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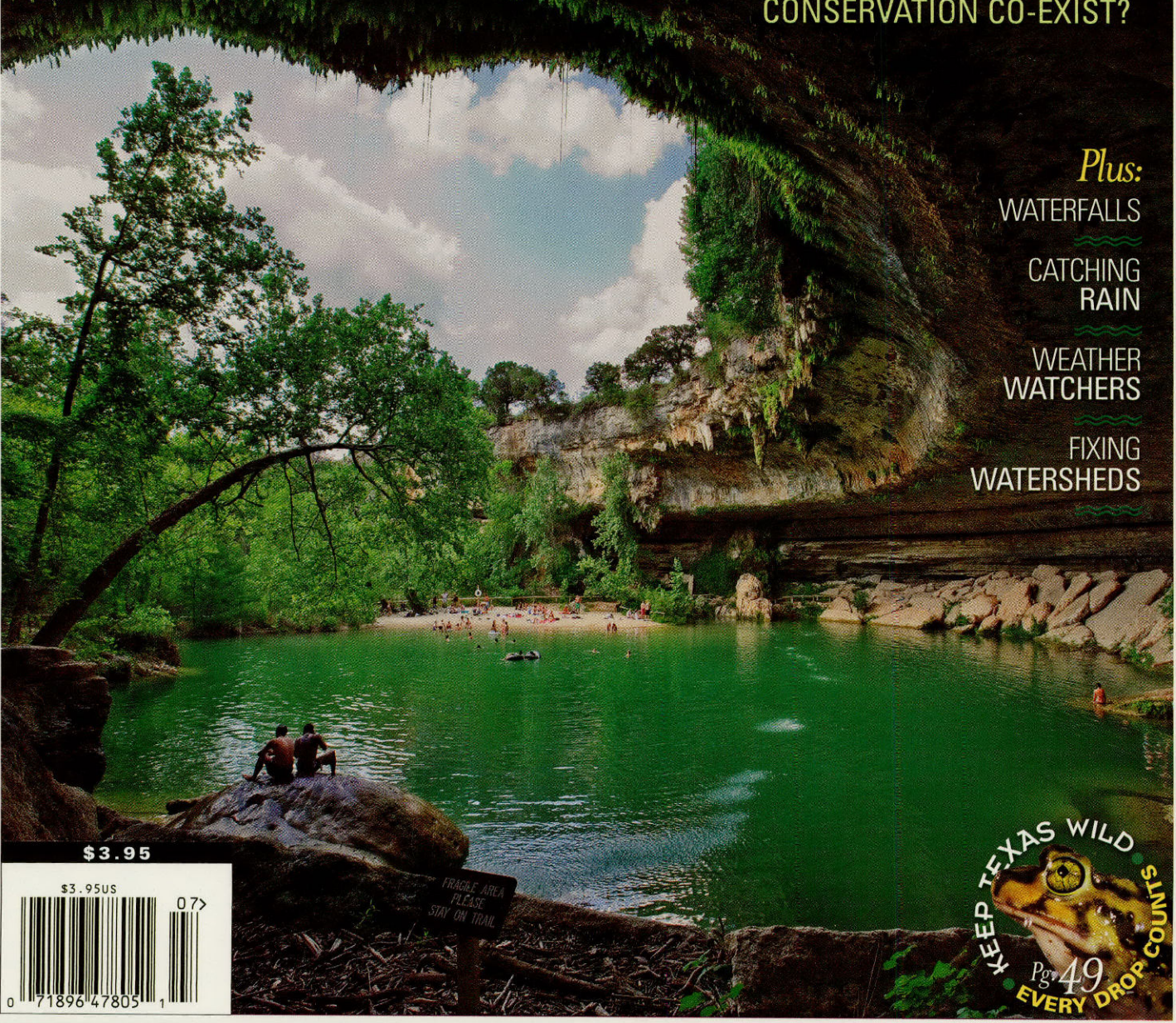
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The OUTDOOR MAGAZINE of TEXAS

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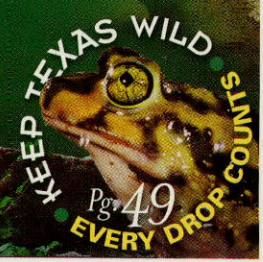
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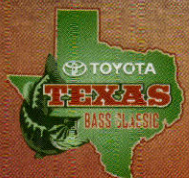
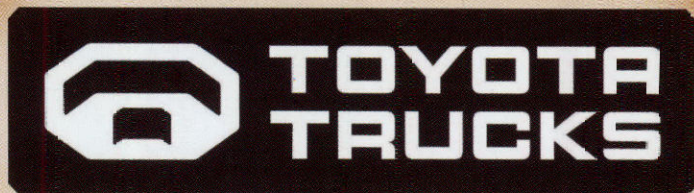
Page 49

SPECIAL WATER ISSUE · SPECIAL WATER ISSUE · SPECIAL WATER ISSUE · SPECIAL WATER ISSUE · SPECIAL WATER ISSUE

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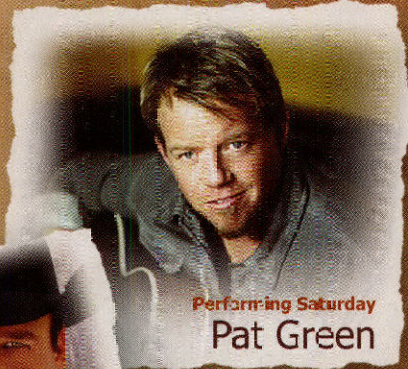


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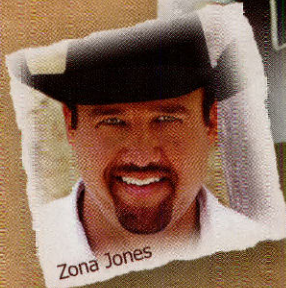
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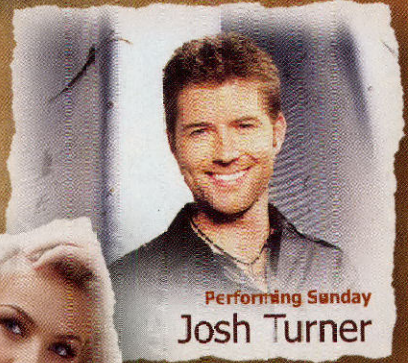
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Features

COVER STORY

16 Water Paradises

By Carol Flake Chapman

Balancing protection and public access for fragile resources.

24 Where the First Raindrop Falls

By Larry D. Hodge

Managing watersheds on a regional scale, involving multiple landowners, is the key to meeting Texas' water needs.

30 The Great Rain Harvest

By Rusty Middleton

Go ahead, collect your rainwater. Everybody's doing it.

36 Laughing Water

Photos by Lance Varnell

No matter what the season, waterfalls transform a landscape into a wonderland.

44 Weather Watchers

By E. Dan Klepper

Trained meteorologists and amateurs alike help keep track of that crazy Texas weather.

49 Keep Texas Wild

Every Drop Counts

Wildlife needs water, too, so don't waste it!

CONTENTS

J U L Y 2 0 0 9



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Departments

6 At Issue

By *Carter P. Smith*

8 Mail Call

Our readers share their ideas.

10 RIO GRANDE WATERMASTER

By *Eileen Mattei*

Divvying up the river's water for homes, farms and many other interests requires a careful balancing act.

12 BLUE-GREEN MYSTERY

By *Wendee Holtcamp*

Sometimes found in Texas lakes, cyanobacteria may be the cause of several diseases, but new research could lead to a cure.

14 TEXAS READER: WATER IN TEXAS

By *E. Dan Klepper*

A layman's guide to the complex world of water issues.

56 Parting Shot

By *Wyman Meinzer*

Covers

FRONT: Hamilton Pool. Photo by Earl Nottingham/TPWD

BACK: Raccoon. Photo © Rolf Nussbaurner

PREVIOUS SPREAD: Storm clouds over the Panhandle. Photo © Kevin Vandivier

THIS PAGE: Guadalupe River State Park. Photo © Lance Varnell

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THE OUTDOOR MAGAZINE OF TEXAS

JULY 2009, VOL. 67, NO. 7

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SUBSCRIPTIONS:

(800) 937-9393

Texas Parks & Wildlife magazine (ISSN 0040-4586) is published monthly by Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744. The inclusion of advertising is considered a service to subscribers and is not an endorsement of products nor concurrence with advertising claims. Copyright © 2009 by Texas Parks and Wildlife Department. No part of the contents of this magazine may be reproduced by any means without the permission of Texas Parks & Wildlife magazine. The magazine is not responsible for the return of unsolicited materials provided for editorial consideration.

SUBSCRIPTION RATE: \$19.95/year; foreign subscription rate: \$27.95/year.
POSTMASTER: If undeliverable, please send notices by form 3579 to Texas Parks & Wildlife magazine, P. O. Box 50062, Boulder, CO 80322-0062. Periodicals Postage Paid at Austin, Texas with additional mailing offices.

Texas Parks & Wildlife magazine is edited to inform readers, and to stimulate their enjoyment of the Texas outdoors. It reflects the many viewpoints of contributing readers, writers, photographers and illustrators. Only articles written by agency employees will always represent policies of the Texas Parks and Wildlife Department.



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In the Field

EILEEN MATTEI

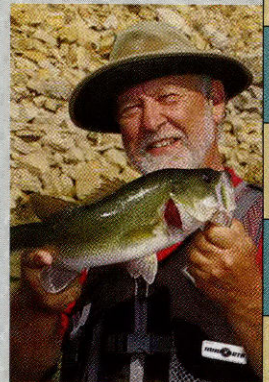
has lived on both sides of the Rio Grande, traveled on the river with border patrol agents, paddled down it in a canoe observing birds in two countries simultaneously, and crossed it on the hand-pulled ferry at Los Ebanos. "The Rio Grande is such a slender lifeline, providing water for so many people," Eileen says. "The

Watermaster program performs an amazing juggling act, controlling water use, not just monitoring it. I wonder if Watermaster controls will have to be applied to other Texas rivers as the state grows." In addition to her work on this publication, the Harlingen writer's stories have appeared in *Texas Highways*, *Texas Wildlife* and *Texas Co-op Power*. Her book, *Valley Places, Valley Faces*, was published last year.



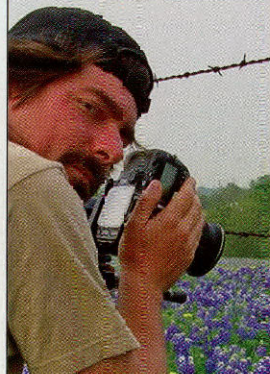
LARRY D. HODGE

grew up on a dry-land farm in Central Texas during the drought of the 1950s and has been interested in water ever since. One of his all-time favorite writing projects was a two-part series on the Rio Grande for *Texas Highways*; the research for that later led to a *Texas Parks & Wildlife* magazine piece that won a gold medal for best environmental article of 1995 from the Association for Conservation Information. His work at the Texas Freshwater Fisheries Center in Athens involves him with freshwater issues daily, including the Trinity River Project, a cooperative venture among TPWD and the Texas Wildlife Association and other natural resource agencies that attempts to increase awareness of the need for watershed-scale management of water resources.



LANCE VARNELL

shares some of his best Texas waterfall photographs with us in "Laughing Water" this month. Lance says he puts aside the guide maps and hikes off the beaten path to find subjects for his photos, looking around the next corner or over the next ridge for the next shot. Water photography fascinates him. "Waterfalls are effortless and spectacular, refreshing to every sense," he says. "They're God's Jacuzzi-powered way of saying, 'You are welcome.'" Lance says he thinks Texas is America's greatest playground. "It's filled with wondrous terrain, seemingly endless features and stories just waiting to be passed on to future generations." www.lancevarnell.com



AT ISSUE

FROM THE PEN OF CARTER P. SMITH

If you have never read *The Time it Never Rained* by Elmer Kelton, I heartily recommend it for your summer reading list. As Kelton does arguably better than anyone, he offers up a poignant tale of the trials and tribulations of West Texas ranch life. The setting encompasses the drought of the 1950s and the ranch of a cantankerous and weathered West Texas stockman, Charlie Flagg, who struggles with keeping his ranch, family, and livestock together during a drought of record. It is a good read and another powerful reminder that in Texas, water, whether in plenty or in need, or whether in urban or rural places, concerns us all.

How we care for the future of our water is one of the most important facets of our work at Texas Parks and Wildlife Department. The fate of our fish and wildlife populations is inextricably linked to the vitality and quality of our aquifers, springs, creeks, rivers, bays and gulf waters. Quite simply, water means life. And nature's biological cycles of breeding, nesting, laying, spawning, fawning, hatching and rearing all tie back to the ebbs and flows of our water, both in quality and in quantity. That is true, whether we are concerned with Guadalupe bass, redfish or Houston toads.

As the title of Larry Hodge's article in this magazine suggests, the thoughtful management of our aquatic resources all begins with where the raindrops land. Thinking like a raindrop, as Aldo Leopold might have said, is an appropriate way for us to steward our precious aquatic resources. To do this, we must approach water holistically and manage it from the aquifers to the estuaries. The logic of such a watershed-based approach is inescapable.

For if the rangelands on which the raindrops fall are not well managed, our aquifers will not recharge. And, if our aquifers are not sufficiently recharged, our springs will cease or diminish in flow. And, if our springs are diminished, our creeks, streams and rivers will flow with less vigor and less permanence. And, if the flows in our creeks, streams and rivers are diminished, there will be less freshwater contributing to the health of our bays and estuaries.

The consequences of insufficient freshwater reaching our bays and estuaries, irrespective of the cause (natural or human induced), may be manifested in a number of ways. Last winter for instance, it was illustrated by the loss of approximately 8 percent of the whooping crane population that winters along the mid-coast, in and around the Aransas National Wildlife Refuge. Without adequate freshwater inflows, blue crab populations were reduced substantially. The blue crabs are a staple of the whooping cranes diet. Without their primary food source, the cranes were stressed nutritionally, and regrettably, an alarming number perished as a result.

As Texans we all have a role to play in managing our aquatic resources. Whether we know it or not, we all live in a watershed. The raindrops that fall in our lawns, fields, woods and pastures ultimately either replenish an aquifer or flow into a creek or stream. As a result, the actions we take and the decisions we make with how we use, manage, conserve and value water impact the needs of those downstream, including our fish and wildlife.

I hope you enjoy this issue about all things water. If nothing else, I hope it helps you think a little more about where that next raindrop lands and where it might end.

Thanks for caring about Texas wild places and wild things. Our aquifers, springs, creeks, rivers, bays, estuaries and gulf waters need you more than ever.



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MAIL CALL

PICKS, PANS AND PROBES FROM OUR READERS

FOREWORD

As I write my last foreword, I'm reminded of the first one, which appeared in the premiere issue of *Texas Game and Fish* in December 1942. I've kept it posted on my bulletin board for almost five years. These lines have always stuck with me: "After the harshness, brutalities and sacrifices of the present conflict, the Texas man and woman ... should return to a pleasanter place in which to live, with the invigorating influence of the out-of-doors doing its full share to cleanse their spirits and temper their character. The immediate endeavor of *Texas Game and Fish* shall be for a realization of this objective."

This is not just a magazine — it's a living, breathing historical record stretching back 67 years. I'm proud of what our small team has accomplished, sometimes against mind-boggling odds. In my career, I've worked at four monthly magazines, and this one has, by far, the smallest staff. Yet the quality of the editorial product is consistently on par with much larger operations.

We couldn't do it without our stable of talented freelance writers and photographers. In my role, I've been the primary liaison with the writers, easily my favorite part of the job. Every one of our writers is a character, a true original, with a fiercely independent spirit. You can sort of loosely direct them, but you can forget about controlling them.

I will be forever indebted to our writers as well as the various experts at this agency for all that I've learned in this job. Five years ago, a vacant lot was just a vacant lot. Now, I see it as a sponge for filtering rain water, as habitat for native flora and fauna, or as a tiny piece of remnant prairie. I understand that often-maligned wetlands and marshes are nurseries of life, and that they're just as important to the environment as our beloved springs and rivers. I'm still bored to tears by the minutiae of water policy, but now I know why we all need to dive in and understand as much of it as we can.

Even before I started this job, I was a big wildlife nerd. Now I'm just a bigger nerd with more information. If I ever see a ring-tailed, long-nosed mammal in the wilds of South Texas, I'll know it's a coatimundi and not some freaky raccoon. I can now recognize the calls of golden-fronted woodpeckers, monk parakeets, eastern screech-owls and a few other birds, and that makes my life better. It's amazing how just a little more nature knowledge can make a simple walk in the park more entertaining. I'm the first to admit that I still have a lot to learn, and I look forward to many years ahead as a diligent student of the natural world.

It's been a wild ride, but the experience has prepared me well for my next adventure. Thanks for everything.

Robert Macias

ROBERT MACIAS
EDITORIAL DIRECTOR

LETTERS

JAGUARUNDI SIGHTINGS

I recently read the letter by Thomas Ruhnke ("Mail Call," June 2009) pertaining to the potential jaguarundi sighting near San Antonio. If I hadn't read your comments that there are no current confirmations in Texas, I would have just agreed and continued on.

My lease near Freer seems to have a resident jaguarundi population. My first sighting was five or six years ago. Since then I have seen them three to four times and my brother, three times. In late March, I was riding down a sendero with the ranch owner's son, talking about this cat, when one calmly walked across in front of us! He had never seen one in his life (50 years).

RAGGY LOY
Rockport

MORE SIGHTINGS

I read about the jaguarundi in the "Mail Call" article. I believe that they do exist in the vicinity. I spent 12 years on Lackland AFB Annex. I have

seen these animals many times in the early morning, at night and late evening. I can also vouch for a kitten of the species choking in some chicken wire some 15 miles west of Lackland Annex in Castroville, where a friend of mine lives. My friend was deployed to Kuwait, and his wife called me to tell me that something "strange" had been caught trying to get at her chickens. You never forget that devilish point on its head.

Some of my troops used to call them "cabbits" because of the way they moved. I never knew they were special; we thought everyone knew about them.

JOHN FERGUSON
Pipe Creek



In late March, I was riding down a sendero with the ranch owner's son, talking about this cat, when one calmly walked across in front of us! He had never seen one in his life (50 years).

Raggy Loy
Rockport

MAIL CALL

AND EVEN MORE JAGUARUNDIS

I believe that Thomas Ruhnke of San Antonio did see a jaguarundi. I have seen two in the past two years — one while hunting last December in eastern Live Oak County, the other on May 14 on the west side of Lake Corpus Christi. It crossed the road in front of us, and looked just like the cat you described. Maybe this will let you know that you are not the only person who has possibly seen a jaguarundi. And we were only drinking Diet Coke!

MITCH PULLIN
Pettus

TPWD RESPONDS: TPWD biologist John Young says: "The jaguarundi is a federally endangered feline that historically only occurred in extreme southern Texas. The last jaguarundi confirmed with hard evidence was a road-killed animal in 1986 near Brownsville. All photographic evidence of jaguarundis submitted to TPWD and to the Caesar Kleberg Wildlife Research Institute from various parts of Texas have either been identified as bobcats or house cats.

We try to investigate sightings, and will review any photographic evidence with an open mind. We are certainly interested in investigating any dead animals suspected to be jaguarundi. We know very little about their populations except that they are extremely rare and are suspected of being extinct in Texas. Jaguarundi are fairly common within parts of Tamaulipas, Mexico, and the potential remains for them to disperse into Texas. It is always difficult to prove the extinction or presence of animals, especially wild cats, so biologists require hard evidence. Unfortunately, sightings don't meet that standard."

Sound off for "Mail Call!"

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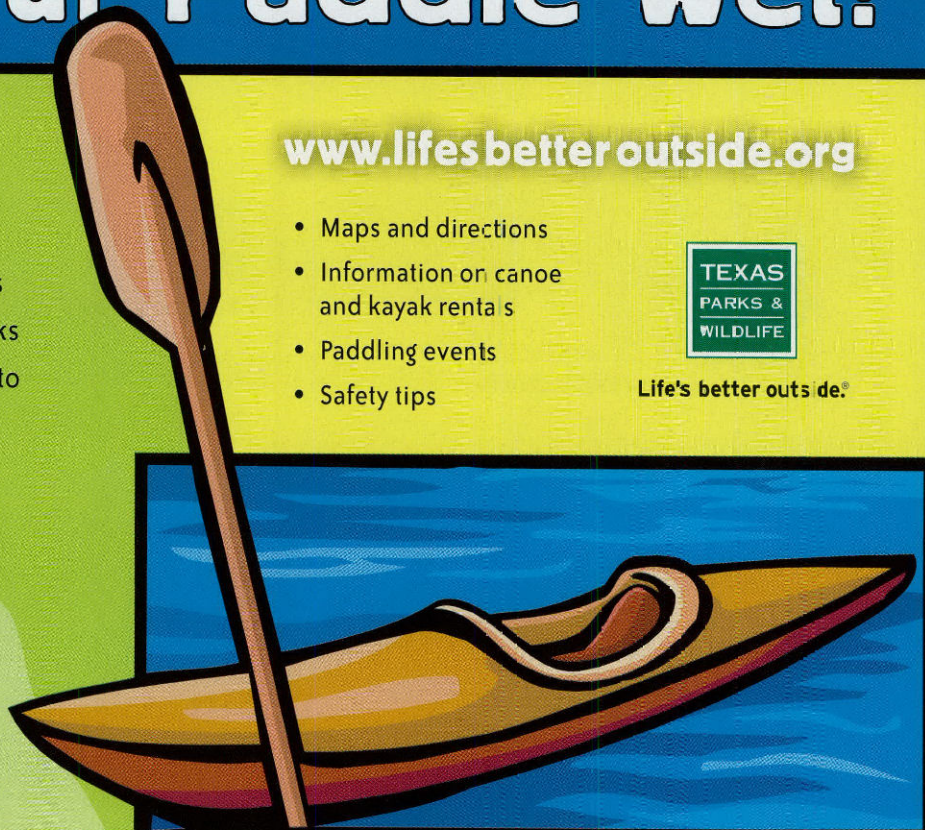


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SCOUT

NEWS AND VIEWS IN THE TEXAS OUTDOORS

RIO GRANDE WATERMASTER

Divvying up the river's water for homes, farms and many other interests requires a careful balancing act.

Unlike the rest of Texas, water rights holders downstream of Amistad Reservoir on the Rio Grande are not assured of water based on the seniority of their rights, the longevity of their claim. Instead, a watermaster controls water allocations along the river from Amistad Dam, north of Del Rio, to the Gulf of Mexico under a complex system that is designed to apportion water first for municipal uses. While other uses, such as industry and mining, get a share of the remaining water, irrigation districts and agricultural users consume most of it.

How much they can take in any given year is subject to water availability.

Rio Grande Watermaster Erasmo Yarrito Jr. explains that the Rio Grande's volume of 1.3 million acre-feet (the average annual yield) is divvied up between 1,600 water rights holders in Texas along the 1,172 river miles under his jurisdiction. International politics complicate the situation: A 1944 Mexico-U.S. treaty apportioned water

rights along the international boundary. While the U.S. has legal rights to 58 percent of the river, Mexican watershed dams sometimes retain water destined for American use.

Now a division of the Texas Commission on Environmental Quality, the Rio Grande Watermaster Program evolved after the 1950s droughts resulted in people with "older" rights at the east end of the Rio Grande receiving no water once

The Rio Grande Watermaster Program was created to apportion diversions from the over-appropriated river, with priority given to municipal needs.



upstream holders had legally diverted their water. The program, which began operating in 1971, covers 17 counties and extends west to Ft. Quitman, although rights upstream of Amistad follow seniority. No unclaimed water rights exist on the river.

Each month the watermaster re-establishes a municipal reserve of U.S. waters in Amistad and Falcon reservoirs of 225,000 acre-feet, the equivalent of one year's average diversions for all municipal demands downstream from Amistad Dam. If the reservoirs have more than that amount, the watermaster divides the surplus among the non-municipal claimants. This quantity is called storage balance and accumulates up to the amount of the assigned water rights. Rights holders withdraw from their usable balance, which is their storage account water allotted the previous year.

"The usable balance is much like a checking account: if you have it, it's your decision when to use it," Yarrito said. Along the Rio Grande, though, it's more complicated than starting up a pump. Water has to be booked days in advance to give the ordered volume time to travel downstream to its destination.



↑ One major use of water from the Rio Grande is agricultural irrigation.

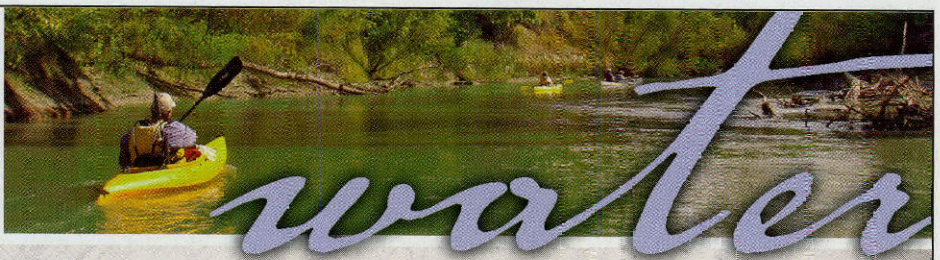
"Folks realize that this is a unique situation. The watermaster system protects everybody's water rights," Yarrito explained. To assure compliance, six watermaster specialists perform 24,000 yearly inspections from Ft. Quitman to Boca Chica Beach.

With reservoirs full this year, Yarrito foresees no immediate restrictions on water use, unlike extreme drought years when some farms and ranches were left high and dry. The program has proven

itself a workable method for managing a finite resource, but does not consider environmental flow needs.

A separate watermaster program monitors rights on the Guadalupe, Lavaca, San Antonio, Concho and Nueces rivers but does not control water use. Other functions of the program include sequencing diversions, answering complaints and following up with enforcement actions, if needed. ★

— Eileen Matrei



Water connects our communities and brings our cultures together. Traces of human habitation discovered near the headwaters of the San Antonio River date back over 10,000 years, and we still depend on the river today. The quality of our lives and the economic development of our communities can be measured by the quality and availability of our water. We at the San Antonio River Authority (SARA) take great pride in preserving and protecting this treasured natural resource.

• We are engineers, environmental scientists, planners, project managers, communicators and operators. Whether we are analyzing water samples in our NELAC certified laboratory; determining the amount of fresh water necessary to maintain the health of the river's watershed, bays and estuaries as part of the Environmental Flows and statewide Instream Flows program; identifying solutions to alleviate flooding, we are stewards of our water resources and partners with our communities and other government agencies contributing to the common good.

PHOTOS © LARRY DITTO



www.sara-tx.org

SIGHTS & SOUNDS

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June 28 – July 5:

Lake State Park; Hill CCC memories; Comal Springs; Enchanted Rock; casting tips and techniques; Elephant Mountain biologist.

July 5 – 12:

Restoring Guadalupe bass; freshwater fishing tips; land trusts and conservation easements; CCC at Fort Parker State Park.

July 12 – 19:

Big Thicket preservationist; saltwater fishing in Texas; sandhill crane art; Ray Roberts

Lake State Park; Hill Country flora.

July 19 – 26:

Buescher State Park biking; following the Guadalupe River; the challenge of rock climbing; King Ranch wildlife; Ray Roberts Lake morning.

July 26 – Aug. 2:

Pier fishing places; Panhandle ranch recovers from fire; West Verde Creek waters; creating a Big Bend museum; Huntsville State Park.



Take a spin through the Lost Pines at Buescher State Park. Watch the week of July 19–26.

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Blue-Green Mystery

Sometimes found in Texas lakes, cyanobacteria may be the cause of several diseases, but new research could lead to a cure.

It may be one of science's most impressive pieces of detective work. Biologists at the Institute for Ethnomedicine, led by Director Paul Alan Cox, believe they've found the culprit for ALS (Lou Gehrig's disease) and other "tangle diseases" including Alzheimer's, Parkinson's disease and supranuclear palsy. The tiny neurotoxic molecule BMAA (β -N-methylamino-L-alanine) is produced by blue-green algae (also called cyanobacteria) found worldwide. The good news? The discovery could lead to a cure. The bad news? BMAA in drinking water could be a health risk even at low levels, but no one's testing for it in water supplies yet.

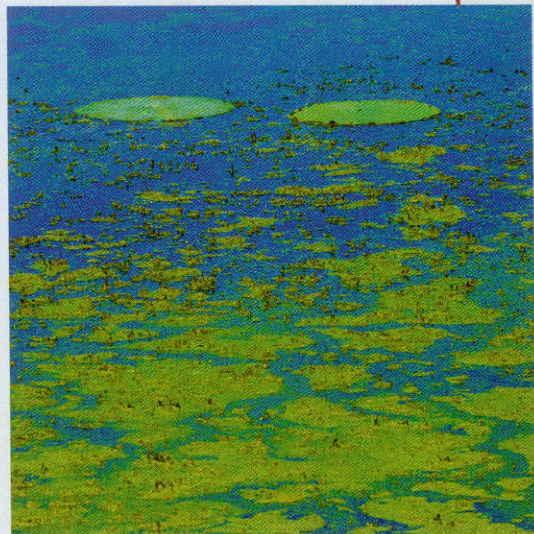
"If you came to our lab right now, you would see a group of highly focused — even tense — scientists pushing as hard as we can for what we hope will open a new door towards novel approaches to [disease] therapy," says Cox.

Along with famed neurologist/author Oliver Sacks and other colleagues, Cox theorized that BMAA gets consumed through drinking water or eating fish and becomes bound in brain protein, creating a neurotoxic reservoir. BMAA releases over time, causing neurodegenerative disease in genetically vulnerable individuals. Though not conclusively "proven," data continue to accumulate, and Cox's findings were recently verified by researchers at the University of Miami Brain Endowment Bank.

The story began in earnest in the 1950s when scientists descended on Guam to solve one of the world's most alluring medical mysteries — why did the indigenous Chamorro people have 50 to 100 times the world's average rates of ALS-like diseases? Scientists assumed they'd quickly find the cause, but decades of research led only to dashed hopes and controversy.

BMAA was first discovered in Guamanian cycad seeds, which the Chamorros pulverize into flour. Scientists then found BMAA concentrated in the brain tissue of disease victims, but were unsure how it might cause disease since it was consumed in low amounts.

And since BMAA was only known on



Blue-green algae, or cyanobacteria, is easily visible on the surface of a pond.

Guam, how could it account for disease elsewhere? By the 1990s, Guam's elevated ALS rates dropped, and most scientists studying the disease left. It seemed the puzzle would remain forever unsolved.

Then, in 2003, Cox linked many threads together in a daring twist on an old hypothesis. First he proposed that BMAA biomagnified through the food chain. Chamorros ate fruit-bats — skin, bones, brains and all. The bats ate cycad fruit, a tree whose roots contain cyanobacteria. The bats became endangered after guns became widespread, and Cox thinks their disappearance may explain the rapid decline in the disease's prevalence. But the story soon got more exciting.

Cox knew that cycad roots harbor cyanobacteria, which seem to benefit the plants by fixing atmospheric nitrogen.

"Cox and I were driving in a car on Kauai after just leaving the lab," his colleague Sandra Banack explains. "Then it hit us. It felt like our hearts stopped and time slowed down. Since cyanobacteria are free-living worldwide, this could be the link to sporadic ALS worldwide."

They set out to test their hypothesis, but never imagined they'd not only find BMAA worldwide, but link it to other tangle diseases, as well.



Research scientists now think that a substance found in blue-green algae can cause various diseases.

It's well known that cyanobacteria produce many toxins which cause fish kills, plus human and animal health impacts. TPWD even has a team dedicated to identifying and studying harmful algal blooms. Until now, scientists only knew of "acute effects" from cyanobacteria, in which toxins cause immediate problems. But this new research suggests chronic exposure to lower levels of BMAA can damage brain tissues, particularly in genetically vulnerable individuals.

"We realized that the BMAA molecule could be found at low levels in our water supplies," says Banack. "We are developing commercial methods that can be easily used by municipalities, but they are not yet available."

Some Texas municipal water supplies, such as Lake Houston, have had significant problems with cyanobacteria. The City of Houston has placed several Solarbee water circulators in the lake to help aerate the water. Lake Houston hasn't seen large cyanobacteria blooms in the past two years, probably because heavy rainfall turns the lake into a flowing river.

Another promising development is legislation recently introduced to the Texas Senate (SB800) that would create a pilot program on the San Jacinto River to require sand mines to get permits and allow for regular monitoring. Sand mining violations on the river cause increased turbidity, which increases cyanobacteria outbreaks.

"You look at the west fork of the San Jacinto, there's a big ol' muddy plume coming into the reservoir. Waves of muddiness and turbidity extend down to mid-lake," says TPWD's Jeff Henson. "You see [blue-green algae] in turbid and stagnant waters." ☆

—Wendee Holtcamp



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Water in Texas

A layman's guide to the complex world of water issues.

As former executive director of the Texas Parks and Wildlife Department, Andrew Sansom championed an era of expansion and conservation on behalf of the state's natural world that continues to resonate today. As the current executive director of the River Systems Institute at Texas State University — San Marcos, Sansom continues to move the state's conservation efforts forward, tackling the most important environmental issue of our time — water. As Sansom no doubt understands, it is an arduous and complicated task.

Now he has made it possible for the average Texan to gain a better grasp on the complexity of issues surrounding the state's water supply by writing *Water in Texas* (University of Texas Press, 2008), the first comprehensive guide to the state's overwhelming aquatic landscape.

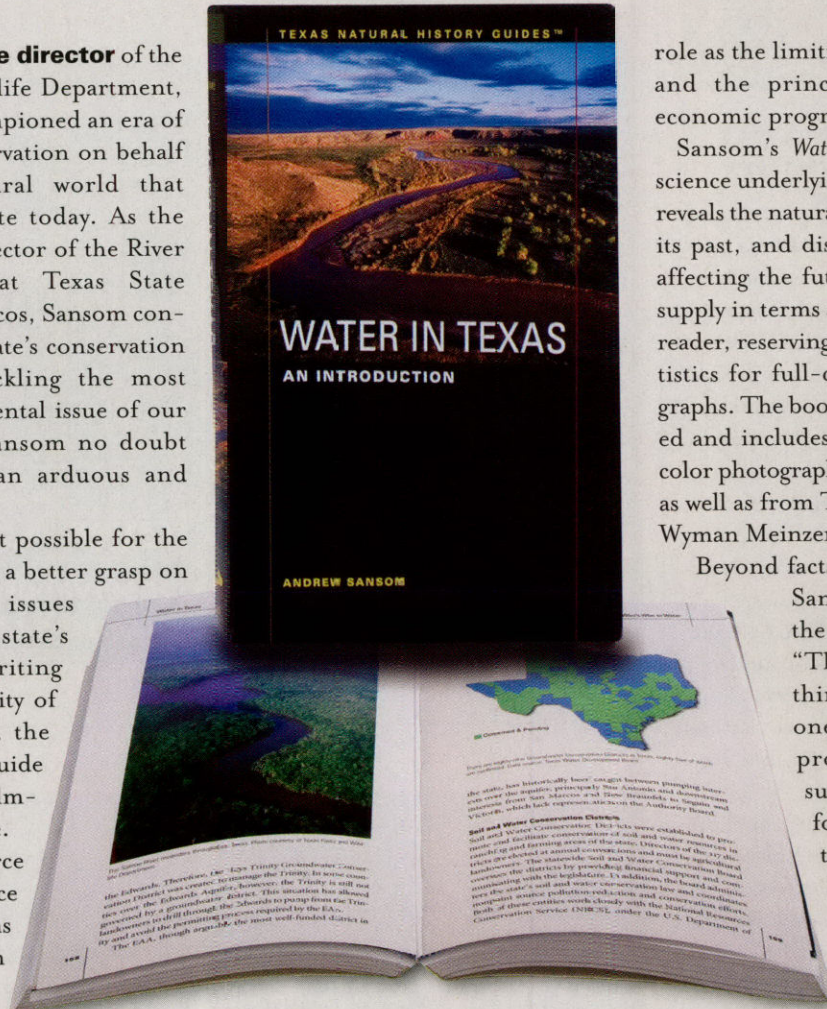
"No natural resource has greater significance for the future of Texas than water," Sansom writes in his introduction. "For nearly 14 years, 12 as executive director, I had the privilege of working at the Texas Parks and Wildlife Department. During that time, I was able to see more of the richness of Texas' cultural and natural history than most people see in a lifetime, and I came to have a profound respect for water's

role as the limiting factor for all of life and the principal determinant of economic progress."

Sansom's *Water in Texas* explains the science underlying the state's hydrology, reveals the natural and cultural history of its past, and dissects the public policy affecting the future of the Texas water supply in terms accessible to the average reader, reserving the complexities of statistics for full-color charts, maps and graphs. The book is generously illustrated and includes plenty of eye-popping color photography from the TPWD files, as well as from Texas photo masters like Wyman Meinzer.

Beyond facts and figures, however, Sansom's call to action is the book's message of note. "The most important thing that each and every one of us can do to help provide a future water supply and quality of life for our children is to take the time to get them involved," explains Sansom. "A child who loves to fish will become an adult who will work to protect our fisheries. A child who loves to canoe will become an adult who will fight to protect our rivers. We will fail them miserably if we do not make the effort to engage them in both the joys and the responsibilities of using and caring for our water resources, for they are the voters and taxpayers of the future."

The complicated issues that will determine the future of water in Texas may not be easy to resolve, but *Water in Texas* equips today's Texans with a fundamental knowledge that can be applied both on the homestead and at the polls when electing leaders who will make decisions about the water supply and sources. Yet Texans may accomplish a more long-lasting legacy than any legislator can simply by doing as Sansom's suggests — take a kid fishing. ☆



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PHOTO BY EARL NOTTINGHAM/TPWD

HAMILTON POOL, WEST OF DRIPPING SPRINGS



WATER PARADISES

Balancing protection and public access for fragile resources.

BY CAROL FLAKE CHAPMAN

THERE ARE CERTAIN SPECIAL PLACES IN TEXAS, like Hamilton Pool, west of Austin, that remind me of paintings I've seen from the Middle Ages of the sacred space known as the *hortus conclusus*, or enclosed garden. When I've come upon these places, created by forces of nature rather than by artistic design, I've felt what I imagine to be the same sense of wonder and awe that those small but precious places must have evoked in medieval times. And the key for both kinds of places, whether natural or artificially ordered, is water, springing forth almost as though by miracle.

In the *hortus conclusus*, there was always water at the center, in the form of a well or a fountain, and the space was often surrounded by a rock wall or by a stone arcade. Water is the focal point of these special places in Texas, too, which I call water paradises. Most of these hidden retreats are sprinkled around Central Texas, thanks to karst formations that lend themselves to collapsed grottoes. At the heart of these places is water, in the form of pools, springs or waterfalls. And there is usually a dramatic backdrop of rocks, as well as the same feeling of sanctuary and seclusion as in the artful enclosed gardens.

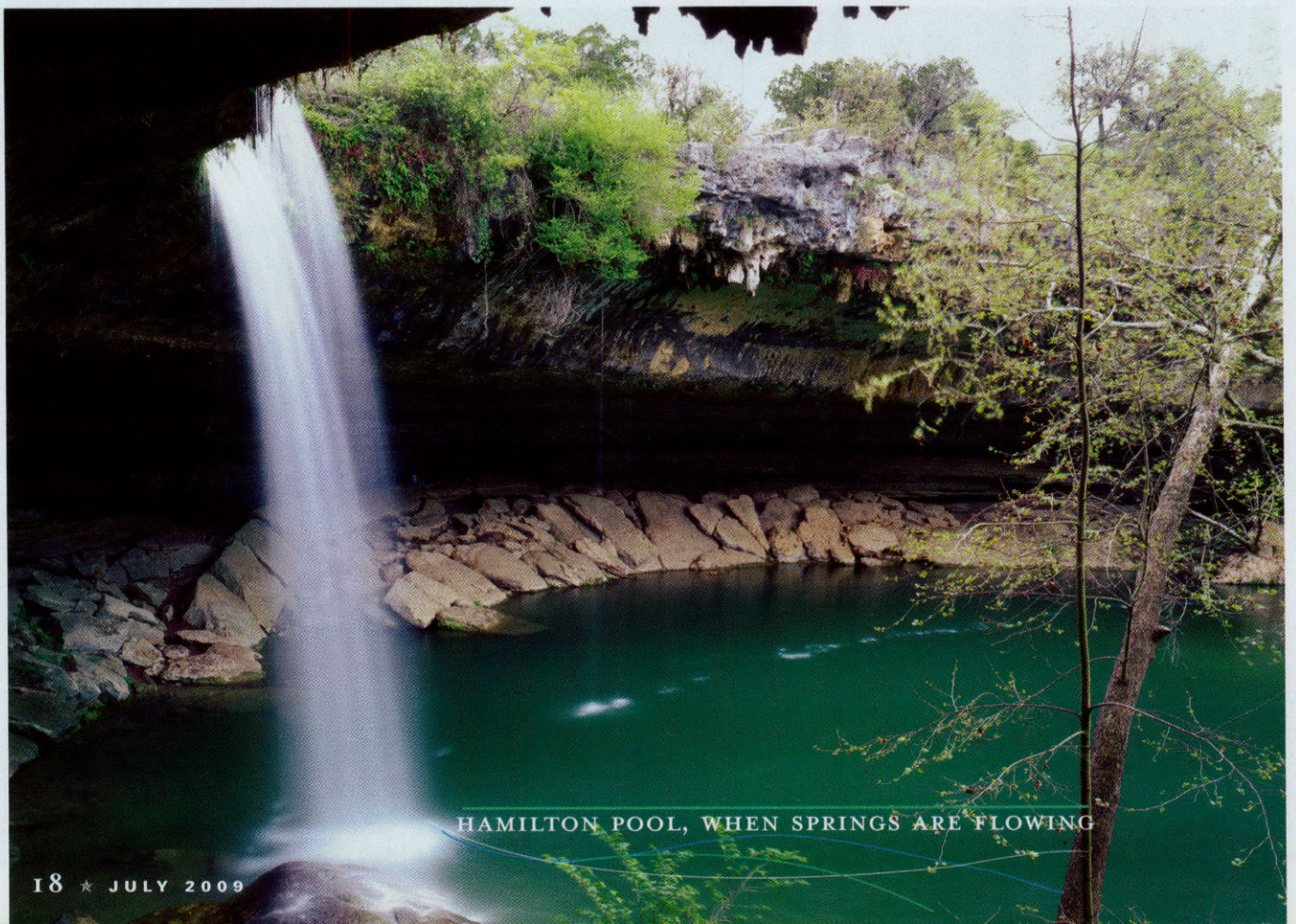
Those who have been fortunate enough to visit the Hill Country treasures of Hamilton Pool, Westcave Preserve, Gorman Falls, Jacob's Well or Blue Hole may have felt the same way I did when I first saw them. After recovering my breath after first seeing them, I had contradictory impulses. The first was a protective feeling, of wanting to keep this secret place to myself so that it would remain unspoiled, and the next was a desire to tell everyone I knew about it so they could share the experience.

Obviously, keeping these extraordinary places to oneself is neither a realistic nor an admirable expectation. Most of them are on public land, of one sort or another, and questions of stewardship can get

quite complex. Over the years, as pressures grow for access to such beautiful places, the caretakers of these water paradises, whether they are located in parks or preserves, have been diligently trying to balance the seemingly contradictory imperatives of public access and the protection of a unique resource. It's a precarious balance that parks everywhere struggle to maintain.

As it happens, each of these unusual water resources in Central Texas has had a different history, but all incurred some form of ecological damage in the past as a result of overuse or outside encroachment. Each has been managed differently, and policies have shifted over the years as physical conditions and public attitudes toward fragile natural resources have changed.

A prime example is Gorman Falls, located inside Colorado Bend State Park. Powered by a spring-fed creek, and overlooking a pristine stretch of the Colorado River, Gorman Falls is an "advancing" falls, which means it is constantly adding travertine deposits that change its shape. Drought has recently reduced its flow. But when the falls are flowing at full force, with rainbowed mists veiling the underlying travertine, it is arguably the most beautiful place in the state. The falls were once easily accessible



HAMILTON POOL, WHEN SPRINGS ARE FLOWING



GORMAN FALLS, COLORADO BEND STATE PARK

WESTCAVE PRESERVE, WEST OF AUSTIN



PHOTO BY BRANFON JAKOBETT/TPWD

from a fishing camp, and old photos from that time show people clambering over its fragile overlooks, ledges and pools.

When the falls and the surrounding area known as Colorado Bend became a state park, the decision was made to close the falls to the public and restrict access to weekend guided tours. Travertine, as park ranger Kevin Ferguson points out, is soft and brittle when it's wet. "It's like walking on crackers," he says. Another concern was the fragile vegetation. "A single step can destroy a decade of restoration," he said. Dan Sholly, deputy director of parks at Texas Parks and Wildlife, explains that the department "had the mentality then that the best and easiest way to manage it was to close it." Twenty years later, the department reevaluated that policy. "You don't get supporters or a constituency for a place that way," says Sholly. The trail to the falls was opened and improved, and railings were put up to prevent visitors from climbing on the falls or its pools. So far, according to Kevin Ferguson, park visitors have been respectful of the boundaries. "The great majority of people love this place and will help us protect it. We're excited about having it open. It's an opportunity to help the public to feel a sense of ownership."

An added means of protection for fragile places often used in park management is providing access for the public to a "sacrificial" place, one similar to the restricted spot but less vulnerable to damage. In a sense, it's a bait and switch technique, but with welcome benefits both for the public and for the fragile resource. At Colorado Bend, after gazing at Gorman Falls behind a protective railing, an activity that TPWD resource specialist David Riskind describes as "appreciative use," you can hike along Spicewood Springs Trail and cool off in a series of inviting smaller waterfalls and pools.

Similarly, at Pedernales Falls State Park the public is not allowed to swim in the pool beneath fragile Twin Falls, one of the park's small, hidden gems that is still recovering from years of heavy recreational use. Visitors can still gaze at the falls from an overlook. However, if you want to take a dip in a beautiful place, you can hike along Wolf Mountain Trail to cool your heels in tiny, scenic Arrowhead Pool, where access is allowed. You won't find any signs, however, to point the way to Arrowhead, indicating a subtle but effective policy of limiting visitors.



HAMILTON POOL AND WESTCAVE PRESERVE — collapsed grottoes of astonishing beauty and delicacy located just miles down the road from each other — provide contrasting images of managing a similar resource, one for recreation, with certain restrictions, and the other for education. Before Hamilton Pool was acquired by the county, recalls Travis County park manager Dan Perry, "it was a pretty wild place." Located three-quarters of a mile upstream from its confluence with the Pedernales River, Hamilton Creek spills out over limestone outcroppings to create a 50-foot waterfall as it plunges into the head of a steep box canyon. In the 1970s, when the pool was privately operated for recreation, says Perry, young people would jump off the cliff into the pool. He even tried it once himself back then, he admits. The area had been nearly "loved to death" by over-enthusiastic visitors. The riparian area of the creekbed had been denuded of plant life by people straying off the trails.

The county turned the property into a preserve and set guidelines,

says Perry, that were "strict but fair." He recalls, "We closed it for a year and cleaned it up. And we made the decision to bring it back to its natural state. We weren't about to turn it into a Disney kind of park." The county kept the pool open for swimming, but formalized the trails and the stair rails around the pool. The decision was also made to limit the capacity of the park to the 75 cars that fit in the parking lot.

As with state parks, the key to protecting the resource, says Perry, is education. "We explain why we need to protect this place, and people respect that. Visitors accepted it right off the bat, and we haven't had negative comments." The problems with the pool have not come from visitors, he points out, but from elements outside the park, including run-off from farmland and from development upstream. The pool is regularly closed after heavy rains when the level of coliform bacteria rises to unacceptable levels. Nearly two years ago, sediment believed to come from a nearby road-building project rushed into the pool after a torrential rainfall, leaving the water with far diminished visibility. The county is still working on a mitigation plan to deal with the damage, says Perry.

By contrast, the area that is now Westcave Preserve has remained closed to the general public, with visitation by guided tour only. Visitors to the preserve begin their tours at the Warren Skaaren Environmental Learning Center, a model of sustainable building design

"So many of us never get a chance to be in real silence. Some places are for recreation. But a place like this is to look, listen and smell."

—John Ahrns, Westcave Preserve

that has exhibits showing how the forces and cycles of nature have interacted to create and sustain the preserve. Although the land is owned by the Lower Colorado River Authority, the preserve is administered by its board of directors, comprising longtime and passionate devotees of the site.

Within its small core space of 30 acres, the preserve encompasses a grassland with wildflower meadows and a limestone crevice leading to a sheltered canyon with a pool and waterfall created by the collapse of a giant cave. Westcave's fragile travertine columns and plant life were seriously threatened in the 1960s and early 1970s by trespassers onto the then-private land.

"This canyon was trashed," says preserve manager John Ahrns, who has been there for 35 years. But the ecosystem has rebounded under the strict guidelines of visitation. And the preserve just added 44 acres around the canyon rim to establish a zone of protection.

Nowadays, when Ahrns leads tours down into the canyon, he points out the almost bewildering array of plant life that thrives along the canyon and even grows on and between the rocks in the grotto. When schoolchildren arrive at the cave, he asks them to sit quietly and just sense everything around them. "So many of us never get a chance to be in real silence," he says. "Some places are for recreation. But a place like this is to look, listen and smell."



THE LESSONS from managing these fragile and pressured places over the years have proved valuable for two water paradises near the city of Wimberley that have recently come under new stewardship: Blue Hole and Jacob's Well. The health of these two places is

closely entwined, as Jacob's Well, the natural spring believed to be the longest underwater cave in the state, is the primary source of water flowing from the Trinity Aquifer to form Cypress Creek, the beautiful stream that winds through Wimberley and that forms the oasis of Blue Hole, where swimmers splash beneath towering cypresses.

These places are at "ground zero" in determining the balance between access and protection, observes Andrew Sansom, executive director of the River Systems Institute at Texas State University — San Marcos and a board member of the Friends of Blue Hole. Policies can be affected, he observes, by the "peculiar artifacts of their origin that complicate protection," including previous easements or deed restrictions. In May 2005, the Village of Wimberley completed the land acquisition portion of the Blue Hole project with grants and donations from Texas Parks and Wildlife Department, Hays County, the Lower Colorado River Authority and The Trust for Public Land and with the help of private landowner Peter Way, who bought and held the land in trust until the purchase could

"This is a place that we feel inspires stewardship, of showing the connection between choices and actions and the health of the water."

— David Baker, Blue Hole

be completed. Long-term plans call for the development of the property into a regional park, and the city is weighing competing interests in the way the land surrounding the pool will be used.

The Jacob's Well Natural Area Trust was recently awarded a grant from Hays County parks and open space bond funds to purchase the 55 acres around the well and to establish a research and environmental education center.

"Jacob's Well is the heart and soul of Wimberley Valley," says David Baker, head of the Wimberley Valley Watershed Association, who has dedicated much of his life to preserving the site. When the well dried up for the first time in history, during the summer of 2000, and again in October of 2008, the events were considered by many as symbolic of the region's increasing water shortage and quality problems.

"Jacob's Well is the canary in the coal mine," says Baker. He hopes that Jacob's Well will become a center for teaching visitors how to live responsibly on an aquifer. "This is a place that we feel inspires stewardship, of showing the connection between choices and actions and the health of the water."

Jacob's Well, like other water paradises, appears to offer in its beauty and serenity a respite and refuge from the noise and problems of the outside world. But these beautiful, unique places of safe haven are inextricably connected to that outside world. And their safety and security are only as strong as the commitment of their human caretakers. ★



PHOTOS BY EARL NOTTINGHAM/TPWD



BLUE HOLE, WIMBERLEY



MANAGING WATERSHEDS ON A REGIONAL SCALE, INVOLVING MULTIPLE
LANDOWNERS, IS THE KEY TO MEETING TEXAS' WATER NEEDS.

Where the First Raindrop Falls

By Larry D. Hodge

John Graves said it best in *Texas Rivers*: “The loss of our primeval forests and prairies, the extinction or increasing rarity of many species of living things, the disruption of our waters’ flow and their pollution — all these evils and more ... are the price we have paid for progress and prosperity and our nation’s power, for getting to the point we have reached today.”

What point have we reached? Gunnar Brune’s *Springs of Texas* (1981) gives a clue. “Texas originally had 281 major and historically significant springs, other than saline springs. Of these, four were originally very large springs (over 100 cubic feet per second flow); however, only two, Comal and San Marcos, remain in that class today. Sixty-three springs, many with important historical backgrounds, have completely failed.”

WHY DOES THIS MATTER?

Spring flow is a barometer of underground water supply. "A spring is normally a spillway for an underground reservoir," Brune said. It is those reservoirs, through seeps and springs, that provide what hydrologists call base flows, the water that courses through streams after runoff from rainfall ceases. Underground reservoirs also supply water to lakes, ponds and wells. The fate of springs is ours as well.

Graves was right. We have paid a tremendous price — not out of our own pockets, but borrowed from future generations — for getting to where we are today.

SO WHERE DO WE GO FROM HERE?

In 1947, former President Johnson recognized that private landowners are the key to conservation when he said, "Saving the water and the soil must start where the first raindrop falls." This is especially true in Texas, where more than 90 percent of the land is privately owned.

Finding ways for landowners to work together while maintaining their autonomy and private property rights is perhaps the central challenge of conservation. Fortunately, it is being done in watersheds all over the state. What follows is far from complete, but it broadly sketches how Texans in different parts of the state are working to improve their little piece of what is still, despite several centuries of abuse, one of the best places to live on the "water planet."

The challenge now facing us is how to move to the next level. Increasingly scientists and land managers are coming to the same conclusion: Successfully managing our water resources requires acting on a broader scale than we are accustomed to. We need to manage entire watersheds, not just pieces within them.

WATERSHED OR WATER CATCHMENT?

"Watershed" describes land where most rain quickly runs off, temporarily swelling streams and perhaps eroding adjacent lands. "Water catchment" depicts land where most rain soaks into the soil after moving slowly through grasses and other vegetation, replenishing aquifers before being released slowly through seeps and springs, feeding streams over the long term and nourishing coastal estuaries and bays. It's a vision for the future as well as the way the landscape functioned in the past.

Wayne Elmore, a riparian specialist from Oregon, preaches converting Texas watersheds to water catchments. "What you do on your land in the upper part of a watershed influences conditions throughout," Elmore says. "After the rain stops and water no longer runs over the surface, all the water in a stream comes from the ground. The condition of riparian

areas and their associated catchments affects how much of that rain goes into the ground and how fast that water comes out of the ground. The opportunity is to increase our water storage area and volume and keep water on the land longer by managing our catchments together."

The Nueces River Authority, with funding from the Dixon Water Foundation, conducted a number of landowner riparian workshops in 2008. It plans additional headwaters stewardship programs through 2010.

"The Dixon Water Foundation funded the Nueces Riparian Network to help people work together to create a riparian whole that is greater than the sum of the individual parcels of land," says Executive Director Robert Potts. "Good land management along our rivers and creeks can create an environment in which water brings neighbors together for their mutual benefit. Better water retention in our state's rivers benefits everyone by providing cleaner, healthier rivers and more usable water for Texas."

BRUSH: VILLAIN OR VICTIM?

The United States Department of Agriculture Natural Resources Conservation Service estimates that brush in Texas uses about 10 million acre-feet (3.5 trillion gallons) of water annually. In comparison, total human use in the state amounts to about 15 million acre-feet.

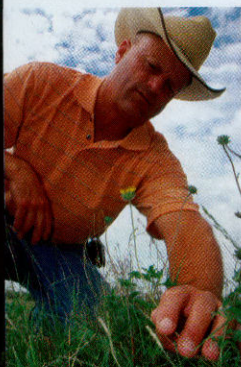
It seems obvious that if we get rid of the brush, we will have all the water we need.

Not necessarily so, say the experts.

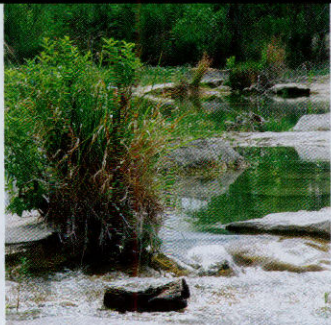
Salt cedar, juniper and mesquite trees have been variously charged with using between 20 and 200 gallons of water daily, and until recently conventional wisdom held that if you clear the brush and let grasses take its place, more water will flow into streams, lakes and aquifers. That thinking led the Texas Legislature to create the Texas Brush Control Program in 1985.

Brush clearing in the North Concho, Upper Colorado and Pedernales River watersheds did lead to increased runoff and rising aquifer levels in some places. Brush control, where it does work, increases water yields only where soils and underlying bedrock are highly permeable. But recent research indicates that the gains may not be permanent and may have resulted more from improved range conditions due to lower

Ranch owners are learning that if you clear brush and water-greedy trees, native grasses will spring up in their place, allowing water to flow freely from natural springs and eventually seep back down into the aquifer.







livestock stocking rates than from brush control.

"Our results suggest that for many semiarid rangelands (where baseflow is a small component of streamflow), large-scale shrub clearing in combination with sound range management will not lead to significant — if any — increases

in streamflow," says a report coauthored by Bradford Wilcox, Yun Huang and John Walker of Texas A&M University at College Station. "This is because proper management will enable a vigorous vegetation cover to be maintained, which means that infiltration rates will remain high and water will be retained in the soil and eventually used by plants."

It should be noted that the plants that replace brush may well be forbs and grasses with higher value for wildlife and livestock than the brush they replaced. And more water in the soil is not a bad thing. Think springs and baseflows.

Brush clearing can also have unwanted side effects. The endangered golden-cheeked warbler depends on bark from mature cedars to build its nests, and the southwestern willow flycatcher adapted to salt cedar as it crowded out the native willows. Clearing brush can destroy their habitat. Brush clearing can also lead to increased erosion and lower water quality until grasses grow up to anchor the soil.

"WATER, WATER, EVERYWHERE, NOR ANY DROP TO DRINK."

San Antonio gets most of its water from the Edwards Aquifer, a crescent of intensely fractured and faulted limestone that arcs across the heart of Texas from Hays and Travis counties in the north to Bexar near the center to Kinney in the west. The recharge zone, a relatively narrow band, lies on the northern rim of the aquifer at the edge of the Texas Hill Country — one of the fastest-developing areas in the nation.

In addition to feeding two of the largest springs in the state, Comal and San Marcos, the aquifer also provides habitat for a number of endangered species, some living in underground caverns. Development poses a serious threat to the aquifer both from possible pollution and from diminished recharge due to increasing amounts of impervious cover.

Water flows downhill, so pressure from water entering the aquifer through the recharge zone forces water downward and southward to San Antonio and other users. Ironically, although the level of water in aquifer-monitoring wells reacts quickly to recharge and pumping, most water in the aquifer lies too deep for economic access. Usage is basically restricted to recharge, which varies greatly depending on rainfall.

In 2000 and 2005, San Antonio voters approved a 1/8-cent sales tax to fund the protection of lands over the recharge zone. Through outright purchase and conservation easements, more than 80,000 of the nearly 1 million acres in the recharge zone are protected from development in perpetuity. Those funds have now been exhausted.

In 2007 the Texas Legislature passed Senate Bill 3, which establishes the Edwards Aquifer Recovery Implementation Program. The law gives the Edwards Aquifer Authority the power to implement water management practices to ensure the continuous minimum flows of Comal and San Marcos springs and to develop a recovery plan for threatened and endangered species associated with the aquifer.

The San Antonio Water System has been approached by landowner groups offering to pump groundwater from aquifers to the east and sell it to the city. Naturally, San Antonio is very interested.

But what of the people who live over those aquifers, who fear their wells might go dry because of massive pumping? Texans like to



A mesquite tree (top left) can use 20 to 30 gallons of water per day. (Bottom) Ranchers take notes as they learn more about what they can do to practice good land management along rivers and creeks during a landowner riparian workshop in 2008.

HOW TO GET HELP FOR YOUR PIECE OF WATERSHED

In recognition of the importance of managing watersheds, TPWD has set up the Watershed Policy and Management Program within its Inland Fisheries Division. However, the program is more wide-ranging than its name implies, says Gary Garrett, the senior scientist/program director. "What TPWD is going to do is have a holistic approach to managing the resources of Texas," Garrett explains. "Even though the Inland Fisheries Division will provide staff dedicated to the effort, we want to utilize all the resources we have within and outside the department."

Garrett stresses that TPWD will be providing advice and technical assistance, but it will be up to stakeholders within the watershed to develop and implement a plan. "The way a rancher does business on his ranch, the way industries operate, the way other people affect land use, is all part of

the picture, and you can't separate them. We will identify areas throughout the state that could benefit from management plans, meet with community leaders and stakeholders, put together an advisory team and advise them on what they need to do and what we can do to help them. In addition, we know where the money is to help them make things happen. But it's their program. They have to make it work."

The challenges are huge, but Garrett points out that the rewards amount to nothing less than keeping Texas a place we want to live. "If we don't do this, we are going to lose this resource — if somebody is not taking care of it, it will go away," he says. "Water is important to tourism, to health, to recreation, to farming, to ranching, to hunting, to sustainable cities and industry. If communities will take care of their water, it will be their legacy for the future. Clean, flowing water. Who's not for that?"

think of themselves as always being willing to help a neighbor in need, but when you start talking about taking water from one part of the state and sending it to another, you can expect a catfight.

RANCHING FOURTH-GRADERS

The Trinity River flows through the heart of the most heavily populated part of Texas, linking its two largest metropolitan areas, Dallas-Fort Worth and Houston. Two-thirds of the state's population lives within its watershed. If ever there was a poster child for the need to manage water in an entire watershed rather than on separated bits and pieces of land, the Trinity is it.

Fortunately, the Trinity also serves as an example of how to do it. Combining technical guidance from TPWD biologists, financial support from private landowner organizations and public water suppliers, cooperation from landowners, the expertise of educators and the enthusiasm of kids on field trips, the Texas Wildlife Association and the Trinity Basin Conservation Foundation are leading an effort to link urban and rural Texans by showing how they are all connected by water.

The Tarrant Regional Water District (TRWD) pumps water from Richland-Chambers Reservoir to supply Fort Worth with water. Ranchers with land in the watershed, like Gary and Sue Price of Blooming Grove, can get grants from TRWD for management practices that improve the quality of water coming off their land.

"What happens in the watershed drives not just the quantity of water in our reservoirs, but also water quality," said Darrell Andrews, TRWD assistant environmental director. "That in turn affects the water we sell to our customers. It translates to reduced costs because the water is cheaper to treat, because the water going into the reservoir is cleaner."

TRWD also partners with TPWD on the operation of constructed wetlands that clean Trinity River water, which is then added to Richland-Chambers Reservoir. Private landowners along the Trinity are banding together for projects that will benefit people throughout the watershed.

If it stopped right there it would be a commendable project. But public and private land managers realize they need public support to achieve their goal of making the Trinity River Basin a model for how to manage a watershed.

For that they've enlisted some most unlikely allies: fourth-graders. Through field trips cosponsored by the Texas Wildlife Association (TWA) and the Texas Freshwater Fisheries

Center in Athens, fourth-graders get to see land and water management as it's being practiced, meet with ranchers like the Prices and even roll hay bales after a picnic lunch under huge bur oaks. They leave with a better understanding of where their water comes from and what it takes to get it to them.

"Young people are the most impressionable. By starting with fourth-graders perhaps we can get to their parents as well," Gary Price explains. "We have to show them the things we do, and the things they do, that connect them to the land. Our biggest challenges in the next few decades will be centered around water. Everything is connected to that. If we don't have the quantity or quality of water we need, we will have problems that can radically change lifestyles. We need to get urban dwellers onto the land to see what happens here firsthand and take that knowledge back home with them. And we need to see their side of things, too. We have to take the big picture approach. If we don't do that, we'll never bridge the gap."

TWA engaged Conrod Associates of Washington, D.C., to develop a plan and secure funding for a Web-based educational pilot project to give schools and landowners the tools to connect with each other and create a continuing dialogue about urban-rural issues.

"The vision for the Trinity River Stewardship Project is for a partnership among various agencies, organizations and private landowners," says TWA's Tamara Trail. "We want to expand the project to more schools in the Trinity River Basin. The long-term goal is to change our conservation ethic."

SOME FINAL WORDS

Henry David Thoreau wrote, "There are a thousand hacking at the branches of evil to one who is striking at the root."

Brush control, interbasin transfers, conservation easements and even conservation itself all address branches of the water problem, but we shouldn't forget the root. Ultimately it all comes down to managing Texas watersheds (catchments) in such a way that springs and streams will flow and underground aquifers will be recharged; making water available for use in reservoirs and wells; providing habitat for fish and wildlife both endangered and common; supporting recreational use; and freshening the coastal bays and estuaries that serve as nurseries for marine life.

We know the way. Do we have the will? ☆

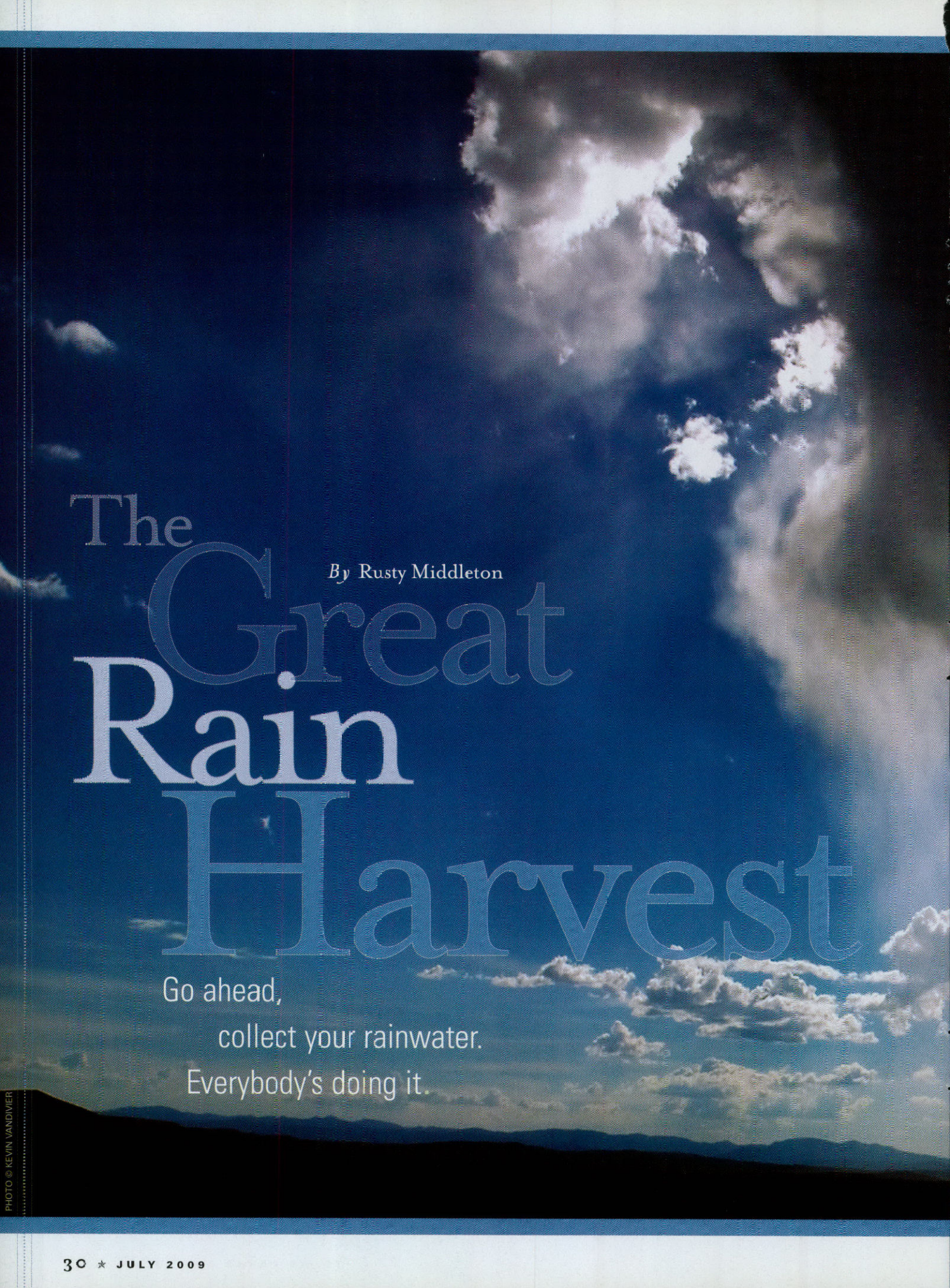


Gary and Sue Price (top left) of the 77 Ranch, 2007 winners of the statewide Lone Star Land Steward Award, are among the volunteers who help teach fourth-graders about managing watersheds in an innovative Texas Wildlife Association and TPWD program.

DETAILS

Interested in learning more about watersheds and water conservation? Here are some informative Web sites you can visit:

- Texas water matters in general: www.texaswater.org
- Neeces River and its Headwaters Stewardship Project: www.neeces-ra.org
- Brush control: www.tsswcb.state.tx.us/brush/control
- Land and water management: www.nrcs.usda.gov, www.fcra.org/community/conservation/creekside.html; www.lcratx.org; www.texaswatermatters.org
- Edwards Aquifer: www.edwardsaquifer.net
- Trinity River Stewardship Project: www.trinityfix.org
- Conservation easements and land trusts: www.texaslandtrustcouncil.org; www.nature.org/wherewework/northamerica/states/texas
- EARIP: <http://earip.tamu.edu>



The
Great
Rain
Harvest

By Rusty Middleton

Go ahead,
collect your rainwater.
Everybody's doing it.





Above: The 12,000-gallon Entry Cistern, one of five that supply 10 to 15 percent of the landscape water at the Lady Bird Johnson Wildflower Center, demonstrates that rainwater collection systems can be beautiful as well as functional.

Opposite: The Tower Cistern also offers visitors great views from the observation deck on top.

WHILE HARI KRISHNA WAS VISITING his native India recently, he traveled through a remote rural village and saw that rainwater was being collected from the roofs of some of the buildings. He stopped and asked the villagers how they learned to build the catchment system. One man went inside and promptly brought out a copy of *The Texas Manual on Rainwater Harvesting* written by none other than Krishna.

A longtime employee of the Texas Water Development Board, now working as a consultant, Krishna was gratified to find his handbook so far from home, but not all that surprised.

"Texas is the national leader in rainwater collection and the U.S. is among the most active internationally," said Krishna, who is a leading proponent of rainwater collection in Texas. "It's an ancient method that is catching on again, and we are leading the way. What was once thought of as fringe technology in Texas has become mainstream, at least in rural Texas. In fact, drought-stricken Central Texas is the most active rainwater harvesting region of the country."

But why did all this happen in Texas and not, say, Arizona, where it is generally drier; or California, where, by reputation at least, early adoption of alternative technology is common?

"Part of it is economics," said Krishna. "Some places like the Arizona desert get so little rain, the expense of the system doesn't make sense compared to the amount of water you can harvest. In some areas, like parts of Central Texas, the groundwater quality is so bad and the cost of drilling a well is so high that rainwater harvesting can make very good economic sense. And another important reason is that Texas is a big state with a lot of population growth and a lot of pressure on existing water supplies."

But when you look beyond the economics, you find that people build rainwater systems for a variety of reasons both practical and, perhaps just as importantly, philosophical. Those reasons are often interconnected. Rainwater collection systems are about as individual as their owners, and the various configurations cover a wide range of situations.

Barry Wall, who thinks he just might be the most active installer/designer of rainwater collection systems in the nation, put a system in a house near Kerrville that was built from the ground up with conservation and the environment in mind. "This is one of my favorite projects," said Wall, owner of Texas Rainwater Systems. "I'm proud of it, and the Ertels (the homeowners) are proud of it."

Not only did the owners forgo a well, they didn't even tap into the electrical system. The house gets its energy from solar panels. It is totally off the grid. (A cautionary note about new home construction: Some banks are still disinclined to lend money for a home that has no outside source of water.)

"We wanted as light a footprint on the land as possible. We wanted to be as green as possible," said Rick Ertel. They succeeded. The house has been awarded the Leadership in Energy and Environmental Design (LEED) and Greenbuilder platinum awards, their highest certifications. It uses many





The Wimberley home and studio of nature photographer Laurence Parent was planned with rainwater collection in mind.

natural and recycled materials such as cedar posts for support, natural clay plaster on the walls and countertops made from recycled glass.

The Ertel house is not only beautiful; it is also a powerful statement of what individual homeowners can do to live sustainably. But it didn't come cheap. And the rainwater collection system was a substantial part of that cost.

Such homes could safely be called high-end, but fortunately rainwater collection, whether installed by a professional or by a homeowner, can pretty much cover the spectrum of economic situations. It's especially reasonable if you build it yourself. Around half of all rainwater systems in homes are partially or completely owner-built, according to Billy Kniffen, an AgriLife Extension water resource specialist. In fact, rainwater systems seem to bring out the do-it-yourself instincts in homeowners.

For example, Wally Dechert of Dripping Springs not only built his rainwater collection system, he built the entire house. Like Ertel, he didn't bother with a well, but for a different reason. The groundwater in his area is unreliable and so loaded with minerals it can eventually clog the pipes. Rainwater collection for Dechert was less expensive than a well and the water of much higher quality. He estimates his total cost for rainwater collection at about \$8,500, which included a 30,000-gallon tank. His 3,800-square-foot roof will collect about 2,500 gallons from one inch of rain.

"It has worked well for five and a half years," said Dechert, "and the water is a whole lot better." During that time, Dechert has run out of water a few times and had small quantities trucked in. The Lady Bird Johnson Wildflower Center in Austin, a pioneer of rainwater harvesting in Texas, can also empty its tanks when demand is high. The center then resorts to city water.

If you are thinking about putting in a rainwater collection system, one of the first decisions you will make is whether or not the water will be used for human consumption. If you aren't going to drink it, your system will be simpler and significantly less expensive. But most homeowners want rainwater for household use because it is much easier on appliances and tastes so much better. To do this you must make sure the storage tank is made from non-toxic material and then decide how to filter and purify the water. At this point the choices begin to get complicated and increasingly more expensive. A specialized ultraviolet light that kills all pathogens can cost as much as \$1,500, for example.

With some exceptions, such as proximity to crop dusting, rainwater itself is almost pure. Most impurities come from the collecting surface, such as roofs. Aside from bird droppings, dirt and leaves, a composite roof poses the risk that chemicals in the shingles can leech into the water, especially if the roof is hot. *The Texas Manual on Rainwater Harvesting* recommends against consuming any water collected from a composite shingle roof. Metal or slate is preferred as long as the sealants used don't pose a separate risk of chemical contamination.

Some experts, however, say it is fine to drink water from a composite roof as long as it is properly filtered, especially with activated carbon. The filters have to be diligently maintained and replaced on a regular schedule. And then there are some rainwater collectors who filter out only leaves and similar debris and then let the water settle.

"I was raised on cistern water," said one harvester who lives near Wimberley. "We never got sick back then, and I still don't have any problems from my water."

The rapidly increasing popularity of rainwater capture has, ironically, led to increasing controversy about its use. For individual rainwater harvesters not connected to a public water supply, it's a matter of personal choice. But for those who are, it's a different story. Much to the consternation of many installers and some rainwater collection advocates, the Texas Legislature decided in 2007 that if your house is connected to a public water supply you are prohibited from using rainwater indoors. The fear is that rainwater could potentially contaminate the public water.

"This is a problem easily solved by backflow preventers or other mechanical means," said Wall. "This really shouldn't be a reason to keep folks from using their rainwater."

Increasingly, the state of Texas and smaller government entities are having a say in the rainwater harvesting world. Mostly they want to encourage it, but there are some notable exceptions.

In 2001 the Texas Legislature passed laws eliminating sales tax on rainwater collection equipment. Later it passed other laws preventing homeowners' associations from prohibiting rainwater collection equipment and tanks. Texas also encouraged rainwater collection on new state buildings and for school districts, and established a committee to create rainwater standards for indoor use with municipal water systems. Counties and some cities have incentive plans, Austin especially. The City of Austin offers as much as a \$40,000 rebate for commercial installations.

Other government entities are not always so rainwater friendly, however. One example is the City of Bandera, which, as of this writing, is threatening to fine a rainwater harvesting business owner \$200 a day for not hooking up to the city water supply. As another example, the City of Dallas decided to classify all rainwater as storm water and requires a licensed plumber to install rainwater equipment, even a rain barrel under a downspout.

Rainwater harvesting is riding a wave of renewed enthusiasm well beyond Texas. Many states and cities have new programs and laws encouraging or regulating rainwater collection. Ohio has the most extensive set of rainwater harvest laws in the country, with very specific codes for such things as materials, pipe size and overflow valves.

Texas does not regulate home consumption of rainwater, but only when it is used in a public water supply. Washington state encourages rainwater collection through incentive programs, as do many cities, such as Portland, Oregon, and Santa Fe, New Mexico. Tucson, Arizona, got national media attention when it mandated that 50 percent of all irrigation water come from rainwater collection. The law was fiercely debated because many thought the percentage too low.

Both the Texas Water Development Board (www.twdb.state.tx.us/iwt/Rainwater.asp) and Texas Commission on Environmental Quality (www.tceq.state.tx.us/permitting/water_supply/rainwater) have published extensive information on rainwater harvesting. Other resources are the Texas Rainwater Catchment Association (www.texrca.org) and the American Rainwater Catchment Systems Association (www.arcsa.org). ★



Volunteers with the Texas Bighorn Society install a rainwater collection system that will fill a wildlife "guzzler" in the Baylor Mountains near Van Horn last spring. The guzzler's automatically refilling trough provides much-needed drinking water for all types of wildlife in remote areas like this.





BARTON CREEK TWIN FALLS, AUSTIN, SUMMER

Laughing Water

PHOTOS BY
LANCE VARNELL

No matter what the season, waterfalls transform a landscape into a wonderland.

*From the waterfall he named her,
Minnehaha, Laughing Water.
— Henry Wadsworth Longfellow*

NOT LONG AFTER THIS CITY KID MOVED TO THE HILL COUNTRY, I found myself spending many a tranquil hour at the trove of idyllic swimming holes that grace our corner of the world. Many had waterfalls of various shapes and sizes — a slow, secretive trickle through a froth of ferns, rapids tumbling over boulders toward their final destination, or dramatic drops of the greatest grandeur. I imagined what it was like for Cabeza de Vaca when he stumbled upon this paradise, finding crystalline water cascading across the limestone rocks, lacy cypress trees and circling hawks sharing an azure backdrop, abundant wildlife also seeking the watering hole that brought life for all.

The seminal moment for me was at a little-known swimming hole near Wimberley, called Little Arkansas. When Mother Nature provided adequate precipitation, the springs flowed with gusto at the top of a cliff, free-falling down dozens of feet in an ice-cold deluge. I stood on a flat limestone ledge in the center of the Blanco River, letting the frigid water pound down on me until I reached the point of squealing for mercy. Then, a slow dive into the bathtub-warm waters of the river calmed the frazzled tingling of my nerves and lulled me into a near-soporific state of well-being.

Three decades later, I am still enchanted by the hypnotic magic of waterfalls. Nature photographer Lance Varnell has spent many years capturing these perfect “laughing water” moments, shown in every changing season of the year.

— Louie Bond



GUADALUPE RIVER, KERR COUNTY, AUTUMN

SMITH SPRING, GUADALUPE MOUNTAINS NATIONAL PARK, AUTUMN







GORMAN FALLS, COLORADO BEND STATE PARK, WINTER

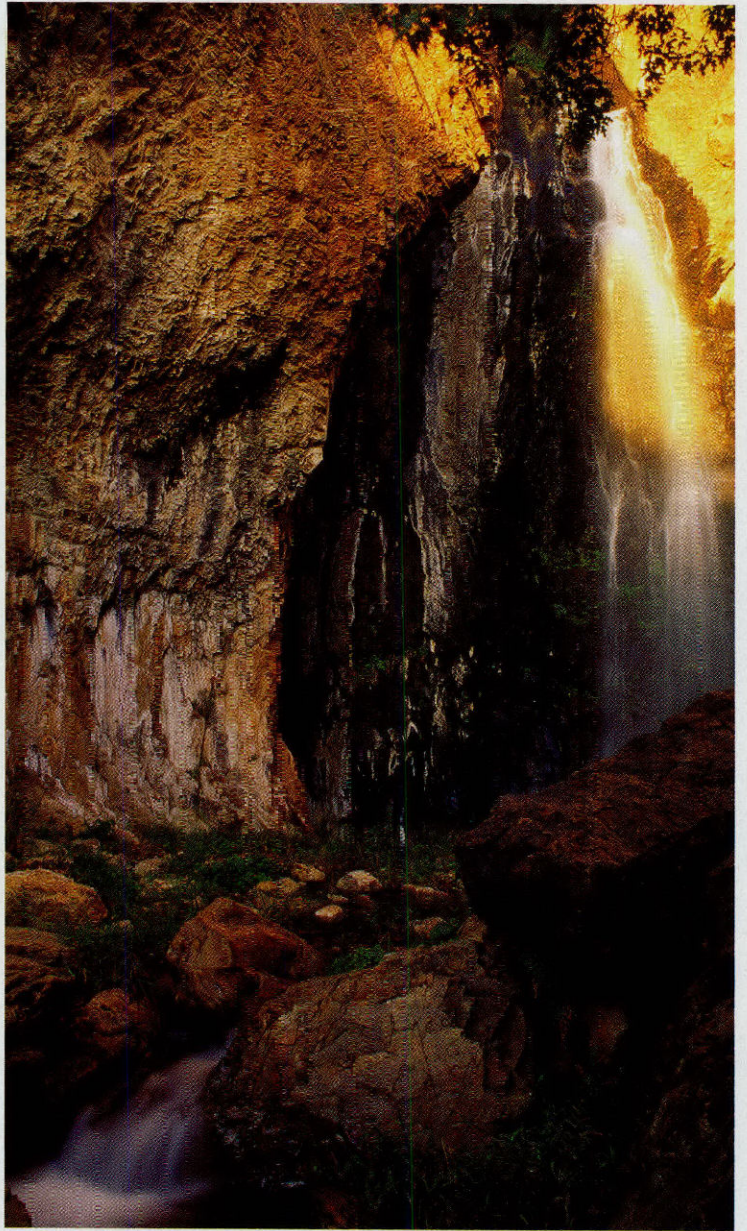


COLCREADO BEND STATE PARK, WINTER





PINE CANYON POUROFF, BIG BEND NATIONAL PARK, SPRING



CATTAIL FALLS, BIG BEND NATIONAL PARK, SPRING

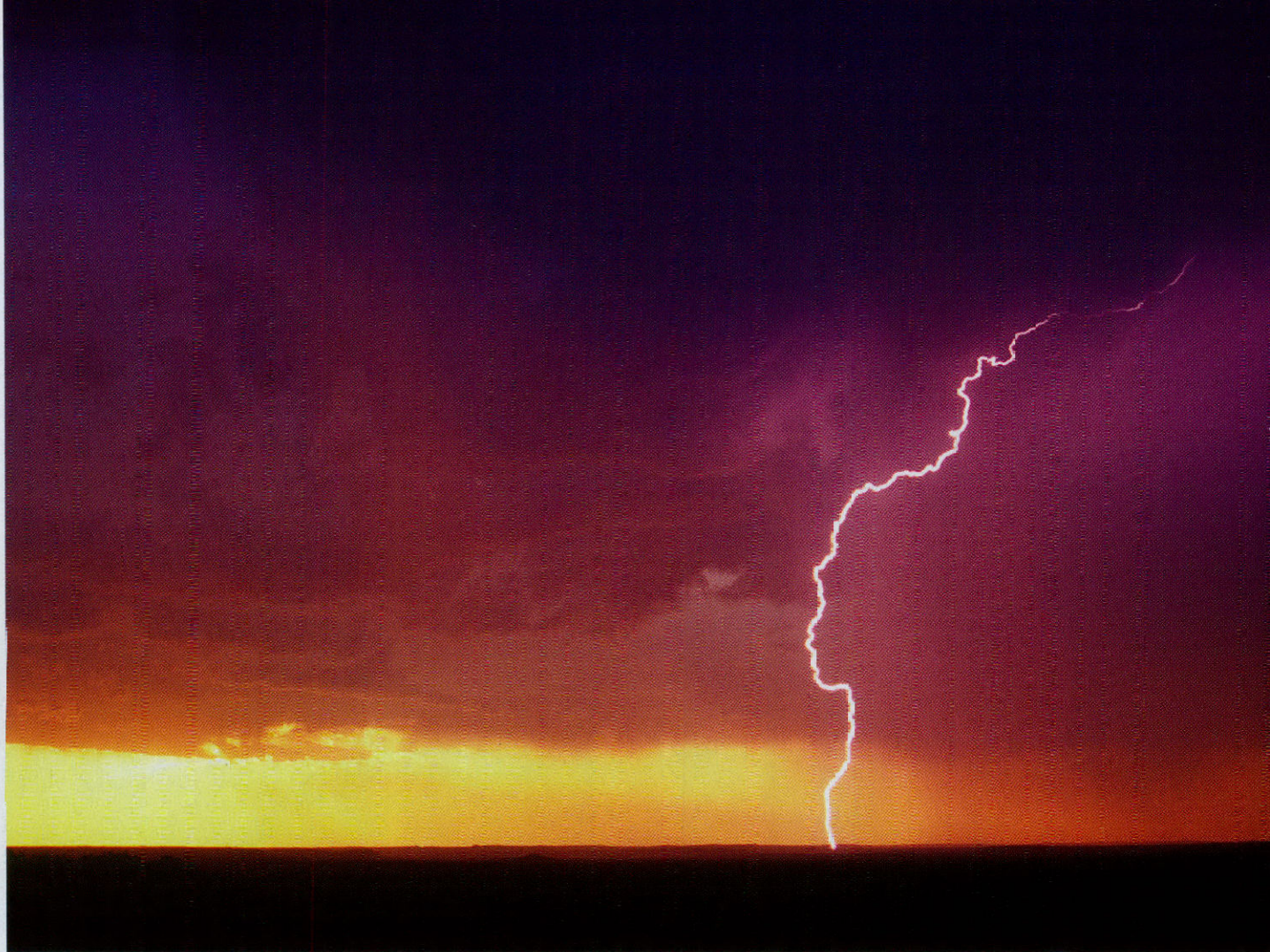


PHOTO © WYMAN MEINZER

WEATHER WATCHERS

By
E. DAN KLEPPER

Trained meteorologists and amateurs alike help keep track of that crazy Texas weather.



THE DAY MIGHT HAVE BEGUN like any other — fresh eggs, dairy cow milk, and a bumpy ride down the dirt bluff road to the beach along the shores of Lake Texoma. Although choppy conditions may have kept the boat off the water, we would have fished anyway, casting our chances from the gravelly shoreline, waiting for the coolness of morning to give way to the heat of the day. By mid-afternoon we would have shed our shoes and gone swimming.

But Mother Nature had other plans. That night we slept inside the cabin's screened porch, a handmade homestead that sat along a rural route stretching north between the oxbow curves of the submerged Red River. The lake air moved gently through the mesh, carrying the scent of cedar berries and striped bass nodding in the riprap.

Abruptly and without warning, a funnel cloud descended out of midnight, screaming like a jet engine just above the treetops. The deafening sound sent us scrambling for shelter beneath the cabin's kitchen table, my sister and I excited, my mother and grandmother terrified. The roar shut down our ears. Then, just as suddenly, stillness.

Afterwards, my father and grandfather surveyed the grounds around the cabin for dam-

age but found none in the quiet of the early morning hours. At daybreak they drove the short distance to the local marina and discovered the twister's brief landing and its dregs: snapped trees, half-submerged docks whirling against the shoreline, boats tossed about like wooden scrap.

Had there been a warning? Unlikely. It was only mid-century in the modern age — no siren; no Weather Channel ticker alert; no streaming weather dotcoms (no Internet at all, in fact); just a television broadcast earlier in the evening. The weather news, teleported out of Ardmore, Oklahoma, suggested evening thunderstorms for the Lake Texoma region. Rabbit ears caught it and channeled the signal into scratchy black-and-white flickers that rolled and skewed, all vac-

uum tubes and sine waves, the voices buzzy and popping as if transmitted from some distant galaxy in decades past.

Technology has bridged a significant gap since then, allowing today's vast weather data to arrive spontaneously and through a medley of venues. Unfortunately, the volatile weather it monitors has continued to blow in just as rapidly and with its own multifarious discharge. Texas, it appears, receives the brunt of this action. Consider the lists of top 10 weather extremes for the nation. Texas occupies three of the 10 available positions for frequency and severity of hail, one for average number of tornadoes, one for the all-time hottest and driest, two positions for the top 10 windiest, and three for the most humid. That's a lot of weather to negotiate.

The professional weather services and research centers parse out most of the details for us, but multitudes of Texans have also taken our extreme weather variables to heart. Want to know the current weather stats at pinpoint locations in Crowley, Midlothian or Frisco? How about Texline or Muleshoe? Hundreds of Texans maintain weather stations in their own backyards as members of the Citizen Weather Observer Program. These “citizen scientists” collect weather data and upload it to state and national weather service centers daily. They offer real-time conditions and detailed climate data — in essence, providing weather quality assurance for the state.

Texans, however, are not alone in their weather watching endeavors. The entire nation is made up of weather monitoring enthusiasts. According to Chris Davis, senior scientist at the National Center for Atmospheric Research, it seems we may have a good reason to be observant.

“The severity of weather in America is generally much greater than in other parts of the world, when one considers extremes of heat and cold, snow, rain and wind,” explains Davis. Tornadoes, for example, occur with frequency in the U.S. but “are comparatively rare in all developed countries. Hurricanes also strike the U.S. with some regularity, but true hurricanes do not affect Europe.”

Davis says that America’s extremes of heat and cold are the result of the country’s vulnerability to the larger continental climate.

“Cold air can originate in Canada or even Siberia and reach the U.S. relatively unmodified,” he says. “Similarly, the elevated terrain of the west and air descending off the Mexican plateau can produce stifling heat waves. Moisture from the Gulf of Mexico makes the humidity unbearable. Many locations, especially in the upper Midwest and Great Plains, experience a range of more than 100 degrees Fahrenheit between their high and low temperatures for a given year. Such a range occurs in very few populated areas elsewhere in the world.”

The lows, in particular, are difficult to avoid. According to Davis, snow and ice storms are likely to occur regardless of where you live in America.

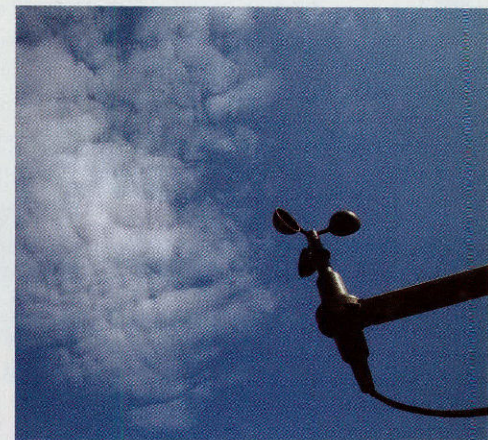
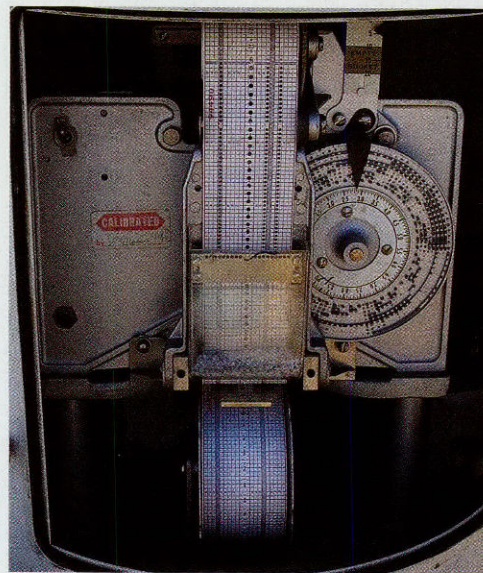
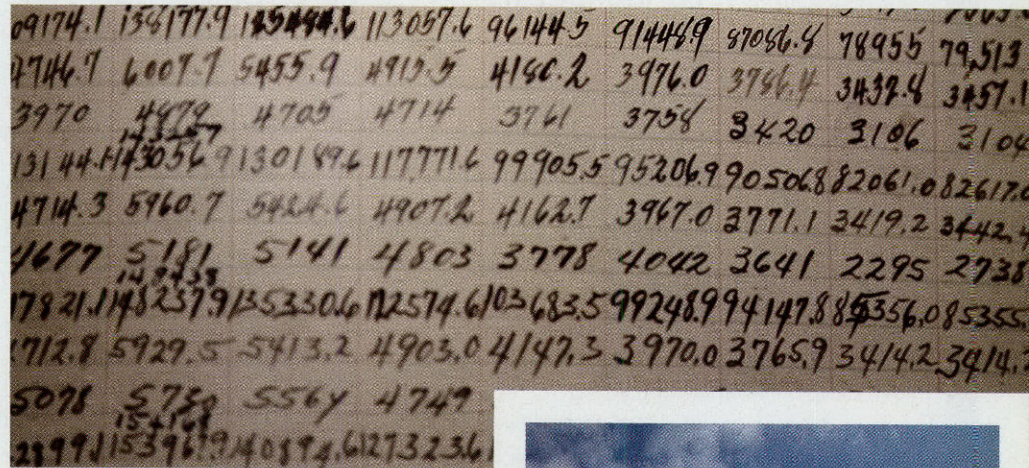
“Blizzards of the Plains and New England are legendary,” he says. “Furthermore, great changes from heat to cold, sun to snow, etc., can occur in just a day or two. With the extremes, the rapid swings, the large population, the dependence of livelihoods and commerce on weather, and the difficulty of

predicting weather, it is not surprising that Americans have an infatuation with weather.”

The National Weather Service (NWS) is the nation’s primary weather watchdog. Part of the National Oceanic and Atmospheric Administration (NOAA), the NWS operates under the umbrella of the U.S. Department of Commerce. According to its mission statement, the NWS is the government agency charged with providing “weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the pro-

the artifacts of weather by hand. The oldest available data for the Beeville 5 NE station, now positioned on the area’s Texas A&M AgriLife Research and Extension Center grounds, dates back to 1906.

These early climate inscriptions harbor a scrivener’s legacy of fountain pen strokes. Hand-recorded data cuts across the ledger pages like ink-black sharks. Oddities, such as number of days with “windstorms” and “fogs,” account for pages and pages of I’s and O’s, incidentally presaging the digital age. The stations’ instruments, a collection of rudi-



Handwritten ledgers, like this one from the Beeville National Weather Station (top), have been replaced by automated data systems (left). Above, an anemometer at the Texas A&M University AgriLife research station measures wind speed and direction.

tection of life and property and the enhancement of the national economy.”

To do so, the NWS maintains a large network of official weather data gathering sites to keep its citizens informed. Many of the cooperating stations have been gathering weather data for at least a century, including more than 30 of the hundreds of Cooperative Station Network sites throughout Texas. By 1910, rural outposts and fledgling communities like Alpine, Beeville, Corsicana, Falfurrias, Mexia and Temple had begun archiving

mentary devices designed to read temperature, wind speed and rainfall, occupy a small plot within the larger research location and still operate, with some modifications, today. As climate analysis improved and the application of weather data evolved, some Beeville observations were abandoned. But the basics, such as temperature and precipitation, continue to be recorded by hand (via the keyboard) and, thanks to advanced technology, by automated systems.

Technology — specifically, affordable

weather gadgetry and the vast reach of the Internet—has, in fact, made weather watchers out of thousands of us.

“The Internet has allowed weather enthusiasts to ‘come out of the woodwork’ and interact with each other,” says Jesse Ferrell, community director for AccuWeather.com, a Web-based entity serving more than 10,000 clients worldwide with weather data and forecasts, including CNN Interactive and MSNBC.com. “The decreasing price of electronics has also contributed, as it is relatively inexpensive to maintain an Internet-enabled weather station and/or Webcam at one’s home these days.”

Our rationale for weather watching appears to transcend routine climate monitoring. Comments on one of an infinite number of Internet weather forums reveal a compelling array of emotional and intellectual reasons.

Some use weather to connect to the natural world. “It fascinates me to see what happens outside my window and know why and how it happens,” writes one AccuWeather forum participant. “It really makes you appreciate the wonders of nature.”

For others, the weather is a source of awe, beauty and humility. “[The weather] is the great equalizer,” writes another forum participant. “All creatures great and small must somehow manage to cope with the effects of it, whether it be rain, cold, warm, snow,

wind, wave, lightning or thunder. It is the omnipresent force against which all must judge their own ability to adapt and survive.”

Comments like these bring to the forefront a simple truth about our relationship with the planet’s climate. Each day the weather provides fresh challenges for coping with conditions that appear completely out of our control. In fact, a monumental change in the climate seems to be on almost everyone’s mind today. But what does our abundance of available weather data tell us about the changing climate, and what does it portend for Texans and our natural environment? These are difficult and complicated questions to address, but many of our climate scientists are making headway with the answers. One of them is John W. Nielsen-Gammon, Texas State Climatologist, professor of meteorology and acting executive associate dean, College of Geosciences, Texas A&M University. Nielsen-Gammon has reviewed the state’s climate data from the United States Historical Climatology Network, much of it dating back to 1895.

“First let’s talk about climate variability,” Nielsen-Gammon suggests, “which is part of climate change, and as you go to smaller scales and smaller time periods it becomes increasingly dominant. The climate in Texas has varied considerably during the past century. By far the most significant climate event

was the drought of the early to mid-1950s, when Texas experienced some of its driest and hottest years. Because of the cool weather during the latter part of the 1900s, the overall linear temperature trend is downward, as it is for most of the southeastern United States. However, a straight line is a poor representation of the actual temperature variations which follow a steady rise up to and including the 1950s, then a sudden drop to cooler temperatures until the 1980s, and a rapid rise thereafter. If you compare this to global mean temperatures, it tracks fairly well, except that temperatures in Texas during the 1950s drought were much higher than they should have been, based on global temperatures.”

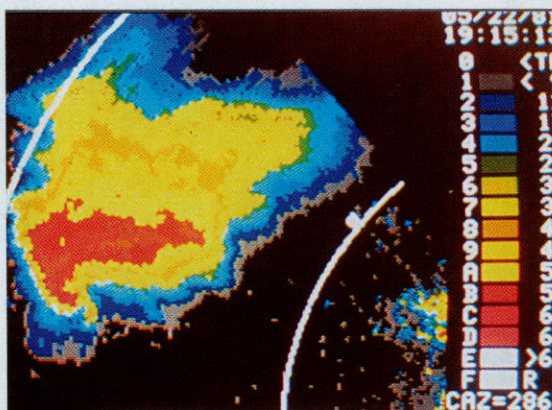
According to Nielsen-Gammon, the cool period was deeper in the state than elsewhere over the planet during the latter 20th century, yet the rise in temperatures thereafter has been more rapid in Texas.

“Just based on temperatures alone,” Nielsen-Gammon explains, “one could not conclude that the temperature in Texas will continue rising. However, there is plenty of other evidence that temperatures should continue to rise, in general. And Texas temperatures are now at their historical highs compared to the past century, so any continued warming will take temperatures beyond the realm of past experience in Texas.”

Evidence for a decline in precipitation as temperatures rise has not shown up yet in Texas despite climate models typically predicting otherwise. Rainfall in Texas has actually increased over the last century, with the 1990s going on record as the wettest decade. “Because of this inconsistency,” Nielsen-Gammon explains, “there is little confidence about what will happen to future precipitation, except that whatever falls will be faster to evaporate because of warmer temperatures, leading to greater water demand and increased susceptibility to drought.”

So what will it be for future Texans? Hotter or colder? Wetter or dryer? Is our change in the weather simply a natural cycle or catalyzed by humans? Plenty of opinions abound. In fact, it seems that every citizen has one. While citizen-scientists across the country continue to record daily conditions, the climatologists move forward with the diligent work, analyzing data, studying climate models and gaining a greater understanding of our changing weather.

It is still uncertain what all that science will ultimately tell us. But one thing is for sure. We’ll all be watching. ★



Jeff Rahmes of the TAMU AgriLife research station reads rain levels for the National Weather Service (left). Above, NOAA radar, and below, a temperature gauge at the Beeville station.

Keep

Texas Wild



EVERY DROP COUNTS

Wildlife needs water, too, so don't waste it!

Leopard frog

» WATER, WATER EVERYWHERE?

ANIMALS (INCLUDING YOU!) DEPEND ON WATER to survive. Deer and raccoons, as well as many other animals, drink from streams and ponds. Some animals, like beavers and herons, find the food they need to eat in the water. Desert animals have little water on the ground, so their bodies have adapted to getting their water from the food they eat. Some animals, like fish, need water to breathe or to breed and raise babies. All you have to do is turn on the faucet to get a drink of water. Do you think there is plenty of clean water for all who need it? In some places there is, but in other places, the lack of clean water has become dangerous for the animals.

» HOW ANIMALS USE WATER

BEAVERS USE WATER for many reasons besides drinking. They construct dams to make ponds. They slap the water with their flat tail to warn other beavers of danger. They enjoy eating the water lilies that grow in the water. The entrances to their home, called a lodge, are underwater for safety.

FROGS



SINCE ALLIGATORS are reptiles, they live on the land, but they like to live near the water. One way they catch food is by hiding under the water. They can hold their breath for more than 30 minutes!



CATTIGLI © RUSSELL A. GRAVES

FISH

A FISH SPENDS its entire life in water. It even breathes using gills, which get oxygen from the water. Fish lay eggs in the water, and raise their babies there. All the food they eat is in the water, too.

» FUN WATER FACTS



The water we use today is the same water the dinosaurs used. There is still the exact same amount of water on earth as there was back then.

- All of the water that we consume gets returned to the Earth and rejoins the water cycle.
- People can live several weeks without food, but only a few days without water.
- Without water, the Earth would look like the moon.
- Water makes up 83 percent of our blood, 70 percent of our brain, and 90 percent of our lungs. Overall, our bodies are 70 percent water.

A watermelon is about 92 percent water. A tomato is about 95 percent water.



BEAVERS



BEAVER © KATHY ADAMS CLARK/KAC PRODUCTIONS

AMPHIBIANS LIKE FROGS live on both land and water. They lay eggs in the water, then the tadpoles that hatch from the eggs live in the water until they become frogs. Frogs also use water to stay cool, and will eat insects and tiny animals they find in or near the water.

RACCOON © DERRICK HAMRICK/ROLYN.COM



RACCOONS

SOME PEOPLE say that raccoons wash their food before they eat it, but probably they are just playing with it in the water. Their diet consists of many different foods, but they will eat fish and shellfish. Like many mammals, they need lots of clean water to drink to stay healthy.

ALLIGATORS



ALLIGATOR © DERRICK HAMRICK/ROLYN.COM

An apple, a pineapple, and an ear of corn are each 80 percent water. A dog is 70 percent water and a frog is 78 percent water.

» HOW MUCH DO YOU USE EVERY DAY?

TOTAL = 200 GALLONS!

- Shower = 3 gallons per minute
- Brush teeth = 1/2 gallon
- Wash hands = 1 gallon
- Bath = 20 gallons
- Flush toilet = 5 gallons
- Wash dishes = 5 gallons
- Washing clothes = 35 gallons
- Water hose = 10 gallons per minute
- One small drip = 25 gallons per day
- Drinking = 2 1/2 quarts

» HOW CAN YOU SAVE WATER?

- Turn off water while brushing teeth – save 3 gallons a day.
- Cut 10 minutes off your shower – save 30 gallons a day
- Turn off a dripping faucet – save 25 gallons a day
- Run only full loads in washer and dishwasher – save 30 gallons a day

ILLUSTRATIONS © FIAN ARROV



Spike's Activity Page



» KEEPING IT WILD

THERE'S NO BETTER TIME than the middle of summer to enjoy water outside with your friends. Here are a couple of sponge games that are cool, wet fun but don't waste a lot of water. All you need is a few small plastic buckets of water and an inexpensive pack of sponges. Have a sponge war by throwing wet sponges at each other like snowballs. Have a cool sponge race by soaking a sponge at one end, then squeezing it into an empty bucket at the other end. The winning player (or team) has the most water in the second bucket when time runs out.



» WILD SCIENCE

THERE ARE LOTS of cool science activities that involve water. Perhaps you'd like to use water to try to make raisins dance. Fill a clear drinking glass with club soda (water with bubbles). Drop in a half a raisin and watch to see what happens. Why does the raisin rise and fall? (Hint: It's all about the bubbles!) Try this with other items, like paper clips, small dry pasta, beans or buttons.



NEXT MONTH: Ssssssssnakessss!



» WILD MATH



SET A MEASURING CUP under a dripping faucet. Using a stopwatch or clock, see how long it takes to fill up the cup. How many cups would the drip fill in an hour or a day (24 hours)? A week? A month? A year?

TEACHER RESOURCE

Visit www.tpwmagazine.com to download a printable PDF, access lesson plans, find additional resources or order copies.

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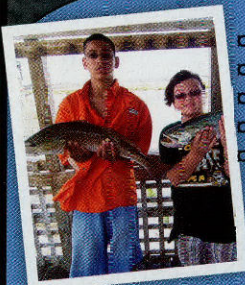
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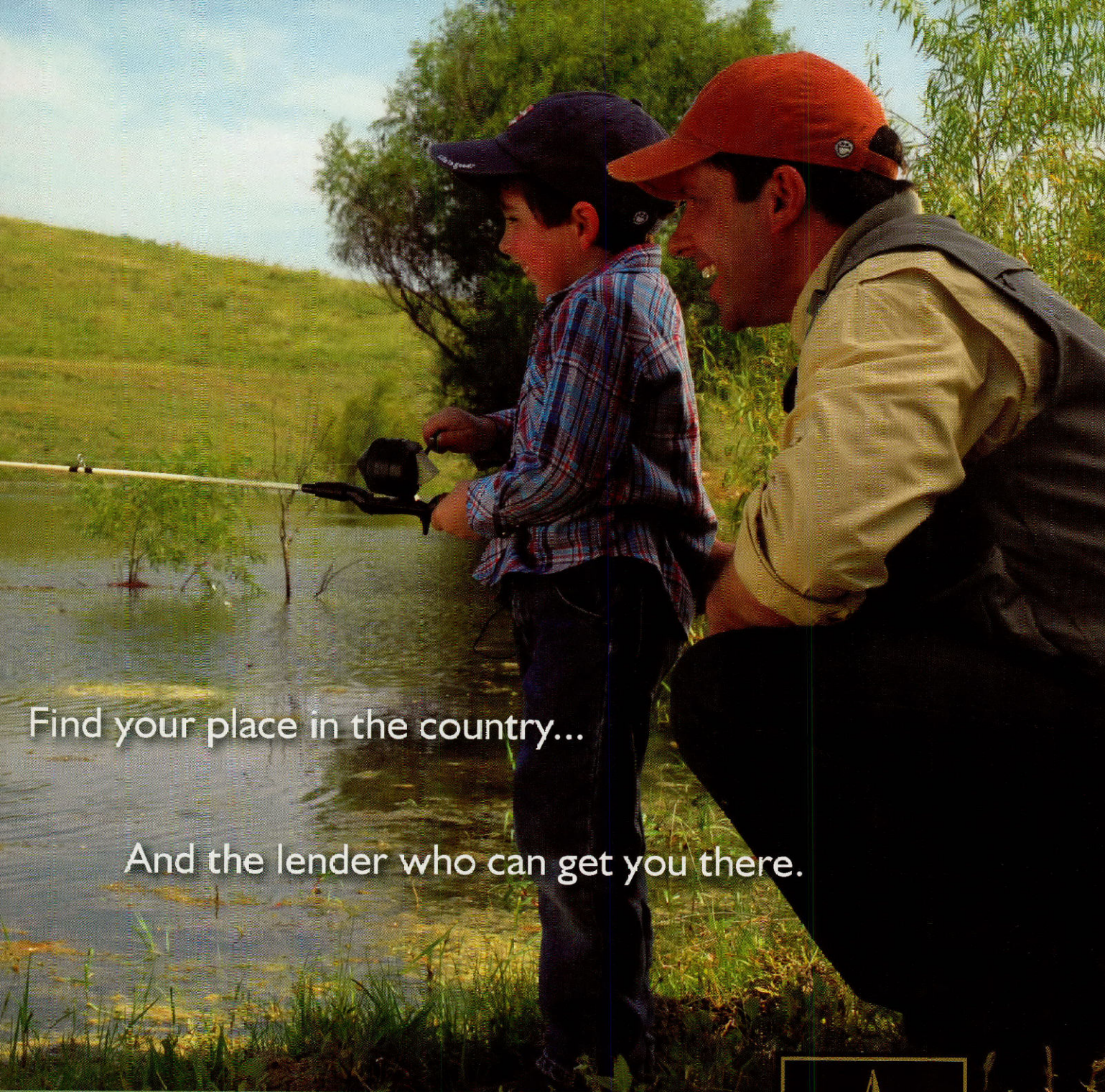
PARTING SHOT

A squall line moves in over the rolling plains in Knox County near Benjamin. Photographer Wyman Moinzer advises aspiring shutterbugs to keep an eye out for lightning within a cloud; that's a sign that things are about to get interesting.

IMAGE SPECS:

Canon 5-D, ISO 100,
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