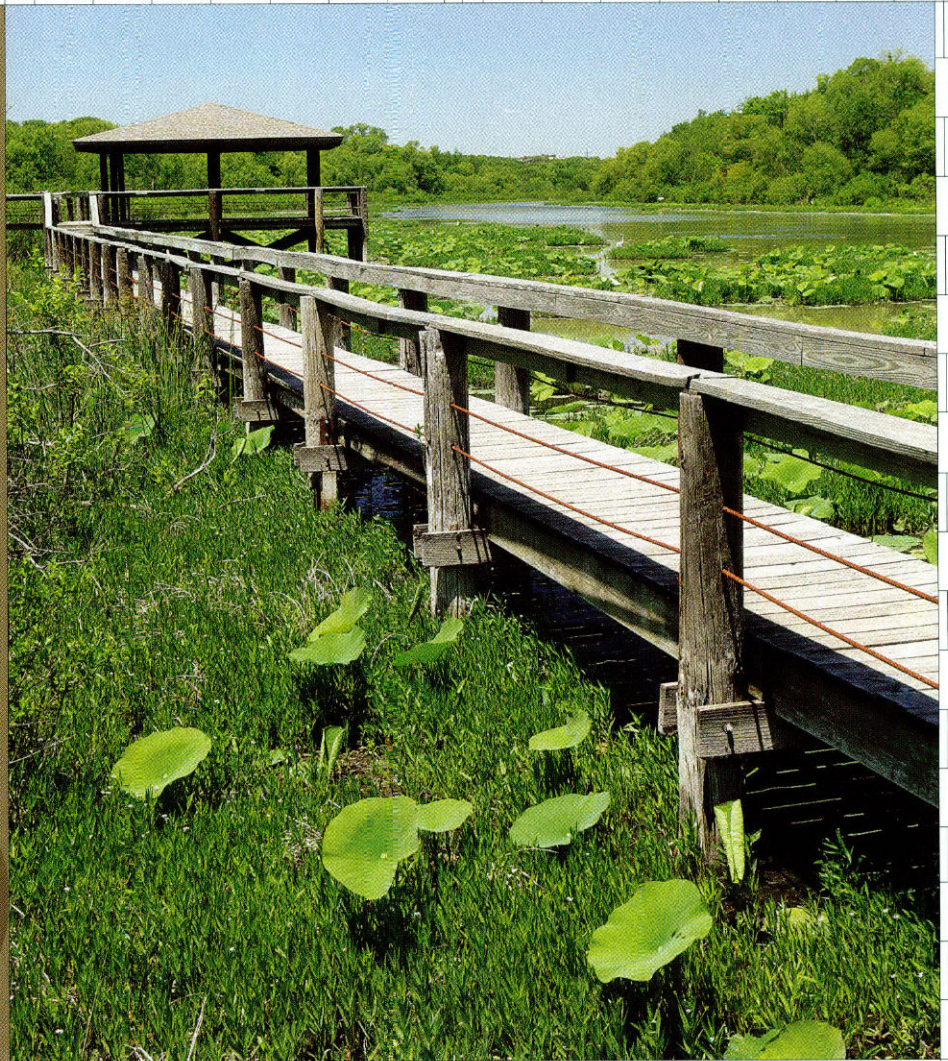


Fort Worth Nature Center and Refuge, Fort Worth

FORESTS, PRAIRIES AND EVEN WETLANDS COMPRISE THIS 3,600-ACRE WILDERNESS just a short drive away from downtown Fort Worth. The Fort Worth Nature Center and Refuge — one of the country's largest city-owned nature refuges — straddles the West Fork of the Trinity River and protects almost 1,000 acres of pristine wetlands.

The 800-foot-long Marsh Boardwalk stretches across a wide marsh that was once a river channel. During summer months, hundreds of lotus lily pads burst into bloom, dotting the marsh with lemon-colored flowers. Prothonotary warblers, eastern phoebes, great blue herons and occasionally pileated woodpeckers can be seen around the marsh. American alligators, turtles, bullfrogs, toads, snakes and even green tree frogs inhabit the area. The marsh's fairly clear water allows good visibility of resident orangespot sunfish, spotted gar, gambusia and minnows.

(817) 237-1111; <www.fwnc.org, www.naturecenterfriends.org>



HONORABLE MENTIONS:

* ARANSAS NATIONAL WILDLIFE REFUGE, AUSTWELL
COME SEE THE REFUGE'S BOARDWALK and its star residents — endangered whooping cranes (late October to mid April).
(361) 286-3559; <www.fws.gov/southwest/refuges/texas/aransas.html>

* BRAZOS BEND STATE PARK, NEEDVILLE
THE CREEKFIELD LAKE NATURE TRAIL is a half-mile, paved trail that includes a boardwalk and observation deck for wildlife viewing at the park's wetlands. (979) 553-5101; <www.tpwd.state.tx.us/spdest/findadest/parks/brazos_bend/>

* HANS A. SUTER WILDLIFE PARK, CORPUS CHRISTI
AN 800-FOOT-LONG BOARDWALK with a viewing platform extends into a marsh. (361) 880-3460

* QUEEN ISABELLA CAUSEWAY WETLANDS, SOUTH PADRE ISLAND

THE BOARDWALK HERE PASSES by some of the largest black mangroves in Texas.
(800) 767-2373 or (956) 761-3005

* SABAL PALM AUDUBON CENTER AND SANCTUARY, BROWNSVILLE
AT THIS 527-ACRE SANCTUARY NEAR THE RIO GRANDE RIVER, a boardwalk passes through a jungle of Sabal Palm and Texas Ebony trees.
(956) 541-8034;
<www.audubon.org/local/sanctuary/sabal/>

* SAN BERNARD NATIONAL WILDLIFE REFUGE, BRAZORIA
THREE TRAILS — Bobcat Woods Trail, San Bernard Oak Trail and Scoby Lake Trail — feature approximately 1,000 feet of boardwalks. Follow the San Bernard Oak Trail to pay homage to the state's champion live oak.
(979) 964-3639; <www.fws.gov/southwest/refuges/texas/texasmidcoast/san_bernard.htm>

* SHELDON LAKE STATE PARK, HOUSTON
TWO MILES OF NATURE/INTERPRETIVE TRAILS feature boardwalks and viewing platforms.
(281) 456-2800; <www.tpwd.state.tx.us/spdest/findadest/parks/sheldon_lake/>

* TONY HOUSEMAN WILDLIFE MANAGEMENT AREA, PORT ARTHUR
AT THIS 3,343-ACRE WILDLIFE MANAGEMENT AREA, a 600-foot boardwalk leads visitors from a Texas Travel Information Center into the Blue Elbow swamp. (409) 736-2551;
<www.tpwd.state.tx.us/huntwild/hunt/wma/find_a_wma/list/?id=38>

* DOUBLE LAKE RECREATION AREA, SAM HOUSTON NATIONAL FOREST, COLDSRING
THE DOUBLE LAKE NATURE TRAIL features a 475-foot-long boardwalk with a birdwatching area. (888) 361-6908 or (936) 344-6205;
<www.fs.fed.us>

REAL

MONKEYS

HOW CAN THEY LIVE?

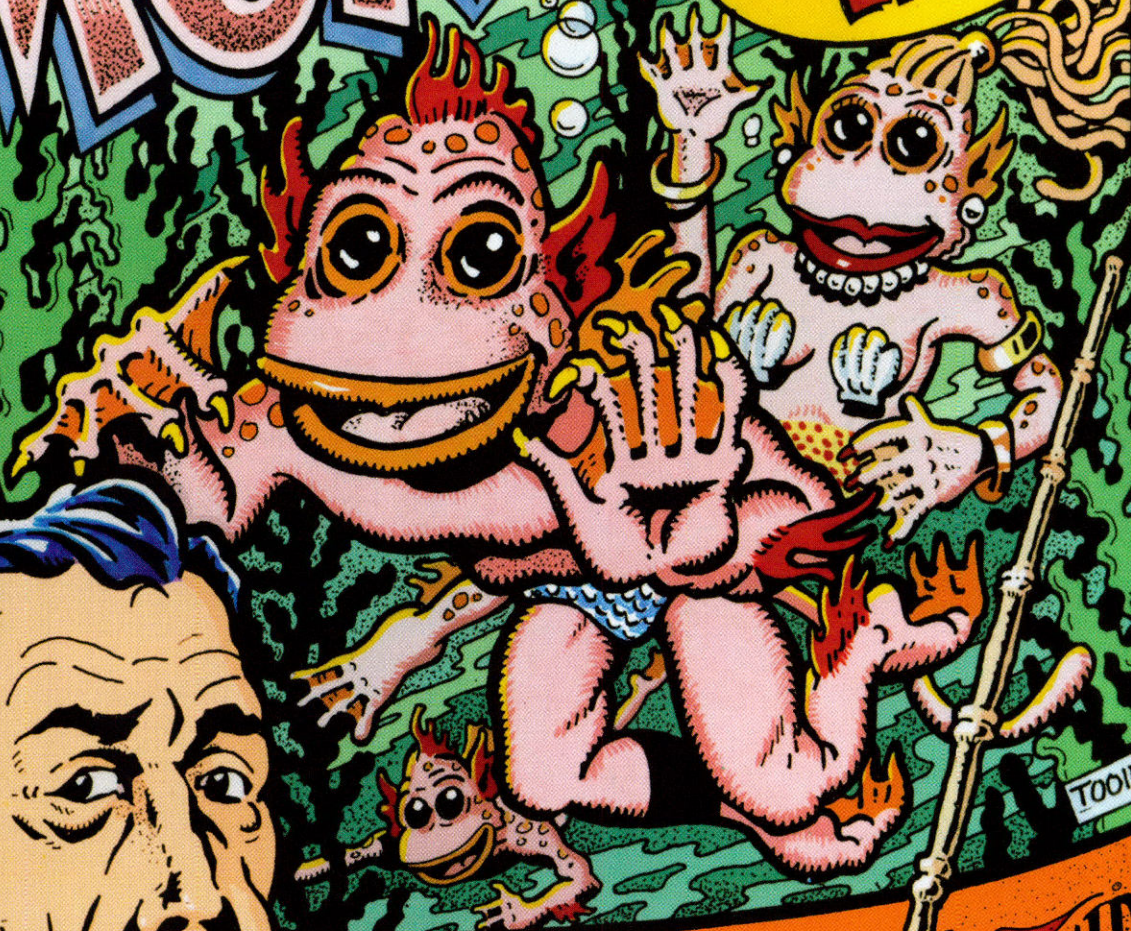
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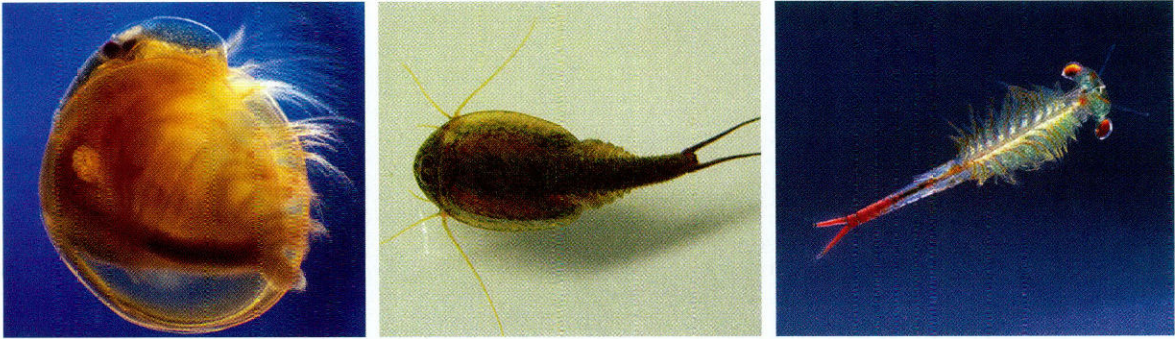
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SHOW

ALIVE INSIDE

TOO!ER





Above, left to right: Clam shrimp, tadpole shrimp and fairy shrimp. Collectively known as branchiopods, these distant relatives of marine shrimp have a knack for living in waters that are too salty, too small or too uncertain to support most forms of aquatic life.

Life in a Puddle

The dormant embryos of “Sea-Monkeys” and other branchiopods can survive being frozen, thawed and even eaten by a bird.

By Dyanne Fry Cortez

Illustration by George Toomer

SOME CRITTER SIGHTINGS leave lasting impressions. Javier Cortez was working with a survey crew in the 1970s when he found a colony of tadpole shrimp in a pool of rainwater on a Kerr County ranch. At the time, he had no idea what they were. “I thought they were tadpoles at first,” he says. “They were brown and had that teardrop shape, round in front, narrow in back.”

Close inspection changed his mind. A tadpole has a tail, but this animal had two lengthy projections at the back end. The rounded front was a shell-like structure that covered most of the body. A co-worker flipped one over to look at the underside and found dozens of tiny, wriggling legs. Cortez wondered if his crew had found the last remnant of a prehistoric life form.

In fact, tadpole shrimp are alive and well in Texas. They belong to a group of

freshwater crustaceans that also includes fairy shrimp and clam shrimp. Collectively known as branchiopods, these animals have a knack for living in waters that are too salty, too small or too uncertain to support most forms of aquatic life.

Sharp-eyed observers can find branchiopods in the Panhandle’s playa lakes, the vernal pools of Enchanted Rock SNA and Hueco Tanks SHS, stock ponds, roadside ditches and other spots that hold water at certain times of year.

Branchiopods are distant relatives of the saltwater shrimp sold in seafood restaurants. Like all crustaceans, they have segmented bodies with compound eyes, chewing mouthparts and two sets of antennae. It may take a magnifying lens to discern those features. Most branchiopods are no more than two inches long, and some are considerably smaller.

Fairy shrimps (order Anostraca) make up the largest group, with close to 300 species worldwide. They’re the only branchiopods that actually look like shrimp, though they lack the tough outer shell of their seagoing kin. North American species have stalked eyes and 11 pairs of legs that are used for swimming and gathering food. They tend to swim belly up.

A few species qualify as giants, with adults measuring three to six inches, but most fairy shrimps are tiny. The 16 species found in Texas range from half an inch to an inch and a quarter when full grown.

This order includes brine shrimp (*Artemia* sp), which were packaged and sold as “Sea-Monkeys” in the 1960s and ’70s. Found in dime stores and comic-book ads, Sea-Monkeys were marketed as “instant pets,” good for hours of fun. Brine shrimp are also sold as fish food for the hatchery and aquarium trades. In nature, brine shrimp prosper in the Great Salt Lake and in other highly saline

SHARP-EYED OBSERVERS CAN FIND BRANCHIOPODS IN THE PANHANDLE’S PLAYA LAKES AND IN THE VERNAL POOLS OF ENCHANTED ROCK AND HUECO TANKS STATE PARKS.

(Continued on page 95)

TOP CENTER PHOTO BY IPW/D; TOP LEFT AND RIGHT PHOTOS © BRUCE J. RUSSELL/BIOMEDIA ASSOCIATES

(continued from page 89)

- 6 a.m.; KVRT-FM 90.7 / 5:33 p.m.;
 KLUX-FM 89.5 / throughout the day
CROCKETT: KIVY-AM 1290 / 8:20 a.m.,
 KIVY-FM 92.7 / 8:15 a.m.
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EL CAMPO: KULP-AM 1390 / 2:36 p.m.
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FAIRFIELD: KNES-FM 99.1 / Sat. mornings
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FORT STOCKTON: KFST-AM 860 / 7:10
 a.m.; KFST-FM 94.3 / 7:10 a.m.
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 a.m., 4:20 p.m.
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 7:54 a.m., 11:42 p.m., 6:42 p.m.; KRVL-
 FM 94.3 / 5:54 a.m., 11:42 p.m., 6:42 p.m.
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PECOS: KIUN-AM 1400 / 10:30 a.m.
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June 25 - July 2:

Preserving the natural Neches; Bastrop State Park; Native American archeology in East Texas; safe gun transportation; two wheelers at Garner.

July 2 - 9:

Hall of Fame angler Ray Murski; black bear research in West Texas; wildlife on the WW Ranch; Sundown Island birds; reliving history at Fort Richardson.

July 9 - 16:

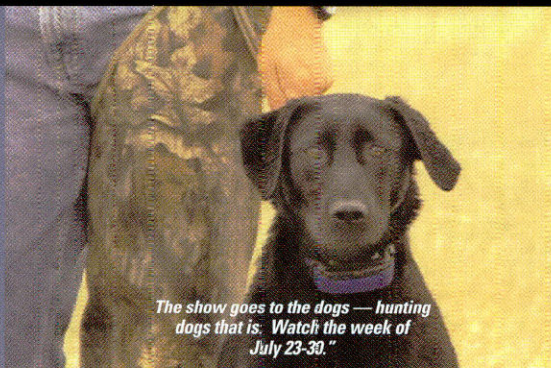
From cadet to warden in six months; Lake Texoma; animal homes; Landmark Inn bed and breakfast; access to history at Hueco Tanks.

July 16 - 23:

Outdoor photography tips; water is the new liquid gold; backwater tours at Martin Dies; geology and ecology of barrier islands; Meridian State Park.

July 23 - 30:

Fantastic fishing at Fairfield Lake State Park; bird dog trainers; restoring habitat on Shepard's Mountain; El Paso poppies; creatures of the night.



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BRYAN-COLLEGE STATION: KAMU, Ch. 15 / Thurs. 7 p.m. / Sun. 12 p.m.

CORPUS CHRISTI: KEDT, Ch. 16 / Sun. 12 p.m. / Fri. 2:00 p.m.

DALLAS-FORT WORTH: KERA, Ch. 13 / Sun. 12:30 p.m. (airs October - March)

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EL PASO: KCOS, Ch. 13 / Sat. 3 p.m.

(rotates with other programs; check listings)

HARLINGEN: KMBH, Ch. 60 / Sun. 5 p.m.

Also serving McAllen, Mission, Brownsville

HOUSTON: KUHT, Ch. 8 / Sat. 3:30 p.m. / Fri. 1 p.m.

Also serving Beaumont/Port Arthur, Galveston, Texas City, Victoria

KILLEEN: KNCT, Ch. 46 / Sun. 5 p.m.

Also serving Temple

LUBBOCK: KTXT, Ch. 5 / Sat. 10 a.m.

ODESSA-MIDLAND: KPBT-TV, Ch. 36 / Sat. 4:30 p.m.

SAN ANTONIO & LAREDO: KLRN, Ch.9 / Sunday 1 p.m.

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(continued on page 88)

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Bastrop State Park

The park's ponds are home to the Houston toad.

EVEN THOUGH THE LOST PINES WOODLANDS of Bastrop State Park may well hold the key to the survival of the endangered Houston toad (*Bufo houstonensis*), few visitors will get a glimpse of the small creature.

The almost-7,000-acre park 30 miles east of the state capital still supports the largest population of Houston toads found anywhere. Bastrop County is one of only a handful of southeast Texas counties supporting breeding populations of this species.

Most visitors to the park will take advantage of the park's fishing opportunities, the hiking trails that meander through the pine-oak woodlands or drive the 13-mile scenic loop that connects Bastrop State Park to Buescher State Park. Park facilities include campsites, cabins and lodges as well as a group barracks and dining hall.

Visitors hoping to learn more about the elusive Houston toad should visit with park staff about toad watching or listening opportunities. The long, high, clear trill of males seeking a mate during late winter and early spring breeding seasons can only be heard about five nights each year. On their own, visitors can learn about the Houston toad through a park pamphlet and several interpretive displays found inside the park. One such exhibit panel has been placed just outside the park office where visitors check in. It pictures the toad and provides details about its endangered status, its preferred breeding habitat (small, shallow ponds), its tadpole offspring and its preference for sandy burrows to protect them from the elements.

TPWD's Andy Price directs Houston toad research, gaining a more complete understanding of the toad's range in the park, how the three-inch, nocturnal creatures move in the landscape and how suppression of forest fires has affected the toads. Colleague Greg Creacy recently completed the mapping of all potential breeding locations within the park and has been conducting the first park-wide Houston toad breeding survey.

"The Houston toad is in real trouble," asserts Mike Forstner, an associ-

ate professor of biology at Texas State University in San Marcos. "Its populations are lower than when it crashed in the '90s. Its habitat is only more fire suppressed and more fragmented by subdivision development, forest clearing and the spread of Bermuda grass."

Though more is known about the Houston toad than ever before, unanswered questions remain. Where do the baby and juvenile toads move as they emerge from small ponds onto the upland landscape? What are the characteristics of prime breeding ponds? How much are toad populations impacted by drought? What can private landowners do to help the toad and steward their lands, while still keeping their farming and ranching operations going?

If Forstner and other biologists are successful, the unique call of the Houston toad will continue to be enjoyed by future generations.

"We need to do whatever we can to move the species past its problem time," Forstner says. "And, we need to do it now. We can't control the rains, but we can try to recover the toad's habitat and work to protect existing populations." ★

—Rob McCorkle

For more information, call (512) 321-2101 or visit www.tpwd.state.tx.us/spdest/findadest/parks/bastrop/

Gus Engeling Wildlife Management Area

Quiet ponds and wetlands await in East Texas.

TUCKED AWAY IN THE WOODS OF EAST TEXAS, just north of Palestine, far from strip malls and sirens, lies a hidden jewel. It was a damp February day when I visited the Gus Engeling Wildlife Management Area, and walking along the roads and trails brought back memories of childhood walks with my family through the forests of Germany and the Pacific Northwest. I heard only bird calls and an armadillo scurrying away through the brush. Visitors will find more than 10,000 acres of quiet, natural habitat to enjoy a variety of wildlife and plants.

Stop at the check-in station at the entrance to register and pick up the various informational field guides available, including "Wildlife Management—Past, Present and Future." This booklet provides an introduction to wildlife management and a self-guided auto tour for visitors along with a site map. Numbered signs posted along main roads correspond to descriptions of each demonstration site in the booklet.

The Beaver Pond Nature Trail is a must for visitors. Register at the site to record your visit and pick up a copy of the viewing guide. The well-marked path at Beaver Pond takes you over the wooden boardwalk for a closer look at the wetlands created by industrious beavers, but plan to spend some quiet time in the wildlife viewing stand before beginning your walk. It's a prime spot to spy the birds and animals — such as nutria, beavers, alligators and wood ducks — that make their homes in the pond. Children especially enjoy the walk over the pond, but remember to take



sunscreen, insect repellent and water. Once past the pond, the trail winds into the woods, with more numbered markers along the way. Although many of the site's most spectacular flora is in boggy areas that are inaccessible, keep an eye out for yellow lotus and swamp thistle. The WMA is the only recorded site of the swamp thistle (*Cirsium muticum*) in Texas.

Fall brings color changes to the foliage of the dogwood, gum, sassafras, hickory and red oak trees. When the weather is right, the splashes of red, gold and yellow are spectacular. The Dogwood Nature Trail is a brightly colored treat in the fall, but the third week of March is also noteworthy, heralding the arrival of the dogwoods' blooming season. Wherever you walk, watch your step! The WMA is home to the four varieties of venomous snakes that occur in this area.

For those who plan to camp, the WMA offers only primitive camping. A large, pleasant glen surrounded by tall oaks and bordered by Catfish Creek is a great setting for individual campers. Organized group camping is available in eight screened shelters, with prior reservations. Visitors at the WMA who plan to hunt squirrel, waterfowl or feral hogs are required to obtain the Annual Public Hunting Permit (\$48) and hunt on designated days only. Those who are planning to camp or fish must have the Limited Use Permit (\$12). Casual day users are not required to have a permit to walk the designated nature trails or take the demonstration driving tour. ☆

— Marian Edwards

For more information, call (903) 928-2251 or visit www.tpwd.state.tx.us/huntwild/hunt/wma/find_a_wma/list?id=10.

Palmetto State Park

This park's mysterious lagoons hold many surprises.

PALMETTO STATE PARK HAS EVERY FEATURE YOU'D EXPECT in a Central Texas nature attraction, and then some. There's the gorgeous, swift-flowing San Marcos River. Visitors can rent pedal boats or canoes and kids can fish for crappie from a pier on the four-acre oxbow lake.

More than 240 avian species have been recorded in the park, a stop on the Great Texas Coastal Birding Trail. The campground is clean and quiet, and the stars at night are ... well, you know the song.

It's what you wouldn't expect to see that makes the 270-acre park special and draws more than 120,000 visitors each year: a swampy wetlands.

And it's not just any old wetlands. The Ottine Swamp, named for the small town just outside the park's gates, is a primeval wonderland of towering trees, peaty bogs and warm springs.

Crouch at the edge of a lagoon, as the spring-fed ponds are called locally, and the sweet scent of wild onion wafts skyward. Spanish moss drips from elm, hackberry and cottonwood trees. Trumpet vines and wild

grape twist around gnarled trunks and climb toward the canopy.

Everywhere, palm fronds rustle in the breeze. The park's namesake palms, dwarf palmetto (*Sabal minor*), give the swamp an otherworldly atmosphere.

The ground-hugging, trunkless palms normally are found in the moist forests of East Texas and Louisiana. The extensive stand in Palmetto State Park was isolated thousands of years ago, considerably west of its natural range.

"Kids call it Jurassic Park," says Bradley Williams, a long-time ranger at Palmetto.

It's little surprise, then, that the exotic locale would give rise to its very own crypto-zoological legend: the "Ottine Swamp Thing" (and, like most such legends, this one is unconfirmed). The creature, said to resemble a diminutive Bigfoot, has been heard, or at least imagined, for decades by residents of the surrounding area.

According to Williams, it hasn't been heard from in more than five years. It could be that the creature — whatever it is — moved out in search of wetter wetlands during one of the area's periodic droughts.

Most of the park's lagoons hold water through the long, hot summers. When a drought, such as the one experienced during the last year, temporarily stops many of the natural seep springs, park personnel rely on an artesian well sunk by the Civilian Conservation Corps 70 years ago. The well — along with a 1,000 gallon storage tank — provides enough water to keep the palmettos flourishing during dry spells.



Keeping the wetlands alive is critical for the survival of more than just campfire tales of mythic creatures. On one misty morning this spring, a group of students bent at the edge of a pool searching for the tiny Palmetto pillsnail. The animal was first discovered here, and the park's wetland edge habitat is one of few places in the world where you can find it.

It may be that the chief joy of this place is, like the tiny snail, simply its unexpectedness. The transition between Blackland Prairie and its swaying grasses and mesquite, juniper and oak trees — and the brooding palmetto swamp — is fascinating.

"In the spring and summer time, the vegetation here is just amazing," says Williams. "You have wild irises, incredible birds. ... It's amazing what you can see in just a short, 20-minute hike." ☆

— Aaron Reed

For more information, call (830) 672-3266 or visit <http://www.tpwd.state.tx.us/spdest/findadest/parks/palmetto/>.

For information about upcoming events in all your state parks, visit www.tpwd.state.tx.us/newsmedia/calendar.

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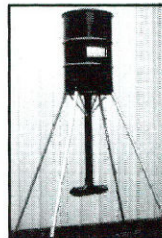
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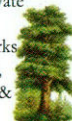
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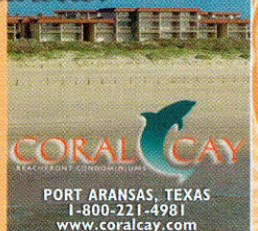
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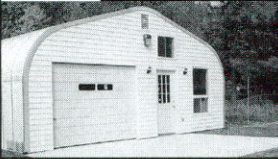
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Clam shrimps, as the name suggests, resemble tiny clams, with a bivalve shell or carapace that encloses the whole body. They are usually classified as order Conchostraca, but some scientists divide them into two orders based on shell characteristics. About 30 species are known in North America; several are found in Texas. Clam shrimps don't get much bigger than a half inch. Depending on the species, they have 10 to 32 pairs of legs. The legs aid feeding, but are seldom used for locomotion; clam shrimp row, using their second antennae as oars.

Tadpole shrimps (order Notostraca) have 25 to 44 pairs of legs, which are mostly hidden under the horseshoe-shaped carapace. Six species of tadpole shrimp exist in North America. One of these, *Triops longicaudatus*, is common in Texas. A large specimen might measure an inch and a half from the tip of the carapace to the end of the "tails," which are properly called cercopods.

Branchiopods find plenty to eat in their small ponds. Most fairy shrimp are omnivorous filter feeders, using their waving legs to collect bacteria, free-floating algae and microscopic animals. A few larger species are carnivorous, dining exclusively on small animals (including smaller fairy shrimp). Clam shrimp move slowly, bumping through mats of algae, feeding on detritus or plankton. Tadpole shrimp cruise the bottom of the pond, sometimes plowing through the mud. They also have been known to eat fairy shrimp, as well as algae, amphibian eggs, tadpoles and insect larvae.

Casual observers usually find branchiopods by accident. The creatures seem to come from nowhere, sometimes appearing in landlocked pools that weren't even there a few weeks earlier. One summer, after an unusual wet spell, a West Texas family contacted the Texas Parks and Wildlife Department with photographs of tadpole shrimp in a stock pond. "This pond hasn't held water in 15 years," the landowners wrote. "Did these things fall out of the sky?"

They may have.

Dried branchiopod eggs can be carried on the wind. It's more likely, however, that the eggs were there in the dry pond for 15 years, lying dormant in the dust,

waiting for the moment when conditions were just right to hatch. If branchiopods had a class motto, it might be *Carpe diem*, or *Seize the day*.

When the rainy season arrives, they don't mess around. The "eggs" left over from the previous season are not, strictly speaking, eggs. They're cysts: partially developed dormant embryos. When conditions are right, these come to life. Larvae appear a few days after a pool fills with water. They grow and develop quickly, reach maturity and mate. Females carry their fertilized eggs for a few days, perhaps providing some protection for the developing cysts. Some species drop cysts over several days in a series of clutches; some release them when the mother dies. The cysts sink to the bottom of the pond and settle in to wait.

In a good year, the shrimp get it all done before the pond dries up. The active phase of the life cycle typically takes three to four weeks. Some species require more time, some less. One type of clam shrimp has been known to complete the whole process in 15 days.

Branchiopods typically breed one generation per wet season, but some will do more if time permits. These species can produce two types of cysts: "summer eggs," which hatch almost immediately, and "winter" or "resting eggs," designed for the long haul. An embryo in the resting state can survive freezing, thawing, desiccation, dust storms, heat waves and extended droughts. Laboratory samples have hatched after sitting on a shelf for 16 years. They even survive being eaten by birds; in fact, this may be one way a species extends its range. Researchers have hatched and raised fairy shrimp, tadpole shrimp and clam shrimp from the droppings of mallard ducks.

Because "blooms" are short-lived and unpredictable, branchiopods are somewhat difficult to collect and study. Brine shrimp, the salt lake dwellers, are an exception. Brine shrimp cysts float, making it practical to harvest them for research and commercial production. Much of what is known about branchiopods in general began with studies of *Artemia*, or brine shrimp.

The unusual life cycle offers several advantages. By living where other organisms can't, branchiopods limit competition for resources and avoid many

potential predators. By developing in a hurry, they get ahead of tadpoles, predaceous insect larvae and other animals that colonize some ponds later in the season.

They also know how to hedge their bets. A female may produce more than 1,000 cysts in her short life, and they won't all hatch the next time the pond fills. Over time, the cyst bank builds up. Ponds inhabited by branchiopods may have hundreds of thousands of dormant embryos lying in wait.

The same traits that make them successful in their environment occasionally turn branchiopods into agricultural pests. Tadpole shrimp can be a problem in flooded rice fields, biting off shoots where they emerge from the mud. Fairy shrimp are a recurring problem at the Texas Parks and Wildlife Department's Jasper fish hatchery, where largemouth bass rearing ponds are drained in winter and refilled in spring. That's just the kind of environment that fairy shrimp like.

As hatchery biologist Lee Hall explains it, before stocking bass fry, the staff fertilizes the pond to stimulate growth of phytoplankton (microscopic plants). These provide food for zooplankton (microscopic animals), which serve in turn as food for the young fish. If the shrimp arrive first — and they usually do — they eat the phytoplankton.

"They hatch out, and three days later, you can see the bottom. You don't want that, because the zooplankton don't have anything to eat," says Hall. The shrimp, she adds, "will outgrow the bass, so you can't utilize them as a food source." So far, the best available control method is to fill a pond, give the fairy shrimp a couple of weeks to hatch and grow, drain it and start over. This practice doesn't completely eliminate the problem (remember that cyst bank), but it helps.

With all their built-in survival techniques, the only threat branchiopods can't handle is habitat destruction. This has become an issue in California, which is home to an endangered tadpole shrimp and several endangered and threatened types of fairy shrimp.

No Texas species are on the endangered list as yet. If we continue to make good conservation decisions, perhaps they never will be. ☆

PARTING SHOT

A snowy egret shows off its spring breeding plumage on Galveston Island. These delicate birds are easy to identify from a distance because of their habit of sprinting rapidly through shallow water in pursuit of minnows and shrimp. They're also known for elaborate greeting displays, which involve bowing and raising plume feathers, when returning to the nest.

IMAGE SPECS:
Canon EOS 20D, 500 mm lens, exposure of 1/320 second at f/14





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