

INSIDE: LEFTY'S LEGACY • UNDERSTANDING BONEFISH DECLINE • CAPTAIN STEVE HUFF • JUVENILE TARPON

A publication of
**Bonefish
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TRUST**



BONEFISH & TARPON

Journal

STEWARDSHIP THROUGH SCIENCE • FALL 2018



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Bonefish & Tarpon Journal

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2018-19 Events

Lower Keys Happy Hour
The Square Grouper—November 28, 2018
6th Annual Florida Keys
Dinner & Awards Ceremony
The Islander Resort—January 17, 2019
9th Annual Boca Grande Event
The Gasparilla Inn—February 1, 2019
8th Annual NYC Dinner & Awards Ceremony
The University Club—April 9, 2019

BTT's Mission

To conserve and restore bonefish, tarpon and permit fisheries and habitats through research, stewardship, education and advocacy.



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Bonefish & Tarpon TRUST

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Features:

The Florida Keys Initiative	16
Lefty Kreh	20
Bahamas Education Program	26
The Bonefish Decline in South Florida	28
Captain Steve Huff	36
Including Habitat in Fisheries Management	46
Habitat: Locally Important, Regionally Essential	54

Updates/Reports:

Setting the Hook	8
Perspectives	8
Tippets	10
Dorsey Pictures Donation	14
Catch & Release Best Handling Practices	32
Featured Artist: James Prosek	42
Conservation Captain Q & A	52
Bonefish & Tarpon Trust Events	58

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BTT is a membership-based organization, and our members are our lifeblood. Since our founding in 1998, we have grown to include concerned anglers from over 20 countries, researchers from throughout the world, and guides committed to working with BTT in order to educate anglers and gather data while on the water. The generous support of our members is critical to our mission: **Conserve and restore bonefish, tarpon and permit fisheries and habitats through research, stewardship, education and advocacy.**

We have celebrated many accomplishments, but there is still much more work to do.

Please help us in our mission by joining and urging your friends, guides, lodges, and fishing clubs to join. Please go to www.btt.org and click "Join BTT" to become a member today.



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Setting the Hook



Harold Brewer, Chairman



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From the Chairman and the President

We love our fish at Bonefish & Tarpon Trust! At any point in time, we're pursuing a dozen or more research projects that focus on our target species. In this issue of the Journal, you can learn more about the causes of bonefish decline in the Florida Keys and the importance of including habitat in resource management plans, among other topics.

But there's another important species—another actor on the saltwater flats stage—that's also critically important to our conservation success—humans.

When we're out on the flats, we become a part of this great ecosystem. Yet, unlike the other species there, we hold an awesome power to conserve or destroy. By becoming ethical anglers, we not only observe what is minimally expected of us but take on a greater responsibility to respect and steward the resource. To lengthen our stride further, we can take steps off the water by supporting BTT's science and conservation projects and advocating for policies that benefit our fisheries, including the ongoing effort to restore America's Everglades.

Our presence on the flats and our role as a catalyst for their conservation can't be overstated. As it's been said, we will conserve only what we love, and we will love only what we understand. In this issue, we place the spotlight on three individuals who have made a difference—Lefty Kreh, Steve Huff, and James Prosek.

When news came last March that Lefty Kreh had passed away at age 93, we were all gathered in New York City to present the 2018 Lefty Kreh Sportsman of the Year Award to Paul Tudor Jones II. In accepting the award, Paul spoke of Lefty as the consummate teacher—a person who had changed the way the world casts flies. Lefty was always generous in his willingness to share his fishing wisdom with students of all ages, skill levels, and walks of life. And as Flip Pallot references in the excellent article by Eddie Nickens published in these pages, Lefty was like the proverbial “canary in a coal mine.” He saw the first signs of a deteriorating environment and its impact on our fisheries. As a BTT Honorary Trustee and recurring cast member on the *Buccaneers & Bones* television show, he used his platform to champion BTT's science-based approaches to conservation, understanding that the more we learned about bonefish, tarpon, and permit, the more effectively we could advocate for habitat protections, improved regulations, and other conservation measures.

At the same time, he encouraged anglers to be more conservation-minded in their approaches to fishing.

Steve Huff will celebrate his 50th anniversary as a fishing guide later this year. One of the most beloved and respected guides in the history of flats fishing, Steve's storied history includes guiding Tom Evans to six tarpon world records on four different line classes and guiding Del Brown to four permit world records. He and his anglers were always formidable competition in Florida Keys fishing tournaments over the years. Steve graduated from the University of Miami with a degree in marine science, which no doubt gave him an edge in understanding his environment on a deeper level than most. His respect for the fish and their habitats has been demonstrated throughout his life. With a quiet, thoughtful touch, he has educated and inspired anglers in ways that go beyond simply pursuing a fish but extend to larger core values about the fishery, its habitats, and the sport that remains a major stakeholder in conservation.

We follow the stories of Kreh, the revolutionary fly caster and teacher, and Huff, the legendary guide, with another talented individual featured in this edition. James Prosek has used his fame as a celebrated artist and author to advocate for conservation and to inspire a new generation of anglers to connect with the natural world through fishing. Called the “Audubon of the fishing world” by *The New York Times*, James considers a fly rod and flies to be tools in the same vein as his paintings and books. In an interview with Monte Burke, who penned the wonderful article that follows, James makes the case. “They are all tools we use to communicate and observe and document. They lead to better understanding, and enhancement of our love for the species, and a greater urge to protect them.” At press time, James is working on a special piece for BTT—a painting of a bonefish that will accompany a shadowbox holding one of the last flies ever tied by Lefty Kreh.

These three individuals all exhibit the best in citizen science. Through their curiosity, their capacity to apply observations in meaningful ways, and their ability to tell a story or share an experience in compelling tones, they have stoked our own passion for the fishery and inspired us to be better stewards of it.

On behalf of BTT, thank you for being the species that's making a difference in the conservation of our flats. For fish and angler alike, we thank you for your generous support and advocacy. 

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Southwest Florida's Fisheries Ravaged by Red Tide

AARON J. ADAMS, PH.D.
DIRECTOR OF SCIENCE AND CONSERVATION,
BONEFISH & TARPON TRUST, AND SENIOR SCIENTIST,
FLORIDA ATLANTIC UNIVERSITY, HARBOR BRANCH
OCEANOGRAPHIC INSTITUTE

An approximately 140-pound tarpon photographed by Capt. Tommy Locke outside Cayo Costa in June.

Once again in 2018, Florida's fisheries have suffered from the legacy of long-time mismanagement of Florida's water resources. Even as water from Lake Okeechobee assaults the Caloosahatchee River and St. Lucie River with blue-green algae, Southwest Florida has suffered from a red tide that is causing unprecedented kills of gamefish. Reports from fishing guides and others on the water estimate that tens of thousands of snook have been killed—all of them adults in the peak of spawning season. There have also been reports of many dead breeding-size redfish. And numerous tarpon, which usually seem to avoid red tide, have been reported dead. The red tide, which as of the time this issue went to press has been ongoing for at least nine months, may be a sign of the 'new normal' in Southwest Florida because too many nutrients are entering Florida's estuaries and coasts.

Although the direct link between too many nutrients and red tide is difficult to make, the available science suggests that the intensity, frequency, and duration of red tides have increased. The organism that causes red tide, *Karenia brevis*, has been present in southwest Florida as far back as written records go—the Spanish wrote about it. So it's a natural part of the ecosystem. In Southwest Florida, there has not yet been a direct link established between human-introduced nutrient and red tide outbreaks. In contrast, the red tide outbreaks in the Texas-Louisiana region have been linked to human-introduced nutrients. The reasons for these differences are unclear.

The lack of a direct link between human-introduced nutrients and red tide in Southwest Florida appears to be because other plankton organisms are better initial competitors for those new nutrients. So it appears that *Karenia brevis* does not benefit directly from the extra human-introduced nutrients. However, given the increasing frequency, duration, and intensity of red tides in Southwest Florida, it's apparent that *Karenia brevis* does benefit secondarily from these extra nutrients; once the nutrients have been used by those other plankton species, and then are cycled back into the ecosystem when

those organisms die and decay, *Karenia brevis* goes to work.

The excess nutrients in Southwest Florida waters are from multiple sources, with two at the top of the list. First, they are from the high-nutrient water from Lake Okeechobee that is discharged into the Caloosahatchee River as part of water mismanagement in South Florida (the same mismanagement that is killing the Everglades and the St. Lucie River). Second, the phosphate mining industry in the Charlotte Harbor watershed produces runoff high in phosphorous, which feeds red tide and other plankton organisms. Runoff from agriculture and lawn fertilizers is also a major source of nutrients.

So what are some of the impacts on Southwest Florida's fisheries? Tarpon gather in Boca Grande Pass and Charlotte Harbor during May and June in association with spawning. It is likely that this red tide will negatively impact tarpon spawning. Charlotte Harbor is also home to an amazing snook and redfish fishery. During summer months, snook spawn in passes and along beaches. This red tide is impacting spawning snook directly, which will impact the region's snook population. And large adult redfish live in Gulf of Mexico waters offshore of Charlotte Harbor, which have been hit especially hard by red tide, which will certainly affect the coming spawning season.

Although we know that red tide has been part of Southwest Florida's ecology for hundreds of years, the changes we have made to the coastal ecosystem by adding so many nutrients has created a new normal. This new normal is bad news for our fisheries and the economies that depend on them. The only way to reverse this trend and get back to the previous normal is to change the state's water management policies, which is also causing a water crisis in many other parts of the state—from Florida Bay to the Indian River Lagoon. The future of Florida's economically important \$8 billion saltwater recreational fishery is at stake and so too are the livelihoods of all those who depend on the fisheries in jeopardy. 🐟



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Tippets

Short Takes on Important Topics



From left: Greg Fay (BTT board member), Cory Deal (BTT Events Coordinator), Dr. Ross Boucek (BTT Florida Keys Initiative Manager), Garrett Gordy (Co-Founder of Gordy & Sons Outfitters), Andy Mill (former Olympian and professional angler), Mark Rehbein, (BTT Director of Development). Photo courtesy of Gordy & Sons Outfitters

fishing with the legendary permit master, Lincoln Westby, and his team of guides. All dues-paying BTT members who join or renew during 2018 will be automatically entered, with the drawing taking place on January 7, 2019. 🐟

PROJECT PERMIT

Project Permit, a collaboration between BTT and Carleton University to track permit movements with acoustic telemetry, reached a major milestone in June with the tagging of our 100th permit. We are learning a lot about permit movement patterns and the data have already influenced permit harvest regulations, such as the expansion of the permit harvest season closure in the Special Permit Zone (SPZ) to include the month of April (previously the closed season was May-July). BTT thanks guides Travis Holeman and Bear Holeman from Key West Angling for helping with tagging efforts, and all the guides and anglers who have donated their time over the past 2 years. This important project is generously sponsored by Costa Sunglasses and the March Merkin Permit Tournament, with support from Lower Keys Guides Association, Hell's Bay Boatworks, and Pathfinder Boats. 🐟



Photo: Dr. Jake Brownscombe

BTT TARPON ACOUSTIC TAGGING PROJECT EXPANDS INTO TEXAS

Bonefish & Tarpon Trust and Gordy & Sons Outfitters are pleased to announce the launch of the BTT Texas Tarpon Acoustic Tagging Project. The family behind the finest hunting and fishing retailer based in Houston, is generously funding the first year of the Texan tagging initiative to harvest local data from the tarpon population that seasonally spans the western Gulf of Mexico. The Texas Tarpon Acoustic Tagging Project will expand the overall Tarpon Acoustic Tagging Project, which is currently focused from South Carolina through the Florida Panhandle, to include the Texas coastline. 🐟

WIN THE PERMIT FISHING TRIP OF A LIFETIME

There's still time to enter BTT's annual, members-only Trip of a Lifetime drawing. This year, one member and his/her guest will win a trip to fish with Blue Horizon Fly Fishing in Belize! The package includes 5 nights at Thatch Caye Resort and 4 days of guided fly



Photo: Kinsey Goff

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PRE-SPAWNING ACTIVITY IN MEXICO / BELIZE

A research team led by Addiel U. Perez, a Ph.D. student of El Colegio de la Frontera Sur and a BTT research associate, recently identified bonefish pre-spawning activity in two sites in Northern Belize. This discovery represents a major step forward in bonefish research along the Belize-Mexico border, as it is the first time any pre-spawning behavior has been documented in the region, and because bonefish from both Mexico and Belize travel to this pre-spawning location. Since 2015, the team comprised of Addiel Perez, Roberto Herrera, and Belizean guides Omar Arceo and Jose "Chepe" Polanco, have tagged over 8,550 bonefish and recovered approximately 650 tags in southern Mexico and northern Belize. This tag-recapture method is essential to track local movement and also the migration of bonefish in the region. Local knowledge from many traditional artisanal fishermen assisted in determining the seasonality of movements in and between Chetumal Bay and the Caribbean coast. Most importantly, veteran guide Omar Arceo's own experience as the only witness of pre-spawning in Northern Belize was crucial to identifying and documenting the pre-spawning behavior activity in the two newly discovered sites. 🐟



Stevie Kim-Rubell. Photo: Daniel Kim

INTRODUCING THE BTT YOUTH AMBASSADORS

The future of our flats fishery will depend on the stewardship provided by the next generation of anglers and conservationists. We are excited to announce the launch of the Bonefish & Tarpon Trust Youth Ambassadors Program, which recognizes outstanding young leaders in flats fishing. Fourteen-year-old Shelby Berger (VA) and twelve-year-old Stevie Kim-Rubell (NY) are the first to be inducted. Shelby has a vested interest in the health of the fisheries that bring her so much joy: "As a fisherwoman and a scuba diver, I have seen firsthand what pollution has done to our oceans and waters, especially our reefs and fisheries. We must protect our natural resources to preserve the beauty and, more importantly, to preserve our ecosystems and the health of this planet." Stevie agrees that protecting and conserving fish populations is a responsibility not to be taken lightly: "I want to continue to be able to fish for tarpon, bonefish and permit for the rest of my life without the fear of these species going extinct. Not only that, but I want my children and grandchildren, and their grandchildren, to have healthy fisheries, too." We are excited to have Stevie and Shelby represent the next generation of anglers and conservationists in BTT's new Youth Ambassador Program, and we applaud their leadership. 🐟

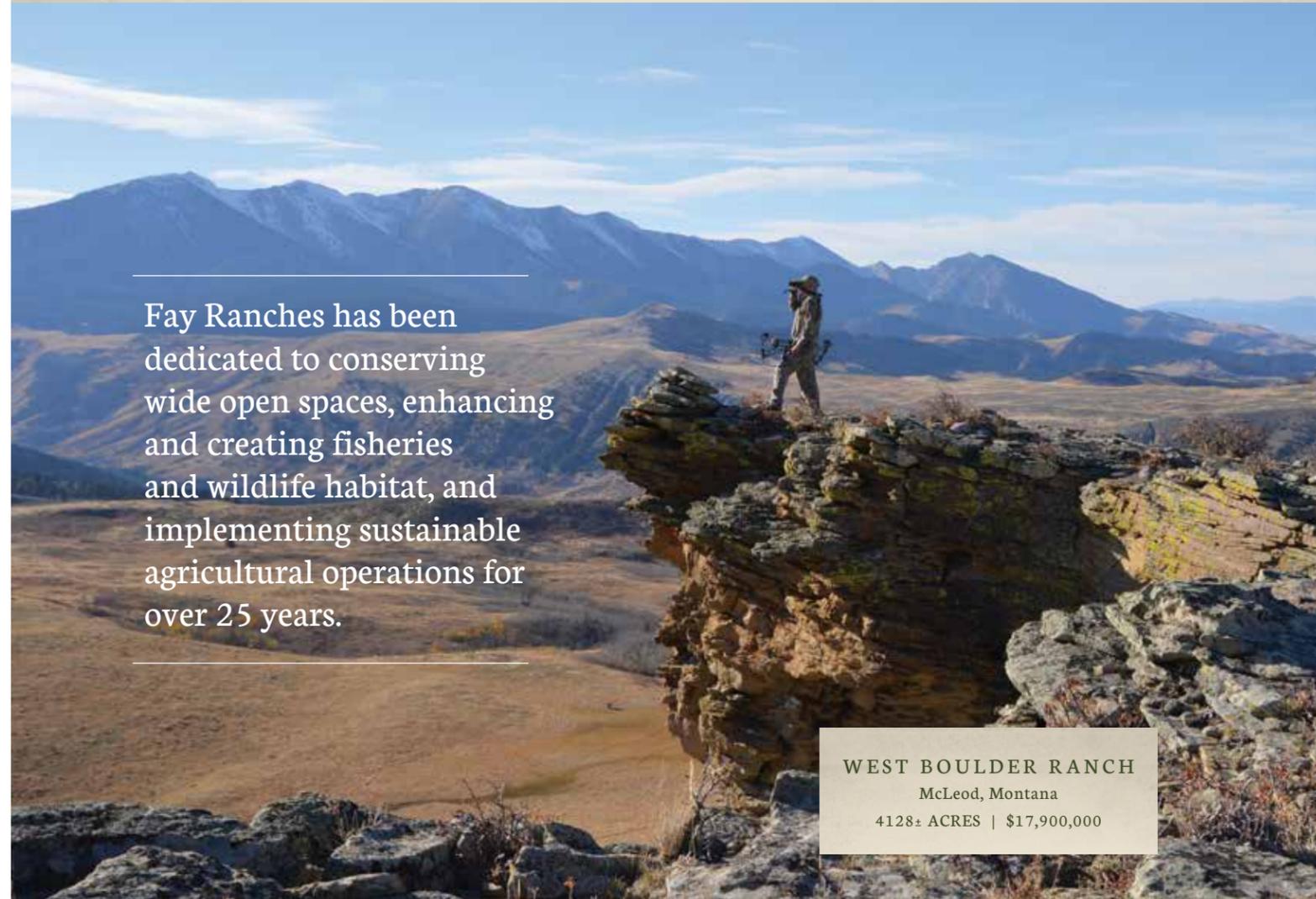
BTT SCIENTISTS ATTEND CUBA WORKSHOP

Scientists, business leaders, and policy-makers from across the globe gathered in Havana last April to attend the third International Workshop of Fish, Pollution, and the Environment. The gathering featured discussions on sustainable development and the use of marine resources in Cuba. Dr. Ross Boucek, BTT's Florida Keys Initiative Manager, and Dr. Jennifer Rehage, a BTT collaborator from Florida International University, attended the workshop at the invitation of Cuban leaders. Dr. Boucek presented an overview on BTT's approach to protecting flats fisheries, and how it could be applied to habitat conservation in Cuba. Dr. Rehage, whose research is focused on understanding why the Florida Keys bonefish population has declined, gave a presentation on possible causes impacting the fishery. In contrast to South Florida, which is working to correct environmental impacts, Cuba has an opportunity to be proactive and protect important habitats. Already, habitat protection strategies are sustaining world-class fisheries in Cuba. On the Southwest side of the island, Las Salinas sits just west of the Bay of Pigs, an estuary that from a satellite image does not look very different from Florida Bay. Yet as a protected area with no pollution, the Las Salinas habitats are in better shape than those of Florida Bay. As BTT and others work to restore the Everglades and Florida Bay, we can use Las Salinas as a gauge to measure our progress. 🐟



BTT AND NAUTILUS REELS COLLABORATION

BTT and Nautilus Reels have teamed up to create 10 limited edition Monster reels to celebrate the success of our Tarpon Acoustic Tagging Project and support BTT's tarpon conservation efforts. The reels will be available to sponsors of the project and each one will be customized with the serial number and tagging coordinates of an individual tarpon, along with a custom Jorge Martinez tarpon engraving. For more information, please contact BTT Director of Development Mark Rehbein at: mark@bonefishtarpontrust.org or (786) 618-9479. 🐟

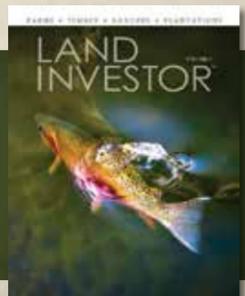


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Dorsey Pictures Donates *Buccaneers & Bones* Footage to BTT



The cast and crew of *Pirates of the Flats*, which became *Buccaneers & Bones*. Photo: Dorsey Pictures

It has been over 10 years since BTT board member Bill Klyn, and Chris Dorsey, the CEO and owner of Dorsey Pictures, created the award-winning *Buccaneers & Bones* TV show during a BTT board meeting in Colorado. Over the course of 56 episodes, this unique series has captured the experience of pursuing bonefish, tarpon, and permit, while educating viewers about the threats that face these remarkable fish and their habitats and the ways in which BTT is working to conserve and restore the fishery. Chris Dorsey generously produced the series at no cost to BTT, thereby raising awareness of BTT's mission while allowing the organization to focus its resources on the science that guides its conservation efforts.

"With a group of A-listers like Tom Brokaw, Michael Keaton, Liam Neeson, Jimmy Kimmel, Huey Lewis, Yvon Chouinard, Tom McGuane, Jim Belushi and, of course, the indomitable Lefty Kreh, I was pretty sure that we couldn't screw up by making *Buccaneers & Bones*," said Dorsey. "And what better group of castaways to raise the profile of an upstart conservation organization with big ambitions."

The successful formula paired these well-known anglers and friends of BTT with extraordinary videographers in spectacular saltwater locations with a storyline that allowed viewers to better understand these fish and their habitats. The seven seasons of the show have been instrumental in helping engage more anglers to support BTT's science-based conservation work.

Chris and his wife Amy further demonstrated their generosity and ardent support of the BTT by donating the entire library of *Buccaneers*

& *Bones* video assets to BTT, along with \$10,000 to be used to further educate and engage new members.

"We appreciate our long partnership with Dorsey Pictures, which has shared the beauty and excitement of flats fishing—and the need to conserve our flats fishery—with audiences around the world," said BTT President and CEO Jim McDuffie. "The financial contribution and ability to repurpose *Buccaneers & Bones* content will allow that important outreach to continue through a vast array of digital outlets."

Buccaneers & Bones, which airs on Outdoor Channel, began in 2009 as *Pirates of the Flats* on ESPN. The final season of the series, hosted by legendary NBC News anchor Tom Brokaw, aired last spring and celebrates the majesty of flats fishing while showcasing the invaluable work of the Bonefish & Tarpon Trust to conserve and restore bonefish, tarpon, and permit fisheries through sound science.

"For anyone who has waded a salt flat, presented a fly to a bonefish, and has then been jolted by the power of this fish, I think there comes a realization that such an experience is so remarkable that it must be preserved," said Dorsey. "And no organization does more for our flats fisheries than Bonefish & Tarpon Trust."

"We thank visionary Chris Dorsey for crafting this masterpiece series and for his instrumental support of BTT," said BTT board member Bill Klyn.

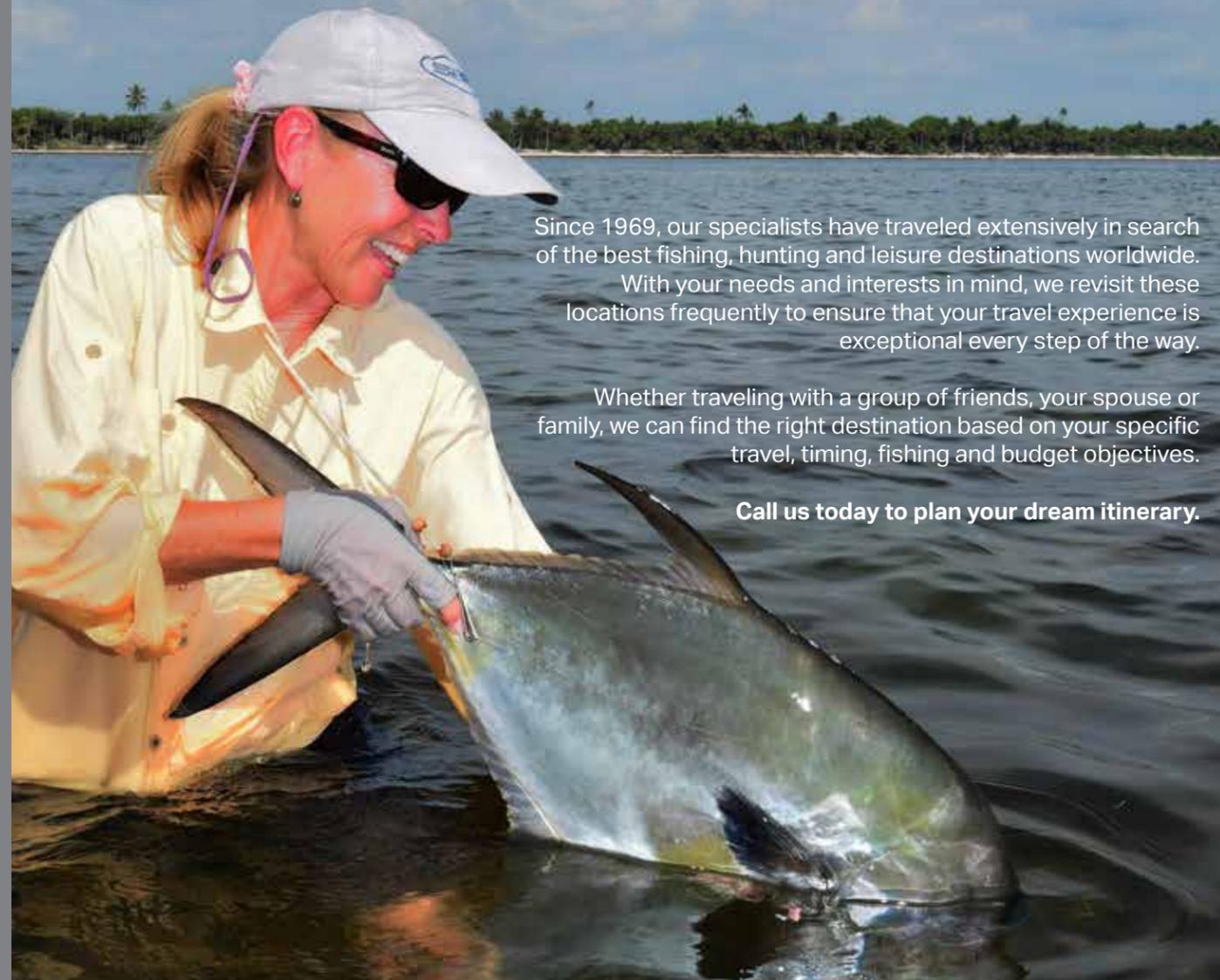
"We applaud his efforts to tell the story of these incredible fish that have inspired and entertained viewers for the past decade, and now, with this gift, will continue to do so for many years to come." 

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Identifying and Addressing Conservation Challenges in the Florida Keys

DR. ROSS BOUCEK
Florida Keys Initiative Manager

The Florida Keys has produced more world records of bonefish, tarpon, and permit than everywhere in else in the world combined. When the fishery was at its best, it attracted anglers from across globe, providing revenue essential to the Florida Keys economy. Unfortunately, multiple lines of evidence suggest that these species are in decline. Bonefish declines are the most severe and began the earliest; angler reports and scientific data show a 60% decrease in catch rates since the late 1980s. For tarpon and permit, angler reports indicate that declines are more recent, occurring over the last 10-20 years. To reverse these downward trends, BTT's Florida Keys Initiative was formed to restore populations of these species.

We take a stepwise approach to restoring the Florida Keys fishery. First, we assess the status of knowledge of the biology of bonefish, tarpon, and permit. We also assess the threats to the fishery. Combined, these are used to prioritize research. Second, we collaborate with scientists who have expertise in that specific research topic. We provide those researchers with the necessary funding to scientifically evaluate conservation concerns and to discover new information about these species essential for conservation and restoration. Lastly, we use this science to guide advocacy and, ultimately, restoration actions. Below is an overview of our progress to date for restoring the Florida Keys flats fishery.

Restoring bonefish

We focused on three areas of research: 1) Did we lose our spawning fish or possibly our larval supply of bonefish? 2) Are juvenile or adult bonefish habitats deteriorating? 3) Or is disease, poor water quality,

and the presence of contaminants causing bonefish to die at a faster rate than they would in a pristine system? We have been funding six research studies to investigate these questions.

Have we lost our larval supply of bonefish?

In the late 1990s and early 2000s, considerable time and effort was spent searching the Keys for larval and juvenile bonefish. This search found only six larvae. The lack of larval bonefish suggests that our larval supply in the Keys has diminished, so BTT initiated studies to determine why.

From our Bahamas work and other research, we know that bonefish spawn in deep water, and that bonefish larvae drift in ocean currents for up to 71 days, providing a scenario where bonefish larvae may be coming to the Keys from locations in the Caribbean. To address this possibility, we funded a study that uses computer simulation modeling of known ocean currents to predict which places in the Caribbean could supply the Florida Keys with bonefish larvae. These simulations identified several important regions: the southwest coast of Cuba, Belize, and Mexico, as well as an area west of Key West. To confirm the results from this model, an ongoing study is determining how genetically related Caribbean populations are to the Keys' population. If we find out that the parents of our Keys bonefish are in fact Cuban, Belizean, or Mexican, then an essential part of restoring bonefish in the Keys means working internationally to ensure that those bonefish populations are protected. In contrast, if local Florida spawning fish are important contributors to the Keys population, we must learn why Keys bonefish are unable to repopulate the area.

Photo: Justin Lewis



Tarpon tagging in the Keys. Photo: Andrew O'Neil

What environmental changes over the last 30 years coincide with bonefish declines?

Our second focus is long-term environmental changes to the Keys that may have impacted bonefish. Collaborators characterized when and where bonefish first started to decline, whether the adults or juveniles are dying at a faster rate than they should naturally, and what changes in the environment occurred at the same time as the bonefish declines began. Results show that some global environmental factors have likely played a role in changing bonefish populations, such as natural fluctuations in ocean-atmospheric climate cycles similar to El Niño, and gradually rising temperatures. But the study identified important local factors as well, including increases in the abundance of sharks, increases in fishing pressure, and deteriorating water quality. More details on this study are provided in this issue's article, "The Bonefish Decline in South Florida: What Have We Learned?"

Are disease and contaminants harming bonefish?

Our third group of studies seeks to determine how disease, contaminants, and other human-made stressors are impacting bonefish health. The degraded state of the Florida Keys' environments has led to a few notable disease outbreaks for other species that have been catastrophic for fisheries and habitats. In the early 2000s, a virus nearly caused the collapse of the spiny lobster fishery. And currently, a coral disease is projected to kill over 50% of the Florida reef tract in the next two years. It is not outside the

realm of possibility that bonefish could be suffering from a disease that is contributing to their declines. BTT collaborator Tony Goldberg discovered that bonefish in the Keys have a strain of retro-virus that is not found in areas that have healthy bonefish populations. Retroviruses are in the same family as HIV. If the retrovirus is hurting bonefish, the virus might not kill the fish out right, but instead could weaken the fish. Weakened bonefish would be more vulnerable to other environmental stressors, such as poor catch and release practices, degraded water quality, and predation.

An extension of this research has been exploring the role that contaminants, such as pesticides, could be playing in harming bonefish. The research found that copper sulfate, a common herbicide, occurs at lethal levels in certain areas in Biscayne Bay and in the Keys. Many of the locations where these lethal levels occur coincide with baby bonefish habitats.

The studies on disease and contaminants are ongoing, and will provide new information in the coming years.

The importance of water quality

Pharmaceuticals and contaminants, and even the lethality of viruses and diseases, are a result of how we manage freshwater. Pharmaceuticals impacting bonefish are a product of sewage treatment that fails to remove these chemicals before they reach our oceans. Removing these pharmaceuticals is possible, just expensive. Copper enters our estuaries as runoff from both agriculture and herbicide treatments to clear vegetation from canals that convey freshwater throughout the state. In terms of disease and viruses, too much or too little freshwater entering estuaries at the wrong



A tagged permit. Photo: Dr. Jake Brownscombe

times can make water too salty or too fresh, or even too hot or cold. Altered freshwater flows negatively impact habitat and reduce available prey, both of which weaken the immune system of fish, making them more susceptible to disease. Weakened immune systems, stress from unfavorable temperature and salinities, physiological impacts of pharmaceuticals, poisoning from contaminants like copper, all result in slowing growth, reducing how much energy bonefish allocate to reproduction, and decreasing the resiliency of bonefish to catch and release fishing. Collectively, these negative impacts affect the longterm health of the population. As we conduct more studies linking these stressors to bonefish with freshwater management, we will have more science-based evidence to pressure policy makers to fix our waters.

Tarpon and permit conservation

Identifying, protecting, and restoring nursery, adult, and spawning habitats is our priority for restoring tarpon and permit in the Keys. For both species, we have identified juvenile habitat. Baby permit are found on sandy beaches, so likely suffer from beach renourishment activities. Baby tarpon depend upon mangrove wetlands, creeks and backcountry ponds. Unfortunately, 50% of the mangroves in Florida have been lost to development, and many of the remaining systems suffer from freshwater management issues. Recognizing the urgent need to stop habitat loss for juvenile tarpon, we initiated our Juvenile Tarpon Habitat Initiative, with the mission to identify, protect, and do the research necessary to restore juvenile tarpon habitats. If degradation and loss of juvenile tarpon habitats continues, our tarpon fishery will also decline. Our Juvenile Tarpon Habitat Initiative Manager JoEllen Wilson has multiple tarpon habitat restoration projects underway.

On the adult side, we use an animal tracking technology called acoustic telemetry. For permit, we track fish to determine whether the Keys flats permit are using habitats outside of the Florida Keys Special Permit Zone. The Florida Fish and Wildlife Conservation Commission estimates that outside of the SPZ, 50% of permit that are caught are harvested. We also track flats permit movements to their spawning sites. Like bonefish, permit spawning sites need to be protected, and the fish that visit those sites should be safe from

harvest while they spawn. Last, we are tracking permit movements on the flats to determine how much space they use in their day-to-day lives. This information can guide habitat protection on the flats.

For tarpon, our focus is on identifying the habitats tarpon use on their migration, and determining how many tarpon are migrants versus residents. Already, the project has resulted in meaningful conservation actions. We have learned that Keys tarpon as small as 50 pounds will migrate over a 1,000 miles north to areas like the Chesapeake Bay and estuaries in the Carolinas, where they spend the summer months. This information enables us to support efforts to improve tarpon conservation, such as the new regulations that greatly limit harvest in South Carolina, and ongoing efforts to make tarpon catch and release in North Carolina. We have also joined a coalition of organizations along the eastern US coast to improve regulations for menhaden, which are essential prey for tarpon during their seasonal migrations.

Looking ahead

Our research points us to three areas of conservation concern. First, we must address conservation threats occurring outside the Keys that are impacting our fishery. For bonefish, this may be harvest in Cuba or habitat loss in Mexico and Belize, and for tarpon, it may be environmental degradation in places like the Carolinas. As we move forward with the Florida Keys Initiative, we will launch projects to address these concerns. The second and most important issue is water quality and Everglades restoration. Multiple lines of evidence suggest that our fisheries are suffering from water quality issues that must be addressed. We will continue to work with our partners in the Now Or Neverglades coalition to advocate for Everglades restoration. Third, proper catch and release practices are essential for the longevity of our fishery. To address this, we will expand angler education campaigns to improve catch and release best practices.

Understanding and addressing the issues that have caused the decline of the Keys flats fishery form the core of BTT's Florida Keys Initiative. This effort will only be successful if BTT's collaborations with the guides and anglers of the Keys continue and even strengthen. Success also requires persistent advocacy to correct the problems BTT-funded research identifies, and this will require a community effort. This isn't only about the high economic value of the flats fishery (\$465 million annually for the Keys); it's also about preserving an important part of the Florida Key's culture and rich angling heritage. 🐟



A healthy Florida Keys bonefish. Photo: Dr. Ross Boucek



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Lefty's Legacy

T. EDWARD NICKENS

I was a kid at my hometown mall the first time I saw Lefty Kreh in person. A casting area had been built on the floor in front of the Sears store, and adults were shoulder to shoulder around the low, makeshift crowd fencing. I was little enough to squirm between a couple of sturdy chaps, yet old enough to understand that I was seeing an entirely new way of catching a fish, and an entirely new way of intersecting with angling technology. Kreh used a rod to cast half a fly line, then broke the rod down and kept casting with just the forward rod section, and then moved his hand up the ferrule to grasp the line between his fingers. And still the cast soared, practically down to the Spencer's Gifts store where I wasn't allowed to go and once I figured out what velvet handcuffs were for, I understood why.

I stood there transfixed, and I didn't know it then, but the spell Lefty Kreh cast on me that day had befallen thousands already and would change the lives of hundreds of thousands of other anglers in the half-century to come.

When Kreh passed away on March 14, 2018—at his home in Cockeysville, Maryland, in his sleep, as peacefully as night falls on laurel-shaded water—the angling community shuddered. We all knew this was coming. And we all know there will never be another like him. Kreh had written 32 books, fished with presidents and celebrities, and with Ernest Hemingway and Fidel Castro in one sun-drenched weekend, been inducted into three fishing halls of fame, taught untold



Lefty giving a casting lesson to the cast of *Buccaneers and Bones*. Photo: Dorsey Pictures

numbers of people to cast a fly rod and untold more how to really cast the damn things, modeled a sort of gentlemanly ethic as rare as empty beaches these days, and had lodged himself like some piscatorial North Star onto everyone's and anyone's list of the greatest and most influential anglers that who ever lived.

All of that began with a ground-breaking, paradigm-shifting cast, and that's how so many will remember him: That magical cast, that marvelously efficient metronomic application of power and grace and nuance to graphite and nylon and feathers and steel.

But a legion of fly rodders isn't the most long-lasting nor the most consequential legacy of the man who taught America to cast a fly rod. Not by a long double-haul shot.



Photo: IGFA

Kreh was born in 1925, in Frederick, Maryland, and given a name he was rarely called: Bernard Vincent Kreh. When he was six years old, his father, a brick mason, was accidentally kicked in the chest and died. This was during the Depression, and most families in Frederick's working-class neighborhoods were on short rations. But the Krehes took a turn into particularly dire straits.

It fell to the eldest Kreh son to haul home the family's welfare rations of cornmeal and flour in a wagon, the bags marked RELIEF to add to the humiliation. He caught catfish on limb-lines and sold the fish to bolster the family's cash flow. But he was a scrapper and an athletic kid, and there were woods and streams in addition to basketball courts and baseball diamonds, and to the end of his days he didn't view a hardscrabble childhood as challenging so much as defining:

He was known to eschew fancy lodge foods for off-brand breakfast grub he'd pack with his rods and reels.

After high school there were larger concerns. He enlisted in the U.S. Army, and fought in the Battle of the Bulge. His unit liberated a concentration camp.

After his military career, he worked at Fort Detrick, known for its work on biological warfare technology. He was famously exposed to the anthrax virus when he went to work in a torn protective suit. He nearly died, but Army doctors took blood samples during his recuperation and used them to create an all-new strain of the virus. They named it after Kreh: BVK-1. He loved that story.

Kreh was like a lot of outdoorsmen in those days, well-rounded and living in a place and at a time when fabulous hunting and fishing was just out the door. He met the famed Joe Brooks in 1947, fishing for smallmouth bass on the Potomac River. He commenced a writing career that leapt from local newspapers to regional magazines to all of the Big Three: *Field & Stream*, *Outdoor Life*, and *Sports Afield*. He became a Baltimore favored son, a piece of Maryland sporting heritage whose name was associated with bass waters such as

the Potomac and Susquehanna, trout streams like the Gunpowder River, and the emerging saltwater fisheries of the Chesapeake Bay.

Then, in 1964, Kreh made a seminal move: From the Potomac's tidal waters he washed up on the shores of the Miami Metropolitan Fishing Tournament, a.k.a. the Met, a rarified atmosphere of south Florida egos, money, and bravado. Flip Pallot remembers the first time he met Kreh. Kreh's old pal Joe Brooks had brought him in to manage the tournament from which Brooks was retiring, and Pallot and a



There are those places that seem linked inextricably to the Lefty Kreh legacy, places that he loved and that he looked after all of his life.

coterie of fly fishing hotshots were prepared to give him a round of hazing that he didn't deserve.

At Kreh's first meeting with some of the fly fishing clubs, he walked into a south Florida lion's den. "We sort of resented him a little bit, because we all loved Joe Brooks," Pallot recalls. "And I think he picked up on that and realized he needed to make an impression." Years later, Kreh would be a little embarrassed recalling this same story, as he wasn't much of a showoff. But he knew hard ground, and he knew how to break it.

Surrounded by some of fly fishing's future greats, most young hotshots—Pallot and Chico Fernandez among them—Kreh placed a fly rod on the ground and walked off 60 feet of fly line. He trod back to the rod, picked up the line in the fingers of one hand, ripped out a cast, and soon was false-casting the entire line, holding it in his fingers, the rod an unnecessary accompaniment on the floor.

"We were gobsmacked," Pallot recalls, howling with the memory. "It was like the Wright brothers when they first flew an airplane. Nobody knew that was even possible! When I saw Lefty do that I realized that there was a dynamic that he understood that was far beyond anything I could comprehend. And I knew that I had to figure out what the hell was going on here, and if that meant asking this short fellow from some place called Baltimore for help, then so be it."

Pallot went to Kreh's house the next day, contrite and self-effacing, and they practiced casting in the street. It was the beginning of a friendship that would span decades and continents.

Kreh's move to Miami dramatically expanded his footprint in the American fishing world, and his fly fishing accolades only grew. He never stopped writing, never stopped teaching, never stopped taking the time to put fly rods into as many hands as possible. Into his 70s and 80s and 90s, Kreh never stopped.

Lefty's Deceiver is a fairly straightforward fly, built sturdily of common materials, simply layered, neatly dressed. Kreh designed the fly in the late 1950s. It's one of those patterns equally at home in fresh water and salt, tied on the small side for bronzeback river bass or worked up big with a 3/0 hook for flats brutes. There's not a lot of flash to a Deceiver. Very little bling. It was artful enough to be featured on a U.S. Postal Service stamp in 1991, but pomp and sizzle never drove the success of Lefty's Deceiver. Still, the fly attracted attention, and held up in rough water and rocky, and always was ready for more.

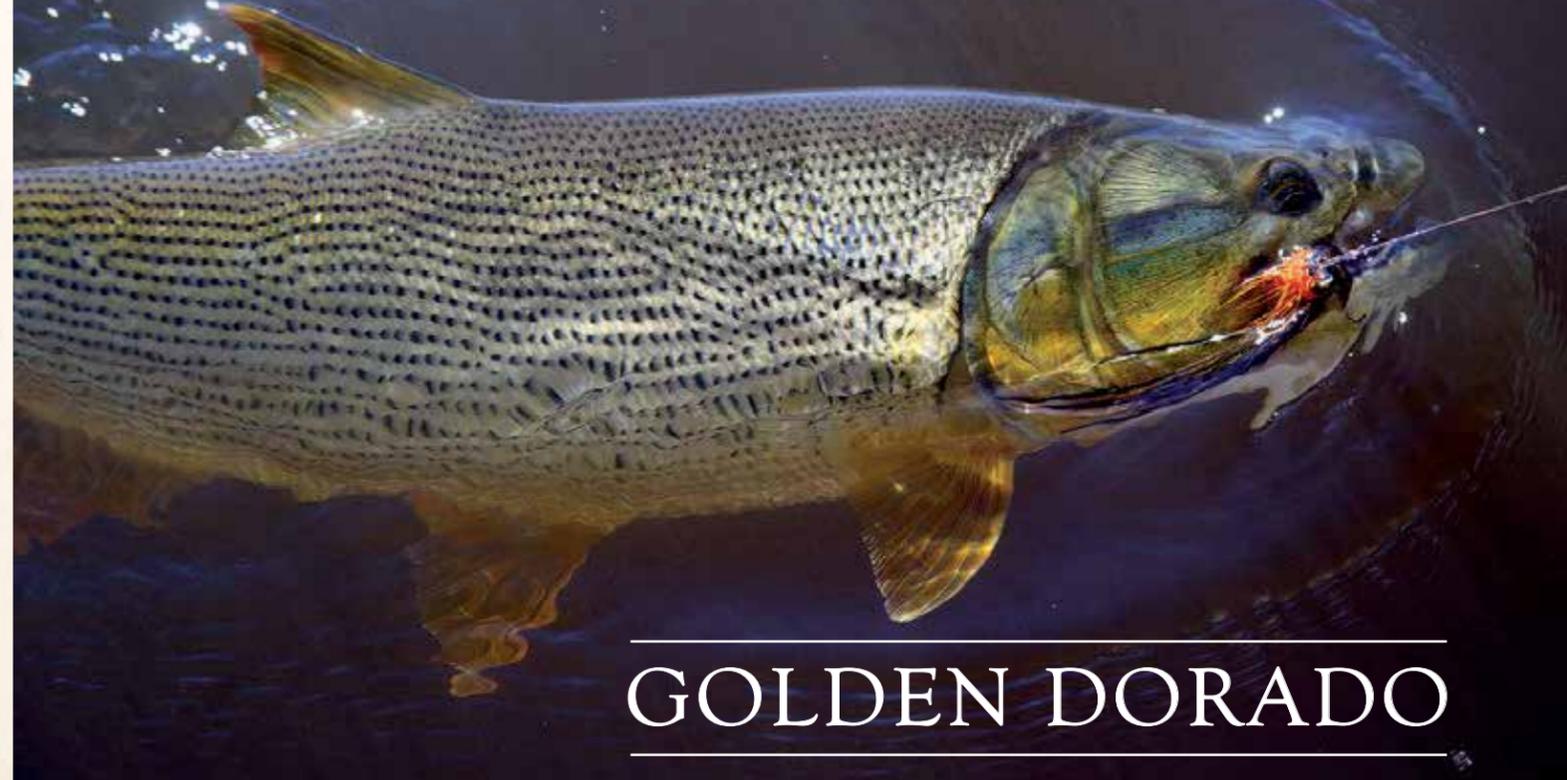
In all of those regards, this eponymous fly is a totem and a metaphor for how Kreh worked in the larger conservation arena throughout his life. Lefty's Deceiver works in the Potomac River, bumping rocks for smallmouth bass. It snookers snook in the Florida Keys and pries open the maws of tarpon in the Bahamas. And in all of those places, Kreh brought to bear the weight of his reputation and the imprimatur of a life completely enmeshed in the wild.



Lefty with Michael Keaton in The Bahamas. Photo: Dorsey Pictures

Few folks hear of Kreh's greater conservation legacy, and that's how he wanted it, say his friends. "He had more access to more fancy people than you could believe," recalls Dr. Mark Lamos, Kreh's personal physician and a long-time fishing partner. "That's what he called his friends like Tom Brokaw and Michael Keaton. But he was proud of being un-fancy. He was an Everyman. He'd fished for catfish with chicken livers in a piece of pantyhose. He'd cook up carp baits with cornmeal and strawberry jam. That Everyman aspect he applied to conservation, too. He didn't shout and scream. He was one step back, supporting the players. He always wanted the organizations to get the credit, not him."

Here's what most people don't know about Kreh, says Flip Pallot. "He heard the canaries sing before other people even knew there was trouble," he explains. "When Lefty walked through the woods, he would see a frog, and he would say, When I was a kid there were frogs everywhere around here. But then they opened that mill and



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Saluting Lefty. Photo: Dorsey Pictures

the stream no longer floods these woods and the frogs are gone. Other people would walk through those same woods—they walk through the same world—and they don't see what Lefty saw. But he saw all those things."

Pallot and Kreh grew into a decades-long friendship forged on waters across the globe. "I saw it time and time again," Pallot says. "Lefty inspired and then set people loose who could be the bones and the sinew of conservation battles around the world."

Over the years, his close friends say, few people saw up-close the changing fisheries as did Lefty. He traveled so widely, and over such a long period of time, that his experience worked as a long-term data set of what was happening on his favorite waters. "He spoke often of the changes in the populations of bonefish in the Keys, or smallmouth bass in his home rivers of Maryland," recalls BTT board member Bill Klyn, who appeared with Kreh on *Buccaneers & Bones*. "Water quality issues and increasing pressure from development were of grave concern. He began to be very engaged in supporting the science-based work of Bonefish & Tarpon Trust. He knew that science was the foundation for action."

There are those places that seem linked inextricably to the Lefty Kreh legacy, places that he loved and that he looked after all of his life. The Potomac and Susquehanna rivers were the stomping grounds of his childhood, and the proving grounds of a young man making a name for himself in the fishing world. Kreh grew up fishing the clear flows of the Gunpowder River and a tributary, the Gunpowder Falls River, in central Maryland. Kreh fought hard to help establish

sufficient water flows from the Prettyboy Dam on the Gunpowder Falls River to feed seven miles of wild trout tailwater. His efforts were immortalized in a designation of the Lefty Kreh Trail along the stream, with a large boulder emblazoned with effusive language about Kreh's impact. But he always considered the river's wild reproducing brown trout a more significant legacy, the smile of a Gunpowder angler a more rewarding tribute.

Which was Kreh's way, beginning to end. He wasn't one for the spotlight, nor one to pull back the curtain and expose too much of himself. He simply wanted all the rest of us to understand what he understood on that day with Joe Brooks on the Potomac, better than half a century ago, with a fly rod and a Black Ghost dry and rings on the river. Kreh stood there transfixed as the older angler landed a half-dozen bass in a row, then spoke. "Mr. Brooks," he said, "I got to have me some of that." 🐟

An award-winning author and journalist, T. Edward Nickens is editor-at-large of Field & Stream and a contributing editor for Garden & Gun and Audubon magazine.



Photo: IGFA



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Educating Future Flats Stewards in The Bahamas

Photo: Elijah Sands

Over the past three years, BTT's Bahamas Initiative has sharpened its focus on outreach and education. This effort has been fueled by scientific research BTT conducts in The Bahamas. The highlight of this effort is a partnership with Bahamas National Trust (BNT) to develop a flats ecosystem curriculum that is targeting students from age 7-18. The curriculum, which was rolled out this past year, has already reached approximately 1,000 Bahamian students and was well-received by educators and students alike.

Throughout the year, and particularly this summer, BTT has also been very active in outreach and education with students, educators and government enforcement agencies. Highlights include BTT sponsoring the Bahamas Reef Environment Education Foundation's (BREEF) marine conservation workshop, which focused on educating law enforcement agencies and teachers about the importance of marine resources to The Bahamas. BTT continued its collaboration with BNT by participating in their Eco-Camp, which was held on Andros. In attendance were 40 students, all of whom were identified by BNT as leaders in their schools. Bahamas Initiative Manager Justin Lewis and Bahamas Initiative Intern Nina Sanchez gave presentations to students on the importance of flats and bonefish to the Bahamas, emphasizing the significance of best handling practices and how healthy habitats are vital to the health of organisms that call the flats home. After the presentation, Justin, Nina, BNT staff, and Andy and Steve Smith, experienced flats fishing guides and BTT partners,

took the students to West Side National Park, where they had the opportunity to net and tag bonefish as part of BTT's tag-recapture program. Over 50 bonefish were caught by the students, giving them all an opportunity to tag a bonefish and participate in ongoing research.

Next, Justin and Nina were off to Abaco, where they participated in the Blackfly Lodge summer fishing camp. Justin and Nina gave presentations focused on flats conservation, and helped teach the campers, alongside Clint Kemp and his guides, how to spin fish and fly fish for bonefish. They also led snorkel trips in mangroves and blue holes, and had the opportunity to teach the campers how to tag the bonefish they caught. To finish off the summer education tour, BTT attended BNT's Discovery Club Leaders Symposium, where 100 teachers from across the Bahamas were brought together to learn about marine conservation education. BTT gave presentations on flats conservation and bonefish ecology, discussed the flats ecosystem curriculum, interacted with teachers, and led a field trip to Bonefish Pond National Park.

"BTT will continue to grow its outreach and education program in The Bahamas by continuing to collaborate and expand our efforts with BNT, other NGOs, and schools," said Justin Lewis. "BTT thanks all those who participated and helped with the summer education tour. It was a great success and we look forward to doing it again next year." 



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The Bonefish Decline in South Florida: What Have We Learned?



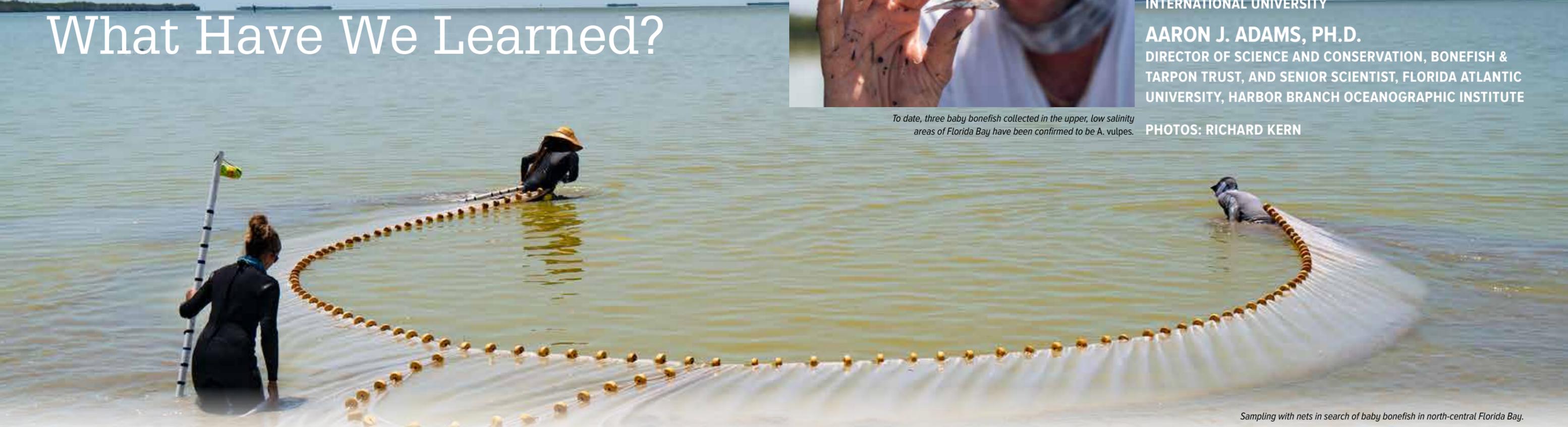
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PHOTOS: RICHARD KERN

To date, three baby bonefish collected in the upper, low salinity areas of Florida Bay have been confirmed to be *A. vulpes*.



Sampling with nets in search of baby bonefish in north-central Florida Bay.

The decline of bonefish in South Florida has weighed heavily on us for 25 years. There are recent signs of a potential recovery—with some smaller bonefish coming back to the Keys. The hope is that the worst is behind us.

Yet, the questions remain: How exactly did this decline unfold? Did it affect only the adults on the flats, or also the juveniles and young-of-the-year (aka babies)? What has been happening to our environment to possibly cause such a devastating decrease? And can the fish be restored?

While the questions are plentiful, finding the answers is challenging. But finding the answers is essential to formulating a conservation plan that will restore the fishery and prevent another collapse. Diagnosing why the bonefish population declined is especially difficult, due to the lack of basic knowledge about Florida bonefish and long-term records on their numbers. Over the past four years, our research group at Florida International University (FIU) has been putting the pieces together on the bonefish decline in South Florida. Here we highlight what we have learned.

When, where and how of bonefish decline

First, we set out to characterize the decline: When did it start? How expansive was it? Was it steady or abrupt? Answers to these questions can go a long way toward helping us understand what

happened. For instance, if the decline is limited to a subset of regions (such as Florida Bay), then it points us to local causes, such as habitat quality and the factors that affect it. In contrast, if the decline is happening throughout the Keys, then regional factors that operate at much larger scales need to be considered. Factors such as larval supply throughout all of South Florida may then be an issue.

Characterizing a population decline entails building a *time series* or timeline of our best estimates of bonefish numbers. Once we have such a time series, preferably across regions (Biscayne Bay, Florida Bay, and the Florida Keys), we can begin to identify patterns over time. Once we have patterns, we can then search for the driving causes of such patterns.

But how does one build a time series when we lack the numbers on bonefish populations? We re-constructed bonefish declines through collaborations with anglers and guides, who reported their catches and told us about changes in the quality of their bonefishing via interviews and surveys. Studies on other fishes have shown how angler perceptions can capture and match the patterns described by scientific studies, making *local angler knowledge* a reliable source of information, especially valuable when other sources are absent. We certainly saw this for South Florida bonefish, and here is what we learned:

- The decline of South Florida bonefish began between 1985 and

1990. This is evident in two angler-derived information sources: a survey of 278 South Florida anglers and guides, and 5,039 guide reports that describe bonefish catches in Florida Bay.

- Fishing guide reports show a 42% decline in bonefish catches in Florida Bay over the period 1980-2014, which is evident starting in 1990. They also show that the decline is not steady, and the lowest catches are seen after 1999.
- Survey responses show that quality of bonefishing has decreased everywhere in South Florida, but the decrease is highest for Florida Bay (56% decline), intermediate throughout the Florida Keys (38%), and lowest for Biscayne Bay (26%). Also, this decline in quality starts earlier in the Keys and Florida Bay (1985), relative to Biscayne Bay (1995).
- The 2010 cold event exacerbated the decline leading to the lowest bonefish numbers seen in 35 years.
- From our interviews and surveys, we learned that over time the number of flats that are good for bonefish fishing is declining (or disappearing in the Upper Keys and Florida Bay), and by the early 2000s only a small number of fishing flats remained productive, while at the same time fishing effort is shifting to the Lower Keys.

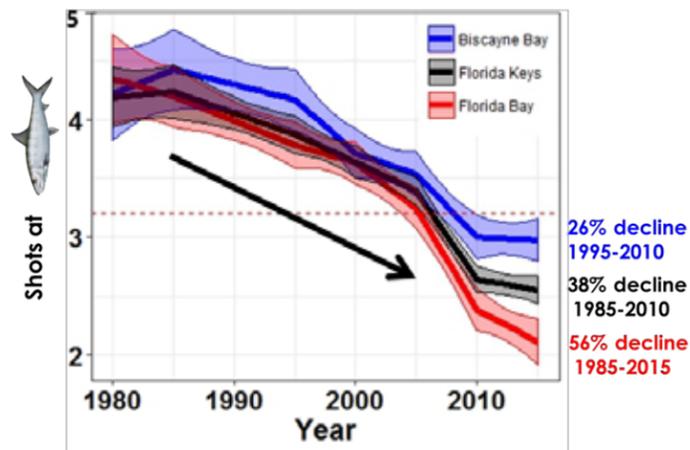
What does this all mean? It tells us that **the decline is a large scale issue that has been affecting all of South Florida, but at the same time, there may be local environmental stressors in places like Florida Bay that are making things worse for bonefish.** It also

tells us that it goes back in time to the late 1980s, but things appear to have really deteriorated starting in 1999. Conservation measures need to target larger spatial issues likely beyond South Florida, while at the same time addressing local issues that are killing quality habitats, and which may be different across regions (Biscayne Bay vs. Florida Bay). The fact that fishing effort is now concentrated on limited areas suggests that we need to pay close attention to fishing practices on these remaining quality flats and minimize fishing mortality by following best fishing practices.

Decline cause: a change in adults or juveniles?

The short answer is both. Colleagues at the University of Florida used computer models to determine whether changes in the adult or juvenile population are contributing to the pattern of decline we see in the Florida Bay catches. The model showed that their decline was best explained by a combination of changes in both the survival of the adults (which explained 40%) and of the juveniles (60%). The model also shows that over time adult survival is decreasing. In other words, the decline is a product of things going wrong with both adults and juveniles, and over time things got worse for the adults.

This finding piqued our interest in the juveniles, particularly because so little is known about what makes for good juvenile habitat in South Florida. If the juvenile population is declining, where is this decline happening? And how can we protect these areas?

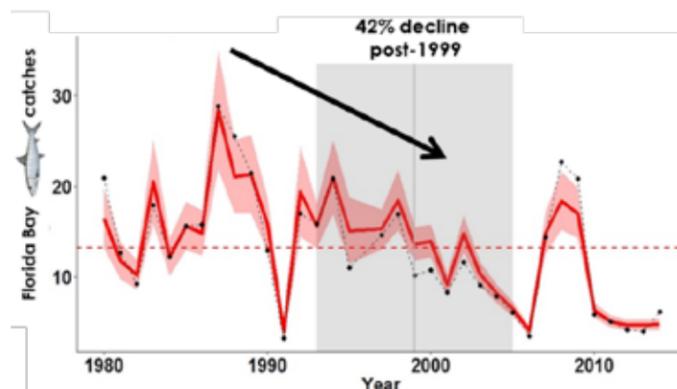


Decline in bonefishing quality (in shots at bonefish) throughout South Florida over 1980-2015, showing a larger decline for Florida Bay.

We went to the ear bones, or otoliths, of bonefish for answers. The otolith is a hard structure inside the ear of fish used for balance and hearing. It grows as the fish grows, and it does so in rings (similar to tree rings), that can be used to age fish. The otolith also provides a record of the environment experienced by fish throughout their lives, because it incorporates the chemistry of the water the fish lives in. So we took a close look at the chemical composition of otoliths, looking for clues about the salinity (salinity is a measure of the salt content of water—full seawater is 35, freshwater is 0) of the environment experienced by bonefish early in their lives. Here, we measured concentrations of the element strontium, a known marker for salinity, along each ring of the otoliths of about 40 bonefish from South Florida and 10 from Cuba. The results surprised us. About 68% of the bonefish in South Florida, and 70% for Cuba showed that early in their lives they lived in an environment of lower salinity.

What does this tell us? First, that estuarine, low salinity environments may be a key part of the bonefish life cycle. We have additional clues that this may be true from recent collections of baby bonefish in freshwater-influenced habitats along the rim of Florida Bay. Surprisingly, this includes locations that are ground zero for algal blooms, high salinity and seagrass dieoff. Second, if bonefish are using these coastal habitats, it means that we need to consider specific risk factors, such as pollution and contaminants that are typically land-derived. Third, and importantly, this tells us that **the link between healthy bonefish fisheries, water management, and Everglades restoration is stronger than we anticipated.** Given that estuarine habitats are among the habitats most threatened by human activities, this finding underscores the need to prioritize addressing water mismanagement issues in Florida.

Another issue of concern is the source of juveniles to the Florida Keys. Due to recent research, we now know that bonefish spawn offshore, at night, between October and April. After the eggs hatch, the larvae live in the open ocean for 41-71 days. The larvae lucky enough to survive their time in the ocean and that find themselves in shallow habitats transform into juveniles—miniature versions of their parents. A just-completed study of how ocean currents transport larvae indicates that bonefish in the Keys likely come from multiple sources. First, they might be spawned locally, with the larvae entrained in local currents and then delivered back to the Keys. This is especially likely if Keys bonefish spawn in the Lower Keys, or even west of Key West. The concern here is—are there enough adult bonefish in the



Decrease in bonefish catches in Florida Bay over 1980-2014, showing a 42% decline post-1999.

Keys to successfully spawn and produce enough larvae to sustain, or even increase, the local population? If bonefish spawn in the Upper Keys, the larvae are probably lost to the Gulf Stream.

Second, the larvae might be spawned in other locations, such as southwest Cuba, the Caribbean coast of the Yucatan Peninsula, or

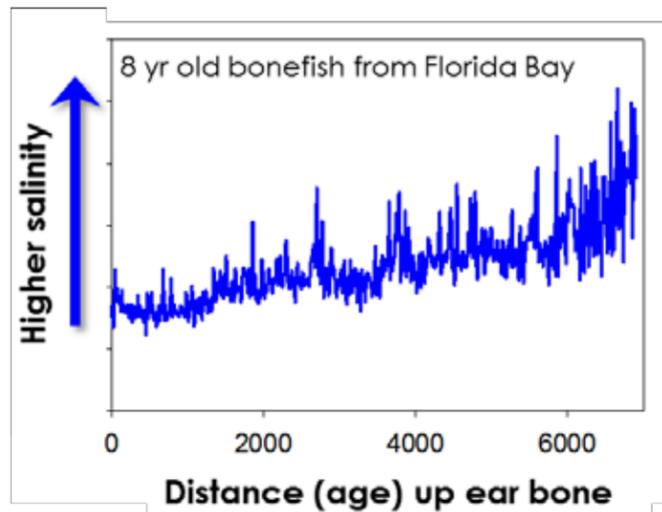
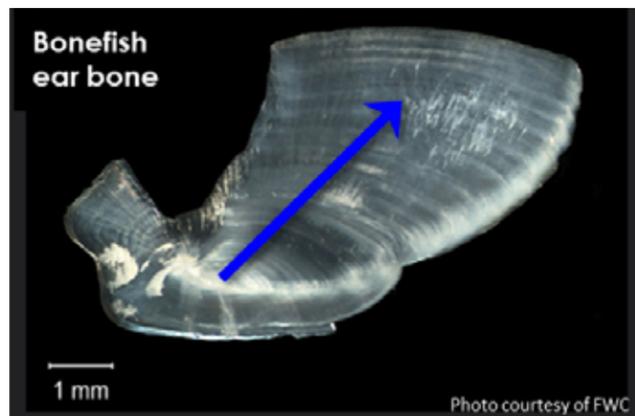


Image of a slice of a bonefish ear bone, and of concentrations of a marker for salinity across it. This 8-yr old bonefish from Florida Bay spent the early part of its life in a low salinity environment.

Belize. The time that bonefish larvae live in the open ocean is plenty of time to reach the Keys from these and other locations in the Caribbean. The concern here is—management of the bonefish fishery and bonefish habitats in these locations sufficient to make sure the bonefish populations remain healthy? The worst-case scenario would be that the Keys bonefish population depends on larvae from distant locations that are losing their bonefish to harvest and habitat loss.

What is driving the decline?

Identifying causes is certainly the trickiest part. Ideally, we need detailed records on bonefish numbers over time, plus solid information on various factors such as habitat, climate, water management, fishing pressure, risk factors, such as contaminants and predation, and how all of these changed over time. Once we have these, we can apply mathematical models to help us differentiate between what may be a correlation (variable X and bonefish numbers are changing at the same time) from true causation (variable X causes bonefish numbers to decrease).

These pieces, however, are largely missing for bonefish. Our best time series is the record of 35-years of bonefish catches for Florida Bay, and we used it to test whether changes in this record were related to changes in the climate, salinity, fishing pressure, and predation. We were able to include only those factors for which we also have 35 years of information.

What did we see?

- Over the 35 years, the bonefish timeline tracks the changing climate and hydrology of Florida Bay. As bonefish decline, water temperature is increasing, salinity is becoming less variable, and

there is a change in the large-scale Atlantic Multidecadal Oscillation, which is known to influence our summer rainfall.

- We did, however, rule out salinity (including the high salinities that are of concern in Florida Bay), and low temperatures—these were not important.
- Instead, we saw evidence that high temperatures, shark numbers (an indicator of predation risk) and fishing pressure may be playing some interacting role in the decline.
- What about seagrass? Florida Bay underwent a major seagrass die-off in 1987 that unleashed over a decade of negative changes in the Bay, which is concurrent with the beginning of bonefish decline. But is it a cause? We could not test this since seagrass cover data does not start until 1995. We can say, however, that from 1995 onwards, seagrass has recovered as bonefish continued to decline, suggesting that seagrass loss may not be a direct driver, although a lagged or delayed effect is possible.
- Last, we saw indications that contaminants, including copper and pharmaceuticals, may pose a risk, and are the subject of ongoing studies.

In sum, these findings drive home the message that bonefish decline is the product of multiple interacting factors. It's not a simple story. Temperature, shark predation and fishing pressure may be harming bonefish populations. These factors may be even more impactful if viruses, contaminants, and poor water quality conditions are weakening bonefish. Responsible angling practices can minimize these risks. Decreasing fishing pressure in certain locations or/and at certain times (such as at highest temperatures or in places where sharks are abundant), along with minimizing fight, release and air time can mitigate against these stressors. 🐟



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Catch & Release Best Practices: Tarpon & Bonefish



Photo: Shane Smith

Tarpon > 40" Fork Length

- Do not remove them from the water. This causes too much damage and stress, and decreases their chances of survival.
- Minimize the time you handle the fish next to the boat before release.

Tarpon < 40" Fork Length

- Minimize handling, since this can remove protective slime from the fish.
- If you handle a fish, use clean, wet hands.
- If you hold the fish out of the water, support the fish beneath the head and belly and hold the fish horizontally.
- Minimize exposure to air.
- If you want a photo, get the shot set up before removing the fish from the water. If the fish is not still dripping water in the photo, it has been out of the water too long.
- Avoid using mechanical lip-gripping devices, since this can cause jaw injury.

All Tarpon

- If a tarpon's weight is desired, measure the length and girth and use the BTT tarpon weight chart to estimate weight.

- Keep fingers away from the gills; damaged gills make it hard for the fish to breathe.
- If a fish loses equilibrium (it rolls over or goes nose-down on the bottom), revive it until it can swim upright, then shorten the fight time on future fish.
- When reviving a fish, be sure that water passes over the gills from front to back. Move the tarpon forward or hold it upright in the water allowing it to pump water through its gills.
- In warmer water, reduce fight and handling time.

Hooks

- When fishing with bait, use circle hooks.
- If a hook is deep within the throat, cut the line as close to the hook as possible; this causes less damage than removing a deeply-set hook. Most fish are able to reject the hook or the hook dissolves over time.

Fight Time

- Keep the fight short. Long fight times result in an exhausted tarpon, which is more vulnerable to predators.
- Use tackle that matches the fish and conditions.

Predators

- Since predators can decrease survival of fish after release, when predators become abundant and appear to be attracted to your fishing activity, consider moving to another fishing location.
- If a shark appears while you are fighting a tarpon, break the tarpon off so it has a chance to escape the shark before it is too tired.

Bonefish/Permit

- Shorter fight times increase survival because a fish fought to exhaustion is more vulnerable to predators. Conversely, a bonefish reeled in too quickly may thrash about, increasing its chances of injury.
- Tackle should match conditions and the size of fish so that fish can be landed quickly, but not until their head can be lifted slightly above the water surface and their movements controlled.
- Always land a bonefish before it is exhausted and loses equilibrium when released (cannot swim and nose dives or rolls over).
- If a bonefish loses equilibrium after you land it, revive it until it can swim upright, then shorten the fight time on future fish.
- High water temperatures may negatively impact bonefish survival after release; in warmer water, reduce fight time and handling time.

Handling

- Minimize handling all fish; slime and scales can be easily damaged and removed with excessive handling, thereby greatly

increasing risks of infection. Research has shown that mechanical lip gripping devices can cause damage to mouth tissue if the bonefish struggles, so their use should be avoided.

- If you have to handle a bonefish, use clean, wet hands and gently support the bonefish from beneath the head and belly; nets, mechanical lip-gripping devices, and wet cloths can cause injury to the fish.
- Use hemostats or pliers to quickly remove hooks while keeping the fish in the water, and have your pliers ready and available to facilitate a quick release.
- Avoid exposing bonefish to air, even when taking a photo; if they must be held out of the water, limit it to a maximum of 15 seconds.
- Touching the gills can cause damage and impair the ability of a bonefish to breathe.
- If a fish's weight is desired, cradle the bonefish in a sling and suspend the sling from weighing device.

Predators

- The survival rate of released bonefish drastically decreases when predators such as sharks and barracudas are abundant, as these predators often attack a bonefish soon after it is released.
- When predators become abundant and appear to be attracted to your fishing activity, consider moving to another fishing location.
- If you have caught a fish and potential predators are near, consider using a livewell to hold your fish for a short time to allow you to release it some distance away from them. 🐟



BTT Chairman Harold Brewer. Photo: Pat Ford

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On a trip to the Cargados Carajós shoals, Millie Paine finds a thriving bonefish population not far from where the dodo went extinct. RICH PAIN © 2018 Patagonia, Inc.

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The Silver King

BY HEATHER RICHIE

PHOTOS COURTESY OF IGFA

There are two kinds of legendary anglers. One is that kind of disheveled, nutty professor who looks like, and maybe is, your grandpa. Captain Steve Huff is the other kind. At seventy-two, he has the agility of men much younger and a stealth that comes from five decades of waking up every workday with the intent to take other people fishing. Fifty years at any one job will hone a skill level most won't ever achieve, but Huff's reputation for being rich of character is less common. Ask around and anyone will tell you Huff is the greatest saltwater guide alive. Some will add he's the greatest there ever will be. But men don't talk about each other like that based on skill alone. The Huff factor is *je ne sais quoi*, a precise aesthetic of one who has amalgamated to his environment so much as to be revered along with it. Like anything natural, there is the integrity of an undivided wholeness to him. He has made his mark in his environs by finding a way of being true within them.

How he got this way is a story well told. His father gave a ten-year-old Huff a spinning rod. He left the next day, and the two never spoke again. Huff immediately made use of the gift around the canals of his childhood home of Miami, and later studied marine biology in college before setting out to become a guide in 1968. As monarchs are preordained to a life of royal service, it is hard to imagine Steve Huff was ever going to do anything but become the greatest tarpon guide of all time. He has fished with clients right up until their retirement from the sport, one that almost certainly postdates their actual retirements; he has broken up with clients who he could not bear to be on the water with; remarkably, he once even witnessed a client die on the bow of his boat when an aortic aneurysm instantly collapsed him to the deck while reeling a 125-pound tarpon. His wife of 33 years was introduced to him by his client, her father. His hours on the water are countless to the extent chronological time stops doing his story service, and it makes more sense to follow the rivers and creeks of his mind and of Southern Florida topographically. Once born, he was never not following them.



In 2010, he was the first full time professional fishing guide inducted into the IGFA Fishing Hall of Fame. He pioneered the tarpon fishery in Homosassa, and guided angler Tom Evans to six tarpon world records on four different line classes. "When Steve and I first went to Homosassa in 1976, I asked him how we were going to learn the place," Evans says. "He said, 'We'll pole it,' which was close to 30 miles. To say that Steve made his living with a stick in his hand would be an understatement." Evans doubts anybody had ever experienced the tarpon fishing he and Huff had over their five years in Homosassa. Some days they ran out of flies, catching 15 or more tarpon a day, averaging more than 120 pounds. "I've never seen anything like it since," Evans says.

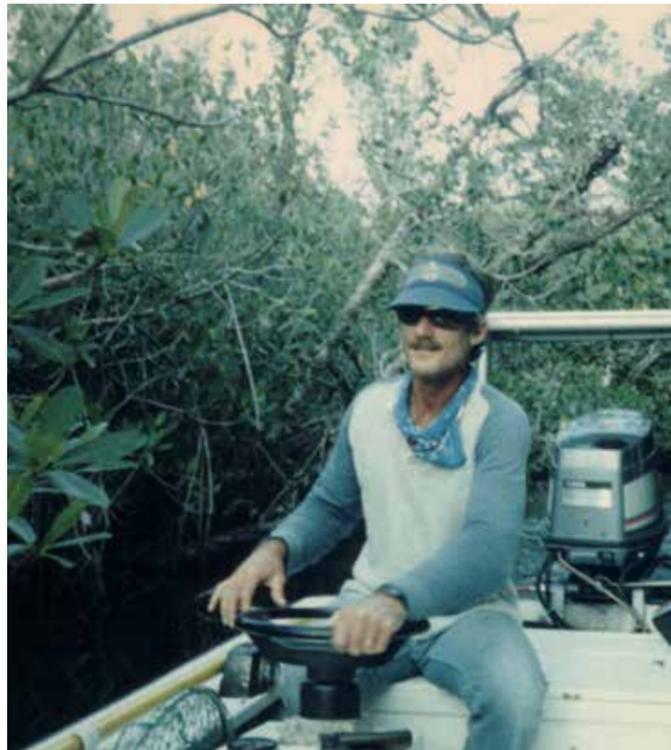
With Del Brown, he popularized permit fishing and developed techniques for catching them on the fly. He guided anglers to 13 championships in the Gold Cup Tarpon Tournament, the Islamorada Invitational Bonefish Tournament, and the Islamorada Invitational Fly Bonefish Tournament. Andy Mill calls Huff "The god of guides," which says a lot coming from the god of tarpon anglers. Mill met Huff over breakfast one morning with Harry Spear at Stout's Restaurant in Marathon, where Huff and Spears often frequented before fishing. Huff and Spear were equal parts competitors and friends. Huff was in Spear's wedding. Mill describes their relationship as one that popularized the sport through their intense victories against each other and all comers in the 1970s. "The bar is raised by two people challenging each other like that," Mill says. "They were competitors, and pushed each other with great heart."

Mill shares a common penchant for success. Considered one of the best US Olympic skiers of his time, Mill has been an accomplished broadcaster for Outdoor Life Network, CBS, ESPN, and NBC, and *Good Morning America*. But it is his first love as a lifelong fisherman for which he is considered the best tarpon angler alive. Both men know what it is like to hand down the angling gene to sons. Huff's sons, Mill says, are great disciples.





Sandy Moret and Steve Huff won the Gold Cup in 1981. The duo was also victorious in '84 and '85.



He is a naturalist in a sense that transcends fishing.

"Dustin is the greatest guide in the Florida Keys today," Mill says. "It's all the DNA from Steve and his passions. Chad and Andrew got it, too. That whole family was born with fins. They know where the fish are before they get there. You either get it or you don't," Mill says. He explains exceptional success as a clear formula rooted in desire. "Greatest is a result of passion, hard work, and diligence, and fighting for those dreams of great days of the water."

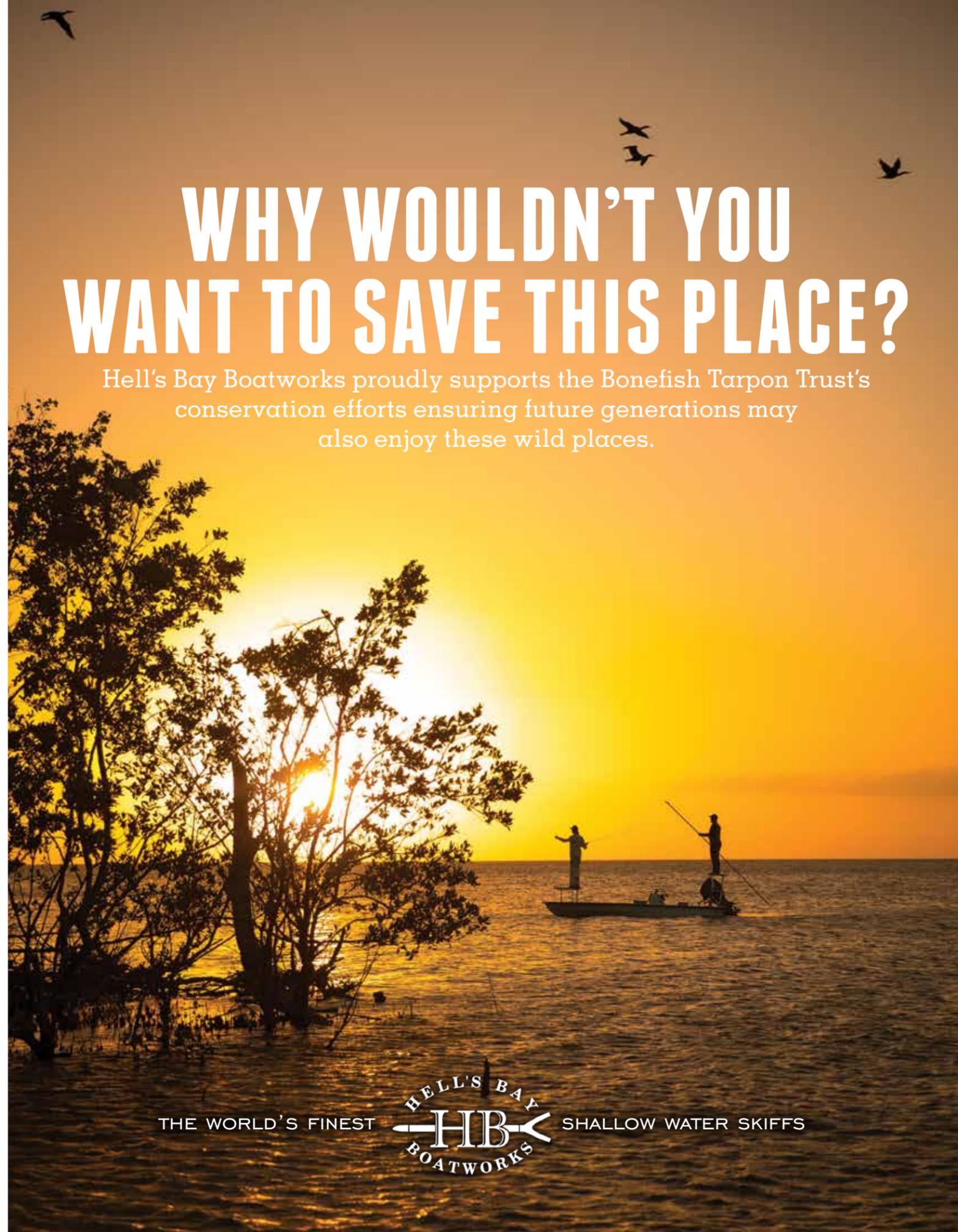
Tibor "Ted" Juracsik of Tibor Reels acclaim met Huff about 25 years ago. Juracsik says he knew Huff was well regarded when they first met in the Keys, and struck up a friendship. Juracsik lives in Chokoloskee, and the men were able to spend more time together when Huff moved to Everglades City. Every morning Huff launches near his home, and Juracsik says you can set your watch by Huff's eight o'clock appearance.

"He doesn't even have a business card," says Juracsik, remnants of his Hungarian accent shaping his words. Juracsik spent his youth fishing Budapest's Danube River. At 17, he became the youngest Hungarian ever to earn his Masterpapers in the tool and die trade before he and fellow Hungarian Freedom Fighters were forced to flee the country. The reel maker is humble himself, so to hear him speak of Huff's humility has a compound effect. "He treats everybody right. A lot of guides speak down to clients for doing things wrong. Huff knows the client must be good at something to afford his fee, and respects them for it."



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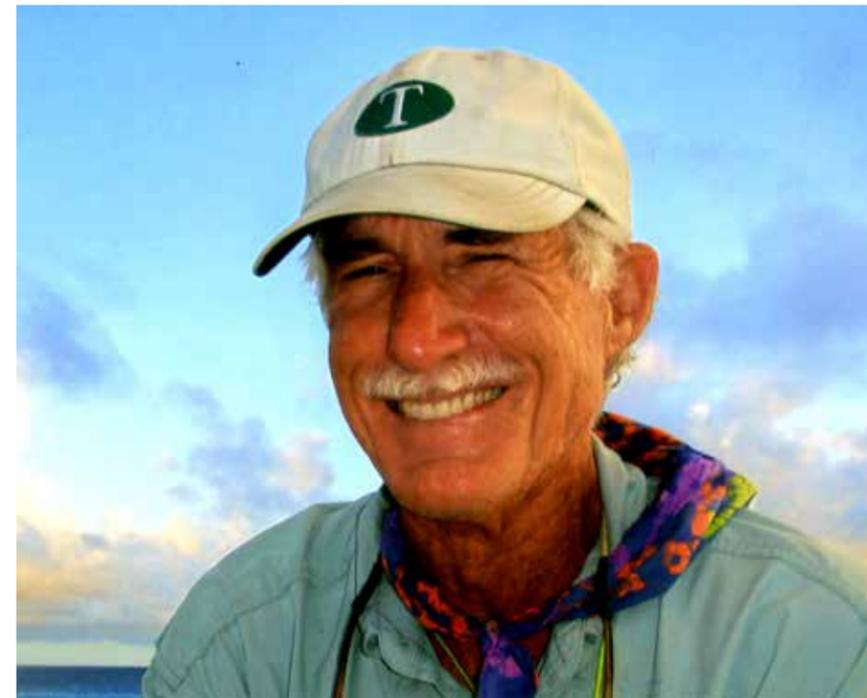


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Juracsik is sure that Huff would have excelled as a tool and die maker because he never forgets anything. Huff reminds Juracsik of specific conditions of trips they took six and seven years ago. "I don't know half—no, I don't know a quarter—of the knots he knows," says Juracsik. Huff advises him on reel design by virtue of excessive use and friendly conversation.

Huff's clients are longstanding, and the list isn't growing. They describe him as selfless in his work. With Del Brown, he popularized fishing permit on the fly. He has guided anglers to thousands of permit and championships in the Gold Cup Tarpon Tournament. He has built his own flats boats. He has never owned a computer. The Everglades, and before them the Keys, are home to Huff's life and work. Southern Florida is his kingdom.

"Fishing with Steve is the one time I know I get to be part of Florida almost exactly since the beginning of time," says author Carl Hiaasen, one of Huff's longtime clients counted equally as friends. "It's the one place they haven't managed to screw up." In the 25



Captain Steve Huff celebrates his 50th anniversary as a fishing guide in 2018. BTT will host a tribute to the legendary guide on January 17, 2019, in Islamorada.

years the two men have fished together, Ten Thousand Islands has remained pristine. "If you go with Steve, you really don't see that many other boats."

Huff goes fishing in places nearly no one else goes, providing Hiaasen the space that every writer needs to emotionally clear the deck. This level of fishing, going with Huff, does more than offer a blank page for Hiaasen. It reminds him as well what is important not just in his own life, but in the world around him. State water policy, pollution, overdevelopment, and overpopulation are all things that have changed much of Florida into an urban state.

"All of those things come into sharp relief when you're standing on

the bow of a skiff in the middle of pure wilderness. Whether fishing or not, it is a spiritual time. It looks like it did when Mr. Watson was there, and a thousand years before that," says Hiaasen.

Huff fished for permit in the Florida Keys where he lived in Marathon before moving full-time to Everglades City. For years, he fished both areas. The two are indistinguishable only in his motivation to fish and care for them. Events like the red tides and the toxic waters discharged from Lake Okeechobee into the Caloosahatchee and St. Lucie rivers have a tremendous impact on tourism and the image of Florida. Water is coming out of those rivers in unnatural colors, so it is clear something bad is happening.

The environmental threat is ominous and yet another sign of changing times. Clients share memories with him, discussing the old Key West, and things like the traffic nowadays between Miami and Big Pine. There's no doubt a tone of lament for the old days when the fishing was better, partly because there were fewer boats around. Huff has an antipathy for noise and bad behavior on the water. There are places in Florida with pretty big bonefish, but to fish them you're looking up at condos, highways, and marinas as a backdrop for your catch. Honking horns and jet skis make the soundtrack. Huff would rather be fishing smaller fish in greater seclusion without another human in sight.

Huff moved to Everglades City for the solitude and purity of the experience of being able to go up creeks that he might be the first person to navigate since Native Americans before him. He goes exploring on his days off in his tiny jon boat, and is truly at one with that place in the world. The neuronal pathways he traces today are the same as the backyards, creeks, canals, and bridges of his Miami boyhood. Every fish on is a synapse fired. It is instructive to fish with him, an opportunity to notice an orchid growing in an area not noticed before. He is a naturalist in a sense that transcends fishing. Huff's vision for where the fish are and the reputation of "the greatest living guide" among anglers and professionals alike is true, but at risk of getting lost in the accolades are the integrity, honesty, and caring that define him among his peers. It is one thing to have a good guide in the boat, and another to have such a decent human being take you fishing. "When you are in Steve Huff's presence you feel the aura of his person more than that of his fishing attributes, and those are off the chart," says Mill. "As great as a guide as he is, he is a better person."

Huff and his wife Patty once bicycled to Oregon and back. This summer, they cycled around Northern Florida. Mill once asked Steve Huff how he'd like to be remembered. "I don't need to be remembered," Huff said. "The only people who need to remember me like that are my sons." 🐟

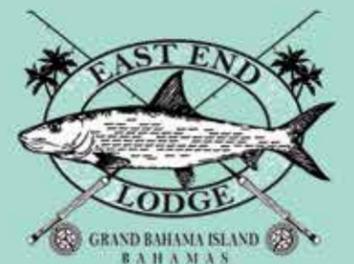
Heather Richie is a writer whose special interest is the land traditions—particularly the foodways and sporting—of the modern American and unbordered Souths. She is the author of FULL, A Slim Volume on Southern Foodways.

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James Prosek

BY MONTE BURKE

On a moody, overcast day in July, James Prosek stands on the banks of a wild brook trout stream near his home in Connecticut, nose deep in his fly box, searching for something he hopes will make a notion become manifest. He works his fingers through various Wulffs and a few Light Cahills before settling on a #16 Adams. “What makes fly fishing so cool is that we create a fly that we think looks like an insect or a baitfish, and when the fish takes that fly, some aspect of perception becomes shared,” he says, as he affixes the Adams to his tippet. “We’ve made a connection. We’ve communicated through that fly.”

This is perhaps not something that most of us fly fishermen consciously think about upon setting out to fish for the day, but it is nonetheless unequivocally true. And that connection and communication—and the deep thinking about it all—is central to understanding Prosek and his work as a celebrated artist and author. To him, a fly rod and flies are not any different from his paintings and his books and stories. “They are all tools we use to communicate and observe and document,” he says. “They lead to a better understanding, an enhancement of our love for the species, and a greater urge to protect them.”

And with that, we are off to fish a stream that Prosek has haunted since before he was a teenager, in an attempt to catch a brook trout, his first love and the fish from which all of his passions and inquiries since have stemmed.

You are perhaps familiar with the outlines of Prosek’s journey from a self-taught child prodigy to the undeniable Artist Laureate of the fly fishing world. In 1996, the then-19-year-old junior at Yale announced his presence with the publication of his first book, *Trout: An Illustrated History*. The watercolors of trout from all over North America, and the prose, were fresh and stunning. Prosek quickly attracted plaudits from legions of literary and heralded admirers, like Tom Brokaw, Thomas McGuane, George H.W. Bush and Jann Wenner. *The New York Times* has described him as the “Audubon” of the fishing world at least three times by my count. The literary critic and Yale professor, Harold Bloom, wrote: “Prosek is a writer at once artful and natural, an original in literature even as he is in painting.”

Since that book, Prosek has published 12 more. He wrote about fishing around the world, on the 41st Parallel (which runs through his Connecticut hometown) in one book, and retraced the steps of Izaak Walton in another. He’s written two books for children. There was a book about eels, a surprisingly rich and interesting topic.

He’s also continued to paint, of course, on commission and for exhibition in places like the Smithsonian American Art Museum and the Philadelphia Museum of Art. And through it all, like the natural world he depicts, he has never stopped evolving, a result of what



Among his current projects, James Prosek is at work on a bonefish painting that will be paired with a custom shadowbox featuring a fly tied by the late Lefty Kreh. This highly prized work of art will be sold at auction by BTT with proceeds benefiting the Lefty Kreh Conservation Fund.

editor and writer, Nick Lyons, describes as his “endless curiosity.”

And, yes, he has painted tarpon, bonefish and permit. The “big three” of the flats were featured in 2012’s *Ocean Fishes*, a book of watercolors and essays. Painting these ocean-going fish created a new challenge for him, particularly with the bigger specimens, like the 750-pound, life-sized Bluefin tuna he has hanging in the living room of his Connecticut home. The trout he grew up painting could be rendered in a more abstract manner because their scales weren’t as pronounced. “But many of these ocean fish had such large scales that the format had to be tighter, a little more detailed,” he says.

In order to do the book, Prosek decided he actually had to lay eyes on each and every fish. “There are just so many things a photo can’t describe,” he says. Case in point was the tarpon. From the hundreds of photos he studied of the fish, Prosek could never quite figure out where the last ray of a tarpon’s dorsal fin (that long filament that hangs over a tarpon’s back) exactly starts and ends.

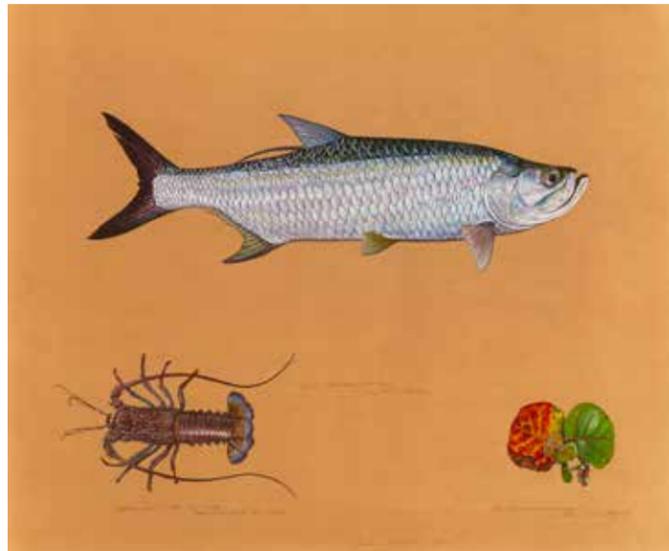
So he went down to the Florida Keys to fish with Jim Murphy. They caught a tarpon. Prosek photographed it, measured it and took copious notes before returning it to the water. (An original painting of that fish sold at a Christie’s auction in 2015.) The bonefish featured in *Ocean Fishes* was caught in Andros, a place Prosek has fished more than 20 times. The permit in the book came from a trip to the Marquesas with Peter Matthiessen and Jeffrey Cardenas. The flats, Prosek says, are some of the most special places in the world. “In the middle of these

WHAT WAS YOUR FIRST FISH ON THE FLY?



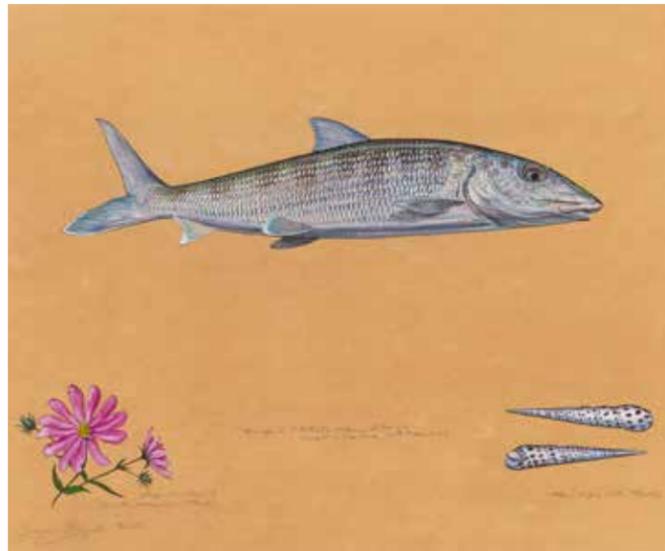
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wide expanses of shallow water, it's all so quiet. All you hear is the sound of the wind and your own breath. It feels so elemental."

The subsequent years have been particularly eventful for Prosek, both personally and professionally. The 43-year-old is now a husband and a father (his son, Cody, is nine months old). In recent years, he's shown at the Royal Academy of Arts and done a residency at Yale. He's guided a certain ex-president of the United States into a big brookie. Though he still paints fish, his newer art has become more complex, abstract and challenging. He's branched into sculpture, using clay, antlers and tree twigs as his media. He's painted the birds and snakes of Suriname and the megafauna of Yellowstone National Park. Hanging in his studio is a recent watercolor of a hunted Scottish stag, which displays an entirely new vibrancy to his work. And in what is likely his biggest departure from his traditional work, he exhibited a new oeuvre of what he called "un-natural" history, a collection of fantastical paintings of imaginary hybrids of marlin and roosters, and foxes and seahorses adorned with birdwings. The paintings challenge our familiar notions of classification and taxonomy, and led him to his latest book project, in which he is writing about the difficulty—and, perhaps, ineffectuality—of trying to name and classify things in a natural world that is ever-changing and fluid. It is a fitting tome for an artist who himself has refused to remain static as he's continued to follow his own curiosity.



But sometimes, like today, Prosek goes back to his roots. This perfect little brook trout stream is a melding of the wonders of nature (the canopy of witch hazel, white oaks and pine trees, the full-throated, harmonized song of a wood thrush) and the artifacts of man (the crumbling remnants of 18th-century stone walls and a 19th-century dam). This is the place where Prosek first took an interest in fishing for brook trout, the fish he says was "the vehicle" into his professional life as an artist and writer. He would catch fish and then draw them, his fly rod, his flies, his drawings and writings, deepening his love and desire to protect, sharpening his skills of observation, becoming a "hero of consciousness," as Jim Harrison once put it.

On the stream, Prosek crawls his way to the bottom of a pool that gives off a light mist and reflects the bright green of the tree leaves hanging over it. From his knees, he makes a graceful cast to the head of the pool, and a fish rises and takes his Adams. The connection is made. Prosek flashes a youthful grin as he brings the brook trout to hand. He holds it for just a moment. "Isn't it beautiful?" he asks. 🐟

Monte Burke is the author three books, including The New York Times bestseller, Saban: The Making of a Coach. He is a contributing editor for Forbes, Garden & Gun, and The Drake.



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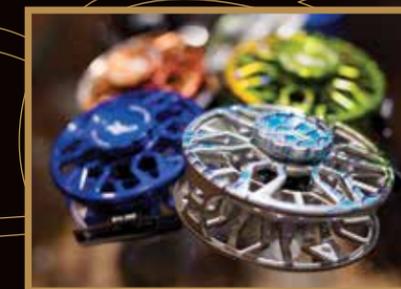
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A New Paradigm: Including Habitat in Fisheries Management

JOELLEN WILSON
JUVENILE TARPON HABITAT PROGRAM MANAGER



Photo: JoEllen Wilson

Photo: Pat Ford

Imagine hiking in the woods and finding a clearing full of beautiful flowers. The colors are vibrant, the species are varied and the meadow is pristine. You try to count the flowers, but there are too many. There is a sign that says each person can pick five flowers each day and you decide to pick exactly five to bring home to your family. A year later you come back to the meadow and now there are two hotels and a subdivision. The amount of greenspace is substantially smaller, the flowers are dull, there are tons of people milling through the flowers, and a new sign reads, "Maximum two flowers per person per day." The problem isn't that too many flowers are being picked, it's that the habitat the flowers need to thrive is being taken away. This seems absurd that instead of blocking off the amount of people tromping through the meadow or reducing the amount of meadow taken up by development, the future health of the meadow and flowers is instead regulated by the number of flowers that can be picked. This is how our fisheries are managed—not by the habitat that fish populations need to thrive, but by the number and size of fish that are harvested.

For most species of fish, the amount of healthy juvenile nursery habitat is critical for ensuring the next generation of healthy adults. This includes many species that we fish for in our estuaries, such as red drum, spotted sea trout, and even groupers and snappers. Most fishes have a reproductive strategy that produces copious amounts of eggs, with only a fraction making it to the juvenile stage. This is exactly why these early habitats are so vital—they enable the remaining juveniles to grow while avoiding being eaten. Nursery habitats are also home to many species that are prey for juvenile gamefish. These systems are

fragile and under constant threat from coastal development, polluted water, and other human-caused factors.

The nursery habitats important to tarpon are especially vulnerable to human activities. These backwater mangrove and saltmarsh wetlands, ponds, and creeks are typically isolated from larger predators because they are accessed through shallow creeks and are periodically cut off from the estuary on low tides. Snook and tarpon nursery habitats are also usually low in dissolved oxygen (the amount of oxygen in the water), which prevents fish predators like large snook or jacks from accessing these habitats. Juvenile tarpon can thrive in low-oxygen habitats—they gulp air at the water surface and use their modified swim bladder like a lung to transfer the oxygen from the air to their blood. (The rolling behavior that anglers see in adult tarpon in well oxygenated water along beaches, and in passes and estuaries is this same behavior, which adults can use to supplement their oxygen intake from the water.) In a nursery habitat with few predators and an assortment of prey that can also tolerate low-oxygen water (like mosquitofish and killifish), juvenile tarpon have only one goal: to grow. After a year or so, once juveniles reach a size large enough to escape most predators, they emigrate from these backwaters into creeks and lagoons, and eventually the estuary and coast.

Common snook, another economically important coastal gamefish in Florida, have similar nursery habitat requirements. Juvenile snook generally don't inhabit the farthest backwaters like juvenile tarpon, but use the same tidally-connected creeks, ponds, and lagoons.

When fish nurseries are impacted by coastal development—changes in water flows, nutrient runoff, dredging, contaminants—they lose their ability to support juvenile fishes. This is especially true for tarpon and snook, which rely on the habitats that are prime areas for development: mangrove and saltmarsh wetlands and creeks that are inland from coastal waters. Degraded habitats have fewer species of prey for juvenile tarpon and snook to eat, and the damaged habitat often offers less protection from predators. For example, a study that compared the diets of juvenile snook in creeks with natural freshwater flows and creeks with freshwater flows degraded by development found that the juvenile snook in the degraded creeks had to work twice as hard for half the prey as the juveniles in the natural creeks. In another study, a juvenile tarpon habitat that had been degraded by a golf course and condominium development still harbored juvenile tarpon, but the tarpon growth rate was extremely slow (about an inch per year). Since it's imperative that juveniles grow quickly so they are large enough to escape predators when they leave the nursery habitats, the outlook for the juveniles from these degraded habitats is not good.

To make habitat a core component of fisheries management will require a paradigm shift, a new way of doing business.

A recent International Union for the Conservation of Nature assessment ranked the Atlantic tarpon population as *Vulnerable*, in part because of habitat loss. Given that Florida has lost nearly 50% of its mangroves and more than 2 million acres of wetlands—nursery habitats for juvenile tarpon and snook—some argue that we are already seeing the result of habitat loss. Despite being a catch-and-release species in Florida, with strict regulations against removing tarpon from the water, we've still seen declines of 30% or more in the Atlantic tarpon population. With such stringent fisheries regulations in place, habitat loss and degradation are high on the blame list.

Snook management in Florida provides a glimpse into how habitat may play a role in whether fisheries management goals are met. Snook are managed as two separate stocks in Florida—East Coast



Large schools of tarpon congregate near barrier islands and ocean passes to form pre-spawning aggregations. During the summer full and new moons, they will make their way offshore to spawn. Tarpon broadcast spawn, which means that eggs and sperm are released into open water and eggs fertilize outside the body. Through the use of satellite tags, we know that tarpon spawn offshore with some reaching depths of 300 feet and rocketing back to the surface. Our best guess is that the pressure change helps dispel the reproductive material from the body. To reach those depths on the Gulf Coast of Florida, tarpon must travel 80-100 miles offshore, but only five or so miles on the Atlantic coast. Offshore plankton sampling in the Gulf of Mexico corroborate this hypothesis, since two-day old tarpon larvae were found adrift near the continental shelf. The eggs are dispersed via the ocean currents, which dictates where the larvae will end up and eventually colonize in nursery habitats as juveniles. Graphic: Thrive Creative Labs

and West Coast—because there are genetic differences between the areas. This genetic information, as well as tagging studies, suggests that there is very little movement of snook between these regions. On the west coast, where juvenile snook nursery habitat remains relatively abundant, the snook population is meeting the management goals for abundance. In contrast, on the east coast, where much nursery habitat has been lost or is degraded, the snook population is not yet reaching management goals—this despite strict regulations on harvest. As with tarpon, it's likely that loss and degradation of nursery habitat is a prime culprit.



Once the eggs fertilize and hatch, tarpon begin the larval phase, which lasts about 30 days. A tarpon larva is called a leptocephalus and is characterized by a mostly white, transparent elongated body, a large eye and fang-like teeth. Their swimming ability gets better as they get larger, but they are mostly driven by the ocean currents early on. This is the same larval type found in eels, ladyfish and bonefish. Once the larvae reach nearshore habitats, they make their way into estuaries and far up creeks into back bays. Once the larvae have settled, they metamorphose into juveniles, which look like miniatures of adult tarpon. Photo: Eric Haffey



Juvenile tarpon tend to find refuge far up tidal creeks in embayments and coastal ponds that are sometimes disconnected during dry seasons. They thrive in low dissolved oxygen conditions due to their modified swim bladders. It is still unclear how long juveniles spend in their nursery habitats and what habitat characteristics are most important (vegetation, depth profile, open or inhibited access), but BTT habitat restoration monitoring assessments will shed light on this. The reported geographical range for juvenile tarpon is from South America, throughout the Gulf and up to South Carolina. Photo: Justin Lewis

The traditional mode of fisheries management, and the approach used for tarpon and snook, is similar to the flower meadow example—it's based on catch, fishing effort, and harvest (this includes fish that are kept and fish that die after being released). Habitat is not included in fisheries management. It is the view of BTT and many biologists involved in fish and habitat research, management and conservation that habitat has to become a core part of fisheries management. In fact, making habitat a core component of management is essential to the future of our fisheries. A fish population that has been overfished can be restored through strict regulations that reduce harvest. In contrast, once a nursery habitat is lost it is no longer available to support juveniles, which limits the size of future generations.

For the past two and a half years, with the help of guides and anglers, BTT has been compiling a database of active juvenile tarpon nursery habitats. All of these sites are inhabited by tarpon 12 inches and under. From this effort, we have produced a map of vulnerable nursery habitats that can directly help resource managers prevent

the potential decline of the fishery. Anglers also described each site as "natural" or "altered." In our test regions (Charlotte Harbor and Indian River Lagoon), the habitat descriptions from anglers were highly accurate when compared to the researcher's description. This introduces a cost effective and efficient way for anglers to act as citizen scientists and report habitat assessment to fisheries managers. Managers can then develop strategies to protect the natural sites from development and identify altered habitat locations for restoration.

With the help of habitat suitability modelers at the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute, BTT has created a ranking system for essential nursery habitat characteristics. This rubric allows us to objectively measure each individual habitat to determine what features are most important to juvenile tarpon and snook. Natural habitats, which are the most productive, can be identified and protected from coastal development and other detrimental human impacts, and can be included in management plans.



An example of a larval creek.

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Once tarpon emigrate from the nursery habitat into the estuary, they are still not sexually mature and can't be considered "adults." This group is known as sub-adults and can be estimated at 2 - 40 pounds, although the defining characteristic is internal. Very little is known about this phase of the life cycle as far as habitat preference and movement patterns, but BTT's Tarpon Acoustic Tagging Project is helping us fill in the gaps. Photo: Dr. Aaron Adams

Altered sites require different action. The results from the characteristics list for the natural sites will give us the blueprints for how to build a productive nursery habitat, or how to change an altered site to more closely resemble natural habitat. Each altered site will be prioritized by how feasible a habitat restoration project is in that location. For example, juvenile tarpon habitat found in the back basin of a marina is less likely to be restored than a natural creek impeded by a culvert. Fortunately, there is funding available for these types of projects through our counties, state agencies, federal agencies and water management districts. These agencies just have to make juvenile fish habitat restoration a priority.

While once an appropriate approach, the system we've been using for fisheries management is no longer sufficient as habitats continue to be lost and degraded and human population increases. Our proposal to include habitat in management for tarpon and snook fisheries in Florida includes the following steps:

- Identify and map habitats important to each life stage of the species being managed. For tarpon and snook, we know enough about habitat use to begin this process, with the first-level focus on juvenile habitats. Indeed, for juvenile nursery habitats we have already begun this process with the help of FWC. Further, FWC has similar data on snook and other gamefish.
- Conduct research to determine which habitat characteristics are most important for a habitat to be a healthy nursery.
- Estimate the fish population size that should result from the amount of available healthy habitats and use this as a guide to set goals for fishery management. Important questions to ask include: Do stock assessment goals match what the population should be based on habitat? What habitats are limiting fish population size? For example, is the amount of healthy mangrove and marsh wetland habitat limiting population size of tarpon and snook?
- Prioritize habitats for conservation and restoration.
- Include the importance of habitats in all evaluations of proposals to alter, damage, or destroy habitats. At present, the importance of habitats to fisheries is not considered.

Clearly, incorporating habitat into fisheries management will require

more steps than those listed above, but this is a start. To make habitat a core component of fisheries management will require a paradigm shift, a new way of doing business. But the evidence is clear—habitat loss is a top threat to coastal fisheries, and if habitat is not included as part of fisheries management, the loss of it will continue to be the detriment of our fisheries. 🐟

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Through the Guides: Conservation Captain Q & A



Photo: Patrick Williams

Capt. Jose Alfonso "Chepe" Polanco

San Pedro, Belize

Favorite species: Tarpon
Favorite fly/lure: Black Death

Since you began guiding nearly a decade ago, have you noticed any changes in the Belizean flats ecology?

Changes that have been very significant in the fisheries include: diminishing or complete loss of fish populations in developed areas, the number of tarpon in migration groups getting smaller, increasingly shorter duration of migrations, availability and accessibility of fishing areas are harder to come by, and populations of certain fish species continue to decline.

Those are some daunting issues to confront in the near future. What are some of the steps that you think should be taken in order to mitigate declines?

The most important measures needed in Belize include protecting the mangrove areas a lot better, since they are essentially the nursery for all fish species; also protecting the beaches from dredging and coastal waters from overwater structures. The laws on protected species can also be enforced a lot more either by patrol units or having a port to check in when you get back from a trip to make sure everything is legal. The reason that's so important is that commercial fishermen still harvest protected species to either consume themselves or sell.

What would you say was your biggest motivation behind getting involved in the conservation and tagging efforts in Belize?

Since I make a living out of the survival of these species, I want to continue to participate in research and tagging efforts. I would love for it to be conserved for my kids and their kids to enjoy it as well—and that way, they can follow in my footsteps as guides!

Wise Words: Always practice safe fish handling techniques and keep habitat areas clean.



Photo courtesy of Capt. Glorioso

Capt. Edward Glorioso

Boca Grande area, FL

Favorite species: Tarpon
Favorite fishing technique: live/cut bait

The Charlotte Harbor / Boca Grande area is a highly productive tarpon fishery and, as you know, it's also a hotbed for sharks. Do you think that conservation ethic has had an effect on your bottom line compared to others who might be more concerned with higher tips?

Yes and no—I explain it to people off the bat. I usually go through Boca Grande Pass when we're running and they'll see all the fish come up and they'll see all the boats, and they say, "Wow, the fish must be right there. Why aren't we fishing there?" So I explain to them I like to have fun fishing and not have to worry about being run over by another boat. So there's that, and, as you mentioned, the sharks. Most of the time they understand, and they agree that they'd rather go out on the beach and have fun, not have to worry about the sharks and not have to worry about all the boats.

What would you say has been your biggest accomplishment in terms of conservation?

My most outstanding day in terms of conservation happened this season. I was out with JoEllen Wilson (BTT Juvenile Tarpon Habitat Program Manager) and we heard that one of my guide buddy's clients had a tarpon on. We went over to him and I had the opportunity watch JoEllen work. At the end of the day, my guide buddy told me that of the five fish his clients had caught that day, the most memorable was the one JoEllen tagged, since they had helped contribute to BTT's research.

Wise Words: Another thing I stress to my clients a lot is the fight time of fish. As you know, tarpon will fight until their last breath. After that information came out, I started beefing up my tackle a little bit. Nothing too heavy, but I like to keep my fight time with the fish between 15 and 35 minutes, no matter how big it is. If it gets to that 40, 45-minute mark, I'm really cranking down the drag because I want to make sure that fish is healthy when it's released. We may not have a shark on this particular bar fighting with it now, but once it gets back to the school or gets to where it was going, I want to make sure I'm not releasing a sitting duck for those sharks. In fact, during a recent trip, JoEllen and I were out tagging fish when she caught one that weighed at least 120 pounds. We had that thing to the boat, hands-on, pictures taken, released—all within twenty, twenty-five minutes.



Photo courtesy of Capt. Cartwright

Capt. Markk Cartwright

Long Island, Bahamas

Favorite species: Bonefish
Favorite fly/lure: Modified Gotcha and Crazy Charlie patterns, and any fly that differs from the regular bonefish fly.

How did you come to be so involved in BTT's research in The Bahamas?

By reading up on the protection and conservation of bonefish and wanting to learn more about the fish and its habitat. The work that BTT has been doing in The Bahamas and elsewhere made me want to get involved. I asked Justin Lewis (BTT Bahamas Initiative Manager) about the fin clipping program and then the tagging program. I have been tagging bonefish ever since.

Highest priority conservation measure(s) needed in the Bahamas right now?

We're overdue for the banning of gillnets. We're working toward protection of the fish and their habitats but we should also make enforcement a top priority! And education of the general population—not just fishing guides and anglers. And above all, the most important and often overlooked measure is the protection of all spawning sites and routes to and from spawning sites and flats. Identifying those sites is our first step in that process.

What does a typical off-day look like for you?

Fishing with my son Maykol, who is ten years old, my brother and friends, reading and studying on the conservation of the fish and habitat (flats, wetlands, etc.), beaching and boating.

Wise Words: Fishing pressure is often caused by guides and/or anglers looking for large catch numbers from one flat instead of catching just a few fish and moving to another location.



Photo: Patrick Williams

Capt. Omar Arceo

San Pedro, Belize

Favorite Target Species: Permit
Favorite Fly: Crazy Charlie

How did you get your start as a fishing guide in Belize?

For 30 years, I was a commercial fisherman. Excessive skin diving started to take its toll on me. Looking for another option, I turned to sportfishing. I had never heard of fly fishing before; it was not popular in Belize at the time. However, I saw some men on the beach one day; they were using rods I had not seen before. I taught myself how to fly fish by observing and listening to the jargon. I bought myself a fly rod and hit the flats. It took me three years to fully transition from a commercial fisherman to a fishing guide. It was a new adventure at the age of 45.

Can you tell me a little about what makes your area so unique and productive as a flats environment?

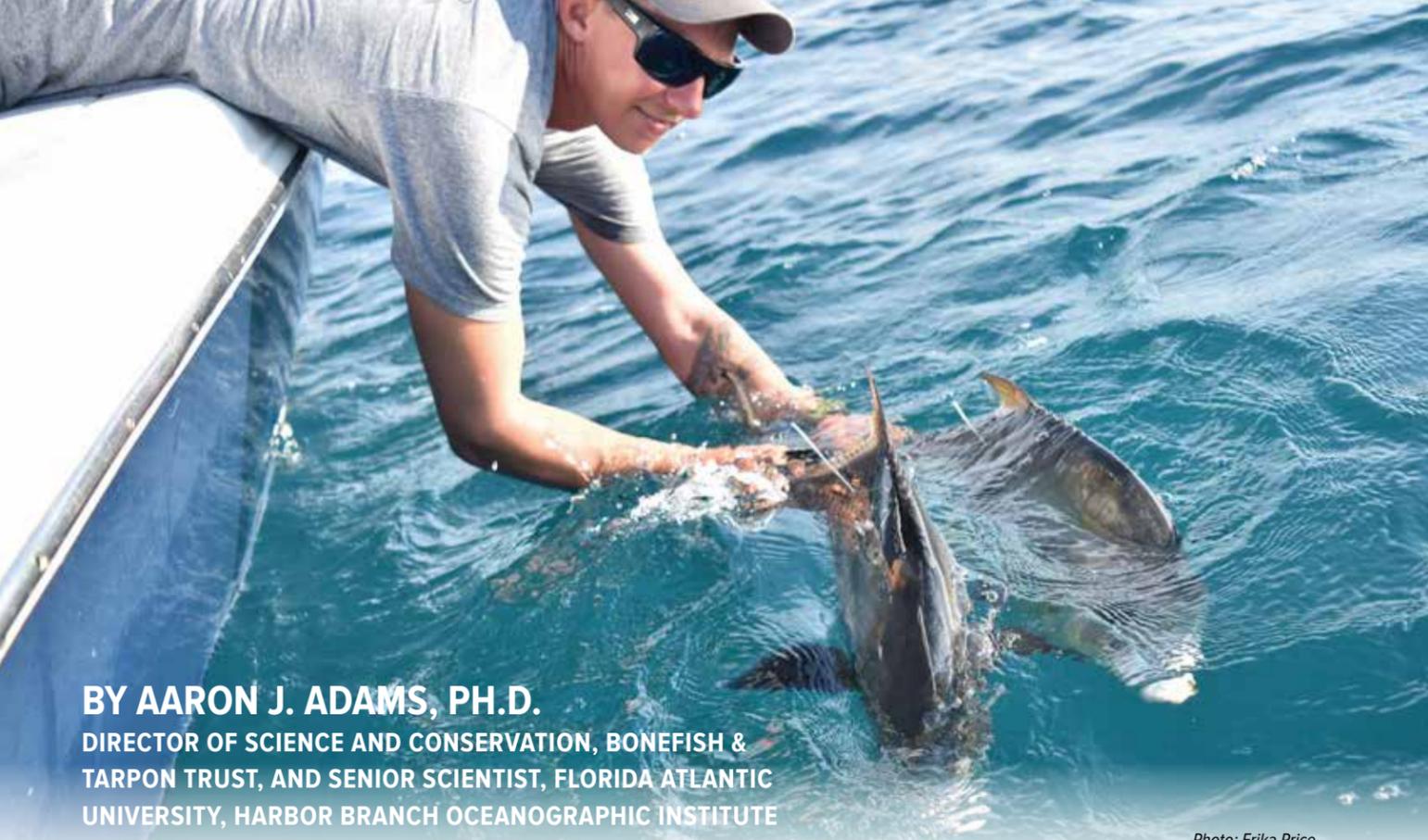
The reason our flats are so unique is that there essentially a large body of shallow water on the northern side of our country. Belize boasts 40 miles of majestic flats which range from four inches to 24 inches of water throughout. At its deepest it will be seven feet in the middle of the flats. Our diverse ecosystems include the reef flats, lagoons, creeks, marshlands on the bay side, sandbars, mangrove islands, and coastal river banks. There you will find the grand slam: tarpon, permit and bonefish.

What, in your opinion, is the most important conservation measure(s) needed in Belize right now?

Belize has designated 40% of the country as a reserve—both land and sea. The most important conservation measure that is needed in Belize is the protection of the marine reserves, as the ruling bodies of this country continue to approve developments that threaten them. The case of Cayo Rosario is a recent example of this threat. Developers have been approved to build 40 over the water structures and 50 bungalows on 1.8 acres of a mangrove island, sitting on a majestic, wadable permit flat. It is absolutely imperative that our marine reserve remains untouched by unsustainable developments.

Wise Words:

During the summer, I volunteer my time to teach kids how to fly fish and tie flies. I teach them all I know, free of cost, and I send them off proudly to venture off on their own or with other fly fishing companies. I am passionate about conservation and I will always stand firmly against any developer that threatens our flats.



BY AARON J. ADAMS, PH.D.
DIRECTOR OF SCIENCE AND CONSERVATION, BONEFISH & TARPON TRUST, AND SENIOR SCIENTIST, FLORIDA ATLANTIC UNIVERSITY, HARBOR BRANCH OCEANOGRAPHIC INSTITUTE

Photo: Erika Price

HABITAT: Locally Important, Regionally Essential

Recent BTT-funded research has been providing some intriguing results. On the one hand, results that show region-scale connectivity suggest that a large-scale conservation approach is needed. For example, a recently completed project estimated the pathways followed by bonefish larvae as they drift in the ocean after spawning. The results show that no bonefish population is isolated. It's likely that every location where we fish for bonefish relies on a mixture of larvae that are spawned locally and larvae that come from faraway spawning sites. The Florida Keys, for example, probably receive larvae from the Yucatán Peninsula as well as southwest Cuba.

On the other hand, results from tag-recapture of bonefish in The Bahamas, and acoustic telemetry tracking of permit in the Lower Florida Keys, suggest that adult bonefish and permit have small home ranges. That is, they tend to remain in a relatively small area during much of the year, making longer distance movements for spawning. This type of behavior suggests a local conservation focus is needed.

The truth is, of course, that successful flats fishery conservation must be both local and regional. Most important—at both spatial scales a

core conservation focus must be on habitat. Let's use bonefish as an example of why habitat conservation is so important at both local and regional scales.

Tag-recapture research in The Bahamas, Belize, and Florida Keys shows that the majority of tagged bonefish are recaptured within 1 kilometer of where they were tagged. This effectively means that bonefish have small home areas where they spend most of their time. This is probably why flats that get a lot of fishing pressure tend to have bonefish and permit that are well 'educated' to anglers and flies—they've seen it all before. In heavily fished areas, a common joke is that bonefish can look at a fly and tell who tied it. In terms of conservation, this means that if a flat becomes degraded or is lost, we will also lose the portion of the population that uses that flat. These fish are unlikely to successfully move elsewhere—research on other species shows that fish that are relocated to unfamiliar locations tend to be less able to avoid predation. This not only impacts the local fishing, but reduces the overall fish population, which means fewer fish to spawn to create the next generation.

Research in The Bahamas and Belize also shows that bonefish migrate long distances to spawn. And that they gather in large

pre-spawning aggregations in shallow bays before moving offshore at night to spawn. This expands the amount of area that requires conservation to include the migration pathways between the home ranges and pre-spawning sites, the pre-spawning sites, and the offshore spawning locations. So already the need for habitat conservation has expanded from the level of the local flat to an entire island.

Like tarpon and permit, bonefish spawn by a process known as broadcast spawning. Large groups of mixed males and females eject eggs and sperm into the open water, where the eggs are fertilized. The eggs hatch in about a day, and float in the open ocean as larvae for weeks to months (bonefish larvae float in the open ocean for between 41 and 71 days). During this open-ocean larval phase, bonefish larvae are transported by ocean currents, and might end up circling back to near their parents' home ranges or transported to distant locations.

If they survive this open ocean phase, the larvae move inshore to sand and sand-mud bottom bays and transform into juveniles. So once again we add another habitat to the mix—juvenile nursery habitat that is different from adult habitats.

If the larvae end up back at the same location as their parents, then conservation at the local scale that protects home range habitats, migratory pathways, pre-spawning and spawning sites, and juvenile habits is adequate. But if larvae come from spawning at different locations, then the spatial coverage of conservation must be expanded to include entirely different locations.

Let's say, hypothetically, that 40% of bonefish juveniles in the Florida Keys come from larvae that were spawned in the Florida Keys, and 60% come from spawning in Cuba and Mexico. In this scenario, local habitat conservation is important, but we also must focus on habitat conservation in Cuba and Mexico. If the bonefish populations in Cuba and Mexico decline due to habitat loss, degradation, or overfishing, there will be fewer spawning fish to send larvae to the Florida Keys. Similar relationships exist between islands in The Bahamas, between Cuba and The Bahamas, and throughout the Caribbean Sea.

Tarpon present a different challenge. Research shows that tarpon also spawn offshore, and their larvae are in open waters for about

a month. Tarpon larvae that survive the open ocean transform into juveniles in backwater mangrove and marsh wetlands and creeks—habitats they depend upon as nurseries.

Adult tarpon show a range of movement patterns. Some migrate long distances—say, Florida Keys to Chesapeake Bay. Others seem to stay closer to home, remaining in South Florida. Some tarpon show different movements each year—Florida Keys to Cape Canaveral one year, Keys to Charlotte Harbor the next. Still other tarpon follow the same pattern year after year, as have a few tarpon that migrate between South Florida and South Carolina. During these travels, adult tarpon use ocean, estuary, and river habitats.

The life cycle of tarpon presents a conservation challenge. Juveniles depend on wetlands as nurseries, and wetlands have been and continue to be lost to coastal development and other uses—not just in Florida, but worldwide. In fact, habitat loss is one of the reasons that a recent International Union for the Conservation of Nature assessment ranked tarpon as *Vulnerable* and in need of conservation attention. The fight to protect and restore these important wetland habitats is local. But juvenile tarpon grow up to join an adult population that moves throughout the region—meaning that we all share the fishery—so the implications are regional.

Permit conservation presents challenges similar to bonefish and tarpon. Juvenile permit the size of a dime—the size when they transition from larvae to juveniles—require sandy beaches as nursery habitats. As they grow, they use a wider variety of habitats, including sand flats, seagrass, and eventually reefs. As adults, ongoing work indicates that permit on the flats have relatively small areas they use regularly, similar to bonefish. But they'll migrate to offshore reefs to spawn. So permit conservation must focus on each of these habitats and permit life stages to be successful.

The take-home message is that the fight for habitat conservation and restoration are local, but the implications are regional. It's not enough to focus solely on our own backyards. We also have to provide support to people working on habitat conservation in other locations, and put pressure on resource management agencies throughout the region to focus on habitat protection. Since we share the fisheries, we also share the conservation responsibility. 🐟

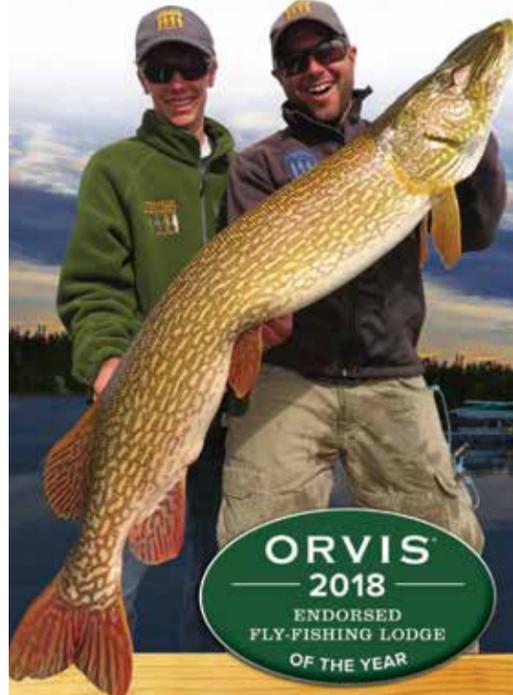


Photo: Dr. Aaron Adams

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BTT Events 2018



7th Annual New York City Dinner & Awards Ceremony

BTT honored Paul Tudor Jones II, one of America's leading conservationists, with the Lefty Kreh Sportsman of the Year Award on March 13, 2018. This award, the highest honor bestowed by BTT, was presented to Paul by his longtime friend, and former Chairman of the National Fish and Wildlife Foundation, Carl R. Kuehner III. Our Special Guest and Master of Ceremonies for the evening was two-time Olympian and champion angler Andy Mill. 🐟



Paul Tudor Jones II delivers remarks to a full room of BTT's friends and supporters. Photo: Brendan McCarthy



Angela Reynolds, Huey Lewis, and Meredith McCord enjoy the memorable and inspiring evening. Copyright 2018, Rick Bannerot



BTT President and CEO Jim McDuffie with NYC Dinner Co-Chair Walt Noonan and Bill Michaelcheck. Photo: Brendan McCarthy



Acclaimed country singer, Caroline Jones, treats guests to a special performance. Copyright 2018, Rick Bannerot



Legendary guide and NYC Dinner Co-Chair Paul Dixon with IGFA Hall of Famer Stu Apte.

5th Annual Florida Keys Dinner and Awards Ceremony, Islamorada



Friends and family gathered in January to honor Sandy Moret, 2018 Fly Fisherman Conservationist of the Year, at an event hosted by Sage and BTT. Moret was nominated for the award by BTT Chair Harold Brewer. The organization received \$5,000 in Moret's name to support efforts by BTT and the Now or Neverglades coalition to restore health flows to the Everglades. Photo: Greg Poland

BTT in Houston



In April, Garrett Gordy hosted fellow Houston anglers at Gordy & Sons Outfitters, the sponsor of the inaugural year of the BTT Texas Tarpon Acoustic Tagging Project. The evening featured a presentation on BTT's ongoing conservation work by Dr. Ross Boucek, and a tarpon angling clinic from world-renowned tarpon angler and former Olympian, Andy Mill (pictured here). Photo: Gordy & Sons Outfitters

Dallas, An Evening on the Flats



David Leake and Tailwaters Flyfishing Co. hosted BTT for a memorable evening that brought together local anglers and featured a presentation by Dr. Aaron Adams, Director of Science and Conservation, on the Tarpon Acoustic Tagging Program. Photo: Tailwaters



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