



A publication of
Bonefish &
Tarpon Trust

BONEFISH & TARPON JOURNAL

STEWARDSHIP THROUGH SCIENCE
2016 EDITION

WHAT'S INSIDE:

DECODING BONEFISH REPRODUCTION

TARPON DAZE WITH MONTE BURKE

LOOKING THROUGH WATER WITH BOB RICH

SCIENCE OF FISHING: RUBBLE FLATS IN THE TROPICS

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**BTT is proud to feature
the 2016 Artist of the Year:**

Kent Ullberg

See page 46



BONEFISH & TARPON JOURNAL

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BONEFISH & TARPON
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Setting the Hook

A Note from the Chairman and President

The year 2016 brings a lot of new excitement to BTT, and a lot of new energy to our mission to protect and enhance the flats fisheries. 2015 saw numerous positive changes and this hard work has built a strong foundation for moving forward in 2016.

First, thanks to your support, we were able to once again increase our funding for science, conservation and education projects in 2015. You'll read about some of the work that these funds are supporting in this issue of the Journal. A few projects for special mention include: a region-wide (Caribbean, Gulf of Mexico, Atlantic Ocean) genetics analysis of bonefish and tarpon to determine which regions are interconnected; an analysis of 30 years of water quality, habitat, and prey data from Florida Bay to try to pinpoint historical causes of bonefish declines; and a new project to track permit in the Florida Keys. All of these projects should lead to better management systems for the flats fisheries throughout the region.



Tom Davidson
Chairman



Harold Brewer
President

It's important to emphasize that BTT achieves its success through collaboration. Whether it is support from members, project sponsorships from the fishing industry, trip donations from lodge owners and guides, or interaction with scientists who are among the world's best in their fields of expertise. Our list of current scientific collaborators includes: Cape Eleuthera Institute, Florida International University, Florida Institute of Technology, Florida Fish and Wildlife Conservation Commission, University of Florida, University of Illinois, University of Massachusetts, Carleton University, University of Wisconsin, Fisheries Conservation Foundation, College of the Bahamas, Bahamas National Trust, The Nature Conservancy, University of Alabama, and the University of Waterloo.


One of our founding goals was to address the decline in the Florida Keys bonefish fishery. We are pleased to announce we received a generous matching grant from the National Fish and Wildlife Foundation for a restoration research project on bonefish reproduction that will help us get closer to that goal. The purpose of this project is to determine how to reproduce bonefish and tarpon so that as we figure out the causes of the fishery declines, and formulate strategies to fix these problems, we can have another tool in our restoration tool box. If bonefish and tarpon in a specific fishery aren't able to come back on their own, we need to be ready to give them a boost. You will be hearing a lot more about this project in 2016 and beyond.

In the Bahamas, we continue to work aggressively with our partners to identify sensitive spawning areas and work to ensure these areas are protected from development and excessive boating or fishing pressure.

We also have exciting changes on the personnel side. We created a new Executive Director position to support our next level of evolution. In that regard we are pleased to welcome Jim McDuffie into this role. Jim brings a great deal of experience from his extensive career in the world of conservation management and fundraising. Jim will be a great asset to BTT, and will help Aaron Adams, our Director of Science and Conservation, and Alex Lovett-Woodsum, Director of Development and Communications, in their respective efforts.

Additionally, we are pleased to welcome Stephen Reynolds, David Perkins, Bill Andersen, Rob Sharpe, and John O'Hearn as new members to our board. These gentlemen bring many years of experience in conservation oversight that will greatly augment our already blue ribbon board.

The transition from 2015 to 2016 saw another big change in our volunteer leadership. Long-time BTT President Matt Connolly retired as president but will remain involved with BTT as a member of the Executive Committee and Board. Matt's years of service to BTT have been very impactful and are greatly appreciated. Matt has been replaced by the co-author of this column – Harold Brewer, a long-time BTT Board member and previously Vice President and Managing Director of BTT's Bahamas effort.

Finally, a big thank you to all who make what we do possible. We are very grateful to our highly dedicated staff who are instrumental to BTT's success. Thank you to our many volunteers, board members, trustees, and a special thank you to the thousands of donors large and small that make our work possible. 

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BONEFISH & TARPON TRUST

A Changing of the Guard

In 2015, after 10 years of devoted service, Matt Connolly decided to step down from his position as President of Bonefish & Tarpon Trust. Connolly will remain a vital part of the BTT Board of Directors, serving as President Emeritus, and fellow board member Harold Brewer has taken over as BTT's new President.


Nearly a decade ago Matt Connolly identified himself to Bonefish and Tarpon Trust leaders as someone who believed in the cause and someone who was willing to help. And help he did.

Matt brought with him a lifetime (50 years) of experience including 19 years of leadership with the prestigious and effective Ducks Unlimited organization and directorships of numerous other conservation groups. Matt also brought his little black book of contacts and quickly attracted numerous other skilled and passionate directors

to the cause. "Being President of BTT was an incredibly gratifying experience for me as the science based facts from our research programs coupled with our membership growth enabled us, for the first time, to advocate and successfully bring about sound new public policies for flats fish," Connolly said.



Matt Connolly (L) with Harold Brewer (R) at the 2015 BTT Tarbone Dinner. Photo: Dan Dow.

"I have been fortunate to have the opportunity to work closely with Matt Connolly over the last few years. His experience and guidance have been invaluable to BTT as we have furthered our science and educational efforts to conserve and restore the fisheries we are interested in," said BTT's new President, Harold Brewer. "While I can never replace Matt, I am looking forward to working more closely with our dedicated group of members, supporters and active volunteers as well as the leadership and staff of BTT in the years ahead." 

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BONEFISH & TARPON TRUST

The Poling Platform

Perspectives from Jim McDuffie, Executive Director

It's all a matter of perspective. From the poling platform, we are able to see things differently in the environment surrounding us, and the view gives us an advantage.

In many respects, the work of Bonefish & Tarpon Trust can be regarded in a similar way. Protecting, restoring and enhancing bonefish, tarpon and permit fisheries across geographically, ecologically and culturally diverse regions requires a different perspective—one that enables us to understand the variety and complexity of forces influencing the health and vitality of these fisheries at scale.

From our boat, we are most aware of the conditions that we see unfurled on the flats around us, while the larger systems are vast and vulnerable to factors that may be less apparent. These can include fisheries regulations and practices in another country, the degradation or loss of habitat critical to species at different life stages, and the quality of water originating in locales far from the flats and affected by development, agriculture and other pressures along the path of its flow.

In developing this perspective at scale, we must ask—and answer—many questions. For example:

- How are the populations of bonefish across the Keys, Bahamas and the rest of the Caribbean interconnected, and how might this connectivity inform our conservation efforts?
- Which habitats are most important to our target species and what must be done to protect and restore them?
- What are the greatest threats to our fisheries at scale, how are these threats manifested in current stresses and how might we best mitigate them?

To answer these complex questions, research becomes our poling platform. It broadens our perspective and ensures that our “cast” as an organization is more likely to land on the nose of impactful conservation outcomes.

In these pages, you will read about many of the research projects currently under way. Collectively they stretch from the coastal Southeastern and Gulf states in the U.S. to island nations across the Caribbean Basin. In each, BTT is working with scientists, fishing guides, lodges, anglers and resource managers to answer research questions central to the conservation and resource management challenges present in our fisheries.



Jim McDuffie
Executive Director

Perspective also leads to innovation and nowhere is that more evident than in an exciting new project set to begin in 2016. BTT, with generous support from the National Fish and Wildlife Foundation, seeks to pioneer the methods for spawning and rearing bonefish in captivity as well as determining the most effective techniques for nursery habitat restoration—all as part of a scientifically rigorous fish restoration program.

This is specifically important in our efforts to reverse declining bonefish numbers in the Florida Keys. As we address the factors impacting the macro-level health of our fisheries, it is likely that the Florida Keys bonefish population will need a temporary boost in returning to a size at which it can sustainably reproduce at abundant levels.

(Continued, pg. 8)



Photo: Dan Dow.



Photo: Capt. Shane Smith.

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Our aim is to perfect the methods to spawn, raise and effectively release cultured juveniles over a limited and prescribed time for the purpose of accelerating recovery. The knowledge gained from this project will constitute a new and valuable restoration tool that will greatly advance our mission. Among the prominent partners collaborating with BTT is the National Fish and Wildlife Foundation (NFWF), which has made an extraordinary leadership commitment to help fund the five-year research program. BTT must match this grant dollar-for-dollar with additional fundraising in order to leverage NFWF's support. We hope our many loyal members will respond generously to the opportunity.

Beyond the significance of this work on the future of our fisheries, it also brings special recognition to our organization and represents an impressive endorsement of BTT's expertise and capacity from regional

and national partners. This enhances our reputation and enables us to develop further as a science-based organization.

These are exciting times to be a part of BTT. Over the next five years, many research projects will culminate and others, like the new endeavor to spawn and raise bonefish and tarpon in captivity, will be far along in their efforts to decode the reproduction of bonefish and tarpon. BTT, atop its poling platform of research, will be armed with the scientific information needed to further inform and refine new perspectives on how we can protect, restore and enhance our bonefish, tarpon and permit fisheries at scale. 🐟



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Tippets Short Takes on Important Topics

Florida Regulations

The regulations for tarpon in Florida are based on research of the effects of catch and release, and are designed to keep more tarpon alive after the catch. If the tarpon is more than 40" long, it has to stay in the water. Period. No dragging of big tarpon into the boat, please. Research shows that large tarpon suffer from a lot of handling, so the less you handle them the better. Tarpon less than 40" can be removed from the water for photos. For all tarpon, there is no harvest unless the angler or guide has a harvest tag from FWC, and the tarpon is being registered with IGFA for a world record.

As a reminder – bonefish are also catch and release only in Florida, and have to be released at the site of capture. Although the rules don't require it, it's also best to keep bonefish in the water. Extensive research has shown that removing bonefish from the water for just 15 seconds can cause enough damage to greatly reduce their chances of surviving. So keep bonefish in the water for the photo, or make sure it is still dripping in the photo if you hold it out of the water.



Photo: Pat Ford.

Florida Fish and Wildlife Conservation Commission passed new regulations for barracuda in September 2015. Prior to these new regulations, the barracuda regulations were so minimal as to make it an essentially unregulated fishery. That has changed, and at press time the Commission is considering additional regulations. We are hopeful that additional regulations are coming, including size restrictions on harvest. The new regulations are: Recreational and commercial daily bag limit of two fish per person, with a maximum of a daily vessel limit of six fish per vessel.

Experimenting with Permit

It was worth the experimentation, but after three attempts we've decided to no longer pursue using small satellite tags to track permit movements. Before investing in a permit satellite tagging program, we wanted to first make sure the approach would work. We fitted a mini-satellite tag on a 15 pound permit that was one in a group of 6 that we held in a large outdoor tank. The fish handled the tag well, it didn't affect its swimming or feeding, and when we removed the tag after a couple of weeks there were no obvious ill effects on the fish.

However, once we started experiments in the field we ran into problems. To be on the safe side, the tagging teams only tagged permit over 20 pounds. In all cases the tag attached well and the permit swam away in good form. Two of the tags popped off the fish and to the surface after 20 days, and when we retrieved the tags we figured out why – there were barracuda teeth marks on the tags. We think that the barracuda thought the tag wobbling above the permit was a fish, and attacked it, pulling the tag from the permit. The third tag never reported on the date it was supposed to pop off from the permit. The tag may have failed to detach, there could have been a tag failure, or the tag could have been rubbed off by the permit on the reef and become stuck. We'll never know.

In addition, the data that we downloaded from the two tags that we retrieved didn't provide the high resolution data we'd hoped for. The depth data was interesting, but the location data had far too much error – putting permit tagged in the Middle Florida Keys anywhere from the Upper Keys to Cuba from one day to the next.

We hoped to use the satellite tags to augment the multi-year dart-tagging study, which has provided some interesting results. Nothing ventured, nothing gained. Conducting research on permit is as challenging as catching them on the fly.

We are now full-speed into the next phase of Project Permit – using acoustic tracking to determine their movement patterns. You can read about this exciting new project in the article by Jake Brownescombe in this issue.

Project Belize Update

In November 2014, the flats guides of Belize held their first Flats Fishing Summit. The Summit was organized to address the guides' increasing frustration with the poor management of the fish and their habitats. Held at the Radisson in Belize City, and hosted by Bonefish & Tarpon Trust and Yellowdog Fly Fishing Adventures, the Summit brought together more than 40 guides and lodge owners from throughout coastal Belize, from Punta Gorda in the south to San Pedro in the north, and points in between.

The top threats to the fishery, as identified by the guides were: gillnets, lack of enforcement of existing laws, habitat loss, and in some cases too much fishing pressure. Guides from throughout Belize related their experiences combating these threats and the real impacts these activities are having on the fishery.

We will continue to tag bonefish and permit in Belize so we can quantify which habitats and locations are most important to the flats fishery. This and other information is being used to propose new or expanded fishery and habitat protections. Unfortunately, at present these efforts are still piecemeal, and aren't yet part of a national flats conservation plan.

BTT will continue to work with guides and lodges to conduct the scientific research needed to support flats fishery conservation and provide advice. As is happening in many areas, the pressures on the coastal habitats and fisheries of Belize are mounting (see the article by Mike Steinberg in this issue), so action is needed.

Bahamas, too

As you will read in the piece on the Bahamas Initiative by Justin Lewis, Bahamas Initiative Manager, a lot of progress is being made. Our Bahamas collaborators, Bahamas National Trust and The Nature Conservancy, were successful in their work with the Minister of the Environment and numerous new and expanded Parks were declared. The Parks most important to bonefish are: on Grand Bahama – The Gap and East End; on Abaco – The Marls and Cross Harbour; Andros – The Joulters. Much still needs to be done – final regulations, confirm the boundaries – but this is a great start. We are hopeful that additional protections are on the way to protect the bonefish fishery and habitats on other islands, where we are working hard to get the data we need to support these efforts.

At press time, the new regulations for the Bahamas bonefish fishery were still being debated within the Bahamas legislative process. However, it appears that the two new changes will be that a fishing license will be required for flats fishing, and that a guide certification system will be established. As we understand it, the fishing license funds will be allocated to conservation and enforcement, both of which are in need of funding. As always, BTT is ready to provide scientific information to assist in conservation efforts.

It's also worth noting that Justin has been putting a lot of time and effort into education throughout the Bahamas. This includes presentations at schools and at community events, field trips with students, and presentations to guides. Justin covers a lot of ground in his presentations, but the two main topics are always habitat conservation and proper catch and release practices.

Catch and Release

On the topic of catch and release – although we have a whole spread dedicated to catch and release, and the topic is sprinkled throughout the Journal, it's worth covering it again here. Catch and release is only a valid conservation tool if it is practiced properly. If a high percentage of the fish don't survive, then catch and release won't work. As anglers and guides, we are the ones who have to get this right, and we have to teach others who don't yet know.

Tournaments That Support

A huge Thank You to the tournaments that donated proceeds to BTT in 2015. This includes the March Merkin, Cabin Bluff Tarpon Cup sponsored by Hell's Bay, Del Brown Permit Tournament, Worldcast Black Tail Invitational, Lowcountry Tarpon Tournament, and the Palometa Club Permit Tourney. These are events that are a lot of fun for anglers and guides, and provide much needed funds for conservation. Plus, many of the tournament anglers also participate in research during the tournaments.

Collaboration


It is worth noting that BTT achieves much of its success through collaborations. Many guides help out, for example, by helping with research, donating trips for auctions, and signing up new members. They are too many to list here, but check out our Conservation Captains webpage to see a list of many of them. Similarly, we have many lodges and travel outfitters to thank as well. They donate trips for auction, host Traveling Angler trips, host scientists, take part in research – all for the future of the fishery. A big thanks to the many corporate sponsors as well, who donate much needed funds as well as their fine products. These strong supporters are all listed within these pages and on the Sponsors page of our web site. Finally, thank you to all of the scientific and conservation colleagues who are essential to conducting

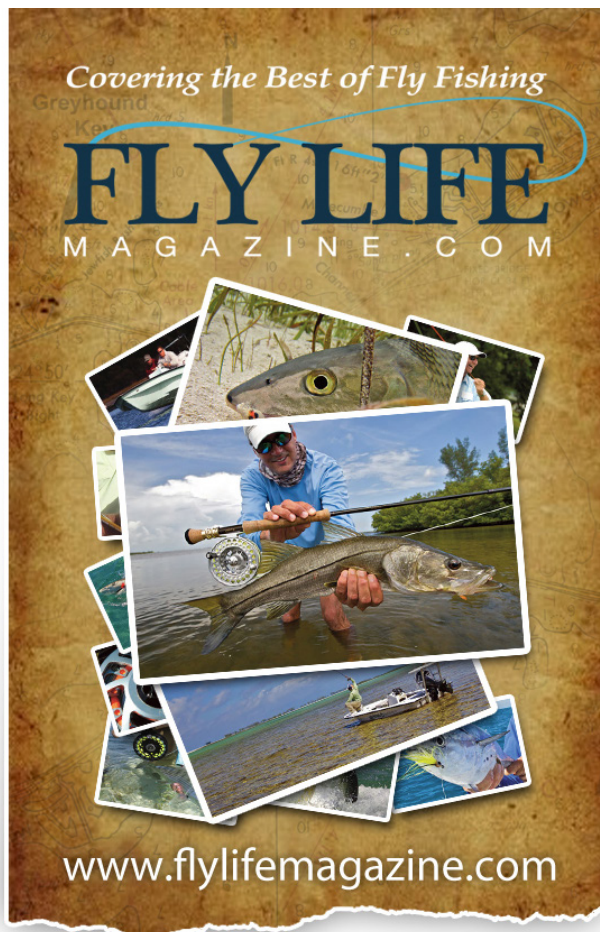


Justin Lewis presents to the Bahamas National Trust.

the research that makes conservation possible. Current collaborators are: University of Massachusetts Amherst, Carleton University, Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute, Cape Eleuthera Institute, Fisheries Conservation Foundation, Bahamas National Trust, The Nature Conservancy, Florida International University, University of Alabama, Everglades National Park, Florida Institute of Technology, ROFFS Ocean Forecasting Service, University of Havana, Cuba Department of Flora and Fauna, and University of Waterloo.

Symposium 2017

It's still a bit in the future, but we're letting you know now so you can save the dates. The next BTT symposium will be November 3rd and 4th, 2017. The last Symposium in 2014 was a huge success by all accounts, so don't miss the next one. The Symposium is held every three years, so don't be like so many who will miss the next symposium and say "I'll make it next year," because the next one won't be until 2020. Stay tuned to the BTT Blog and E-Newsletters for more details. 



The Florida Keys Initiative

BROOKE D. BLACK, M.S.
 Florida Keys Initiative Program Manager
 Bonefish & Tarpon Trust

BTT has one major goal in the Florida Keys: return the flats fishery to what it once was. We will do this by restoring the bonefish and tarpon populations, further protecting the permit population, and protecting and restoring habitats. Around the water cooler, the Keys flats fishery is becoming the poster child for “used to be” and “in the good ol’ days.” Although we have recently seen small flurries of better fishing in some areas of the Keys, other historically excellent fishing areas remain woefully devoid of healthy numbers of bonefish, tarpon and permit. Additionally, the Keys are facing unprecedented changes in resource use, environmental policy and management.

So how do we restore our fishery?

- 1** Figure out why the flats fishery declined in the first place.
- 2** Formulate a comprehensive strategy to bring the fishery back to even-keel.
- 3** Work holistically to restore it.

Our approach is to frame and support research that addresses the unique issues surrounding our fishery. The first step is to assess the current status of the fishery including overall fishery health, habitat degradation and the conservation strategies already in place, of which there are many. This is a task that we can’t do on our own, so we enlist the help of many collaborators who appreciate the fishery as much as we do.



Taking a mucus swab from a bonefish.
 Photo: Dave Denkert.

Turtle grass in Florida Bay.
 Photo: Brooke Black.

After securing bonefish as a catch-and-release species by Florida law, BTT and collaborators have been following up with a slew of education and research in the Keys. BTT is working with several groups, including Everglades National Park, to develop educational programs that guide users on everything from how to interact with the habitat to properly handling fish to

increase chances of post-release survival. The education component of research is imperative to conservation because it translates science into best practices.

BTT is also busy keeping up with research in the Keys. We’ve located juvenile bonefish habitat thanks to help from our colleagues at University of Massachusetts Amherst, who learned about juvenile bonefish through their work in the Bahamas. So far it’s been hard to find juveniles in these habitats in the Keys. After sampling all over the Keys and locating juveniles in so few places, the next question became, “Why aren’t juvenile bonefish present in so many ideal Keys habitats?” One possibility is that there aren’t enough juveniles coming into the system.

This potential reason for the lack of juvenile bonefish in the Keys prompted us to initiate YET’s Bonefish Genetics Program. With the help of guides and anglers, BTT is collecting bonefish fin clips (much like clipping a human finger nail) from all over South Florida, the Bahamas, the Gulf of Mexico and the Caribbean as part of a population genetics study to answer the question – where do our Keys fish come from? Such analysis helps us get at issues that may have a very distant origin. For example, are bonefish spawning in Cuba providing larvae to the Keys, thus supplying the local bonefish population? The same question is important for tarpon. To build on the genetics research, we’re also funding a study of ocean currents to estimate where bonefish larvae entering the Keys are coming from if Keys bonefish aren’t contributing to their own population. Understanding the geographic connectivity of our flats fish populations is fundamental to protecting the fisheries because we need to know where to focus conservation efforts.

(Continued pg. 14)



BTT’s Brooke Black with a bonefish blood sample.
 Photo: Dave Denkert.



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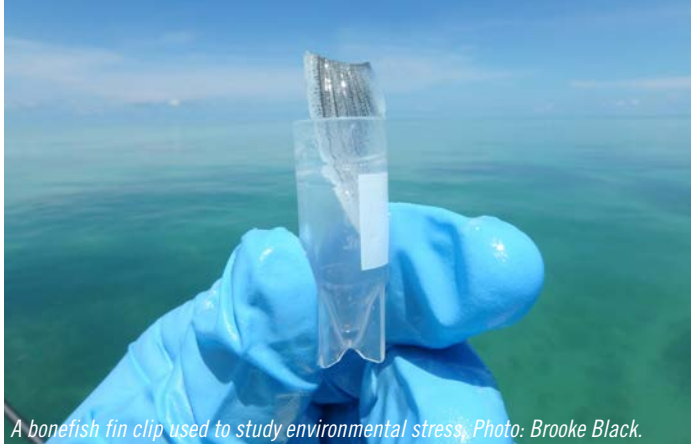
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In an effort to understand local causes for bonefish declines, BTT has been in the air looking for potential spawning habitat off the Keys, using the results of research on spawning bonefish in the Bahamas as a guide. We are also working with the University of Wisconsin-Madison and the University of Massachusetts Amherst to hunt for disease or environmentally-born fatal threats (e.g., mercury) in our bonefish – other fish populations under environmental stress have declined due to diseases caused by that stress, something that is not obvious without doing the research.

We've teamed up with the University of Florida to examine factors that could negatively impact the bonefish population, and how much of a punch the bonefish population can handle before it takes a dive. Lastly, our partners at Florida International University are analyzing 30 years of water quality, habitat, and prey data in Florida Bay to find linkages between the state of the environment and the decline of bonefish in Everglades National Park. Each of these projects addresses a Keys-specific aspect of the question – what is impacting the bonefish population?

We also suffer from a lack of historical data, so it's difficult to quantify changes in the fishery. Moving forward, we are working with guides and anglers on a new logbook program. It may seem trivial now, but in 10 years we'll have one heck of a database that will help us answer questions about the state of the fishery.

Big-picture research is also dedicated to permit. As a community, we worked hard to pass the Special Permit Zone regulation in the Florida Keys to protect our flats permit. But are those boundaries sufficient? Thanks to the tagging efforts of guides and anglers, we learned that most permit are homebodies. But a couple of tag-recaptures let us know that some free spirits travel a long way from the Keys. So BTT is redoubling efforts with collaborators by launching an acoustic tagging permit study, which kicked off in the Lower Keys in September 2015. By implanting a small transmitter in larger permit and picking up their signal in an array of locations, we can learn how adult permit are connecting flats habitats to reefs and wrecks and using varying water depths, thereby refining our current knowledge of home range size. Understanding where and when permit move can provide data to further protect their fishery and the habitat on which they depend.

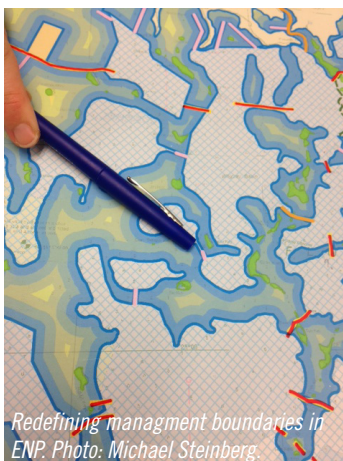


A bonefish fin clip used to study environmental stress. Photo: Brooke Black.

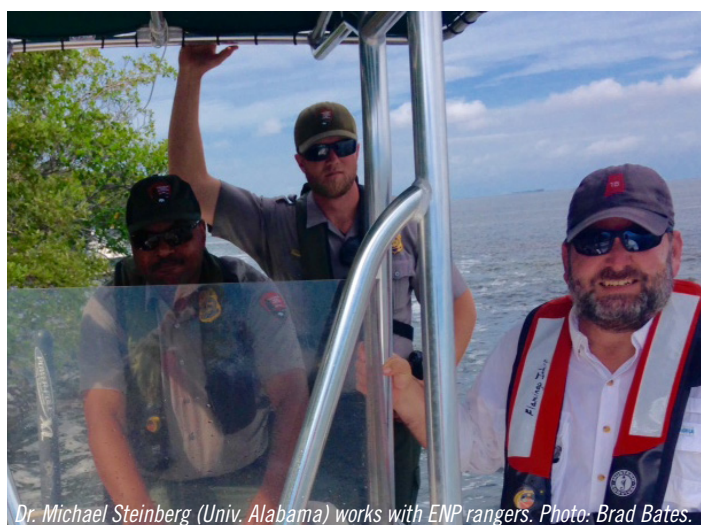
Everglades National Park, Biscayne National Park and the Florida Keys National Marine Sanctuary are rewriting the code for conservation.

If you're in Florida and fishing in marine or estuarine waters south of Chokoloskee and Key Biscayne, you're fishing within a national marine boundary that's currently under conservation management revision.


Everglades National Park, Biscayne National Park and the Florida Keys National Marine Sanctuary are rewriting the code for conservation, all driven by the same motivation that drives BTT, guides, and anglers — degraded habitat and declining fisheries. That's why we collaborate. Over the past three years, BTT has been bringing guides and anglers, scientists and policy makers together to produce essential map data in a novel partnership. Essentially, the product of all that data is a map representation of where guides and anglers fish and the routes they take to get there. In the very near future, BTT will be taking this work to the next level by integrating some of the data into a GPS-friendly platform, making it available to anyone so that access channels and different zones (pole/troll, idle speed) are shown. In doing so, anglers and boaters with a GPS unit will know when to use a push pole or trolling motor, when to idle, and when to stay on plane based on their location. This angler-derived data provides the foundation for reasonable spatial management, research and habitat rehabilitation. It also allows managers and anglers to use conservation tools such as Pole/Troll Zones and Catch-and-Release in lieu of complete closures, which helps maintain access to the fishery while accomplishing larger conservation goals. We can restore habitat and the fishery with better regulations, integrating top-of-the-line technology and stewarding good practices.



Redefining management boundaries in ENP. Photo: Michael Steinberg.



Dr. Michael Steinberg (Univ. Alabama) works with ENP rangers. Photo: Brad Bates.

Over the past year, BTT has been doing everything from helping develop catch-and-release educational tools for Everglades National Park to working with others to get new regulations to protect the declining South Florida barracuda population. Next year is ramping up to be just as busy in the Keys. Our current projects will continue and we will be introducing some new players to the lineup. Fishery restoration is no small feat and it's imperative that our research is broad scale and built on a solid foundation. The Keys Initiative frames research that will lead us toward a healthier flats fishery. Each of the previous, ongoing, and future projects completes an important piece of the puzzle, and guides and anglers are a critical component of our science. If you're interested in being involved in any of our Keys studies, please contact us. Every bit of research we're conducting applies to a better understanding of how to restore our Keys fishery back to what it was "in the good ol' days." 

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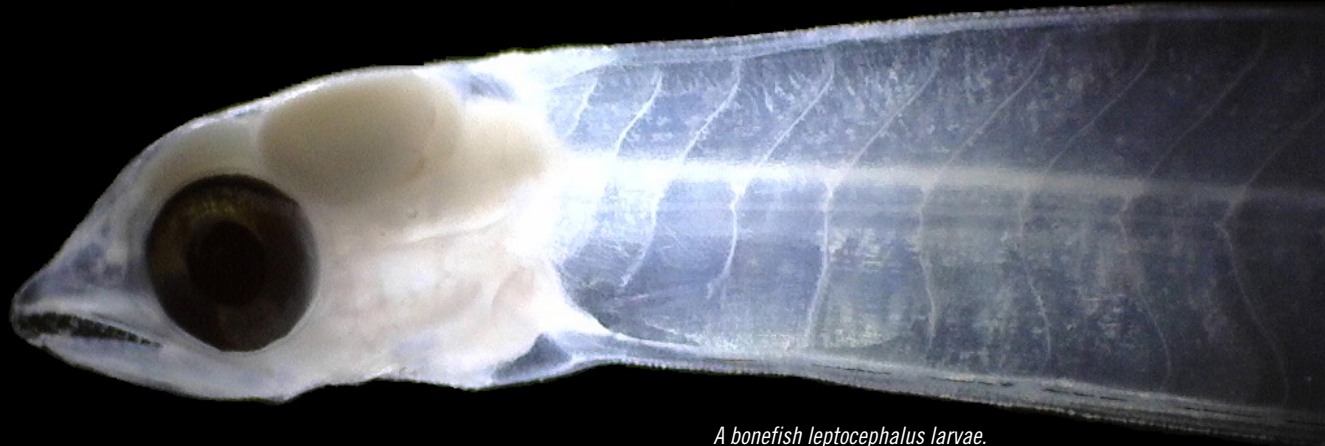
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ANOTHER TOOL FOR THE TOOLBOX:

Decoding Bonefish Reproduction

JON SHENKER, Ph.D. Associate Professor, Florida Institute of Technology

AARON J. ADAMS, Ph.D. Director of Science & Conservation, Bonefish & Tarpon Trust



A bonefish leptocephalus larvae.

Photos by JON SHENKER, Ph.D.

The decline of the Florida Keys bonefish population over the past decades is rather well known. The causes, on the other hand, remain a bit of a mystery. It's likely that changes in water quality, habitats, and other local factors share part of the blame. Certainly, bonefish can't be fully healthy if the water they and their prey live in isn't clean. But it's also quite possible that problems in distant locations factor into the decline as well. For example, we know that bonefish spawn in deep, open water offshore, and that once the larvae hatch from the eggs they drift around in the open ocean as plankton for an average of 53 days before they move inshore and transform into juveniles. This means that bonefish in the Keys could be produced by local spawning or by spawning in distant locations, such as Cuba.

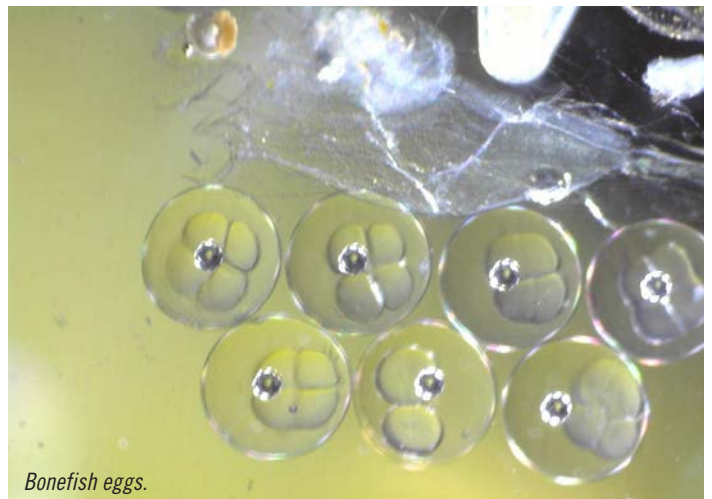
we can formulate restoration strategies. We anticipate that we'll need to push for changes in water management and maybe even habitat restoration. But we're not yet sure of the specifics for these restoration tools. We may also need to work with colleagues in Cuba or other locations to make sure they keep their bonefish populations healthy. In short, we anticipate using many tools from our restoration toolbox in the not too distant future.

The bonefish research will occur in 3 stages:

- 1** Determine how to spawn and raise bonefish in captivity.
- 2** Determine when, where, and how to release bonefish to maximize their survival.
- 3** Implement controlled stocking from a facility in the Florida Keys.

One way to look at this is as if we are doctors in an emergency room. A very sick patient has been brought in, but we don't know why they are sick or what the illness is, just some of the symptoms. As good doctors, our first goal is to identify the illness and then to determine a strategy to get the patient well. For Florida Keys bonefish, we are at the first stage – figuring out the illness and causes. You can read more about some of the work on this in the article on the Florida Keys Initiative in this issue of the Journal.

As we learn the causes of the bonefish population decline,



Bonefish eggs.

However, we are concerned that the Florida Keys bonefish population is at such a low level that even with aggressive water quality, habitat, and other restoration tools, the population won't be able to restore itself to higher abundance without help. So we are embarking on a new program to add another tool to the restoration toolbox. Beginning in 2016, we will be conducting research to determine how to spawn and raise bonefish in captivity so that, if bonefish need help in recovering, we can stock juveniles to help boost the population. Once the population is at a self-sustaining level, we will cease stocking and let the population maintain itself.

In a perfect world, the stocking of bonefish won't be needed. But given experiences in other places where bonefish populations haven't recovered on their own, we need to have this tool in the toolbox. For example, in the 1960s and 1970s, the bonefish fishery on St. Croix, U.S. Virgin Islands was fantastic. There are many reliable and first-hand reports about that fishery. But in the 1970s and 1980s, fisherman used large nets to harvest fish along the shorelines and in the seagrass beds, and virtually wiped out the bonefish population. Despite the fact that nets are only rarely used anymore, by the late 1990s the bonefish population was tiny – bonefish could be caught in only a couple of small bays on the entire island. They didn't recover on their own.


The challenge is that no one has ever been able to successfully spawn bonefish in captivity, or raise them, since their specialized larvae are different than other fish larvae. But, we have learned enough in recent years that we are certain we will be able to meet this challenge. Through ongoing research of bonefish spawning in the Bahamas, we know what bonefish need to spawn and we are learning more about their spawning behaviors. Current advances in fish larval rearing for other difficult species will also help us greatly. In the fall of 2015, BTT received a generous matching grant from the National Fish and Wildlife Foundation to get started in this new endeavor, with research beginning soon.

We're concerned about tarpon too. A recent international assessment of tarpon classified the species as "Vulnerable." This classification means that the tarpon population declined at least 30% in the recent past. This decline occurred for two reasons: 1) Harvest primarily in the Caribbean



Tanks used to rear bonefish.

and Gulf of Mexico in the 1960s and 1970s, though recreational harvest within the United States through the 1980s was also likely a contributor; 2) Past and ongoing habitat loss and degradation. Recent studies have shown that tarpon spawn along the shelf-break off the Florida Keys, off the central west coast of Florida, and south of the Mississippi River mouth. The Deep Water Horizon oil spill in 2010 occurred exactly where tarpon spawning has been detected. Pollution impacts in the Gulf of Mexico, direct alterations and destruction of coastal juvenile fish nursery habitats, and impacts of projected sea level rise on these coastal marshes, make the tarpon population increasingly vulnerable in coming decades.

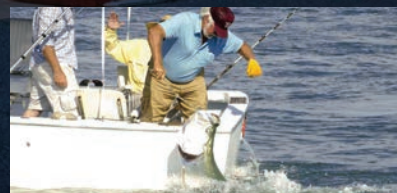
Fortunately, tarpon larvae are just like bonefish larvae, so once we figure out how to raise bonefish larvae, tarpon will quickly follow. As with bonefish, the plan is not to create a permanent stocking program, but instead to give us that additional tool if it is needed. In our fight to restore the flats fishery to its glory days, we'll leave nothing off the table. 

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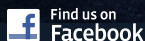
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Tracking Permit in the Florida Keys

Insights on Habitat Use and Connectivity

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Ph.D. Candidate, Carleton University

ANDY DANYLCHUK, Ph.D.

Associate Professor, University of Massachusetts Amherst

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Director of Science & Conservation, Bonefish & Tarpon Trust

Photo: Capt. Bo Sellers.

Understanding the range of habitats fish use is critical for their conservation. For example, we have recently learned there is more to bonefish habitat than where we fish for them - scientific studies have shown that the grey ghost actually spawns in deep waters offshore in The Bahamas, and typically stage in large pre-spawn aggregations in transitional near-shore waters - regions that are also often considered for shoreline development. This type of detailed information can only be identified through rigorous scientific studies, especially since fish are tough to follow without sophisticated tools. Indeed, there have been numerous tracking studies conducted on both bonefish and tarpon using identification, acoustic, and satellite technology, gaining unprecedented insight into their habitat use and connectivity. However, until recently, permit have been the forgotten stepchild of flats fishing science. This is all changing with Costa's Project Permit.


In collaboration with Costa del Mar sunglasses, Florida Fish and Wildlife Conservation Commission (FWC), March Merkin Permit Tournament, Del Brown Permit Tournament, numerous fishing guides, anglers, and lodges, BTT research is examining permit movements using small external dart tags, relying on recaptures to provide information on movement. To date over 1,000 permit have been tagged and 20 recaptured. The majority of recaptures were within 10 miles of the initial tagging location site; however, two fish had moved considerable distances in Florida, the longest being 65 miles from Biscayne Bay to Lake Worth. It seems individual permit may occupy expansive areas of the Florida Keys, and this broader scale connectivity could be important for their conservation and management.

It is particularly important to understand permit movements in Florida due to the nature of its fisheries protection laws. The recently established Special Permit Zone (SPZ) spans the majority of Monroe County - from South of Cape Florida and Cape Sable to past the Dry Tortugas. It places greater limitations on anglers to harvest permit, and completely bans spearfishing for them. This is an important step in protecting this fishery, although it is unclear whether the SPZ protects permit that occupy the

region full time, or whether permit move beyond it, becoming more vulnerable to harvest. It is also uncertain whether permit observed on shipwrecks in the Gulf of Mexico and offshore reefs in the Atlantic Ocean, occasionally targeted by spear fishers, are the same fish that make up the fishery inshore on the flats in the Keys, or if they are permit that exclusively reside offshore.

To address these important questions, BTT, in partnership with FWC, Carleton University, and University of Massachusetts Amherst, is conducting an extensive tracking study on permit in the Lower Florida Keys using an acoustic telemetry system. Permit are being tagged with acoustic transmitters, which emit ultrasonic waves that are recorded by specialized receivers. These receivers, which can be thought of as "listening stations," are placed throughout the Lower Florida Keys across a broad range of habitat types and regions, including on the flats, as well as nearshore reefs and shipwrecks on both the Atlantic Ocean and Gulf of Mexico where permit are known to spawn. The tags will function for over two years, providing extensive, long-term information on permit movements and habitat use. This project will also benefit from the presence of similar acoustic telemetry networks in the greater Florida area, including Integrated Tracking of Aquatic Animals in the Gulf of Mexico (iTAG), and Florida Acoustic Tracking network (FACT) along the Atlantic coast to detect broader scale movements of our tagged permit. These other networks will let us know the extent that permit from the Keys travel outside of the Keys, which will let us know if current management needs to be adjusted.

SPONSOR THE PROJECT! Please visit www.btt.org/JonAinFund to sponsor, or email us at info@bonefishtarpontrust.org for more information.

We need your help catching permit for tagging. We're working in the Lower Keys right now, and hope to expand in the near future. If you are willing to help us catch permit for this study please let us know. 



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Millie Jo Painsi releases a gray ghost back to its old haunt. Jardines de la Reina, Cuba. **Rich Painsi** © 2015 Patagonia, Inc.

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Rubble Flats in the Tropics

AARON J. ADAMS, Ph.D.
 Director of Science & Conservation, Bonefish & Tarpon Trust
 Photos by AARON J. ADAMS, Ph.D.

The habitats most overlooked by flats anglers fishing the Caribbean are rubble flats. It is uncommon to see rubble flats in the background in fishing magazines or web sites, and I rarely see articles about fishing rubble flats. It's too bad, because rubble flats are fantastic habitats to find permit, bonefish, barracuda, jacks, triggerfish, snappers, and small sharks. Good wading boots and knowledge about the habitat and how the fish use it are all you need. And many Caribbean islands have rubble flats that are mostly unfished.

Rubble flats are formed when coral is broken from reefs by storms and waves and deposited in shallow areas. Over time, the rubble builds up, sand fills in the crevices between pieces of broken coral, seagrass grows, and a rubble flat is born. Rubble flats can be split into two major types: backreef and shoreline flats.

Backreef Rubble Flats

Backreef rubble flats occur behind the fringing reef that protects the flat from wave energy and is the source of the rubble that formed the flat. They are sometimes reachable by wading, other times only by water craft like a kayak, paddleboard, or boat. Backreef flats tend to experience a lot of water exchange – water is constantly pushed through and over the reef by incoming waves – and tend to be cooler than the surrounding shallows in summer and warmer in winter. This is because the temperature of the open ocean water pushing onto the flat undergoes less dramatic seasonal changes than shallow water. Water depth is the primary determining factor of whether you will find gamefish on a rubble flat. The two factors most important in determining water depth on backreef rubble flats are tides and waves.

Tides

Tidal range in the Caribbean is generally small, the water level changing a foot or less through a normal tidal cycle. Strong high-pressure systems can cause long periods of low water, and low-pressure systems can cause long periods of high water that override the tides. Even though water depth on rubble flats doesn't seem to change much with tides, gamefish respond to even minor tidal fluctuations just the same. On shallow flats, gamefish may be completely absent at low tide, but may venture far onto the flat in search of food at high tide even though the water depth only changed a few inches.

In general, fishing the backreef flats is best from the latter half of the incoming through the first hour of the outgoing tide. Backreef flats that hold good water throughout the tidal cycle are great places to search for fish at dawn and dusk, regardless of tides. I am not a big fan of early mornings, but when living in the Caribbean I frequently dragged myself out of bed before dawn to walk my favorite backreef flat at first light. Factors that guaranteed an early wakeup call were rising tide, calm seas, and light winds.

Waves

Waves are almost constantly assaulting the outer edge of the reef that protects backreef rubble flats, and the surf pushes water onto the reef. Some of this water is deflected seaward by the coral reef, but some of the water passes over, through, or around the reef and onto the flat. If the reef is relatively deep or the tide is particularly high, a considerable amount of water can push over the reef and create an appreciable current on the flat. Both the wave-induced current and small waves continuing across the flat can dislodge prey hiding among the rubble, and feeding gamefish are usually quick to chase them.

Whether the reef and flat are shallow or not, extended periods with strong surf can increase the water depth more than tides. The constant surf will actually push more water onto the flat than can escape back to sea through cuts and channels in the reef. This results in higher than normal water depths for the duration of the strong surf. Gamefish will often take advantage of these high water periods just as if the high water was due to an extended high tide. The one caveat is that the currents can become too strong, and gamefish—particularly bonefish—will move off the flats entirely.

Strategies for Fishing for Permit

Permit like to come through the reef to access backreef rubble flats, often riding the remnant waves through the reef into the shallow water of the backreef. Once on the flat, permit might encounter especially shallow water. Numerous times I have seen large permit swimming sideways to get through particularly shallow areas, only to rotate back to a vertical position once in deeper water. This is important for two reasons. First, look for cuts in the reef that provide easier access from deeper water outside the reef to the backreef, and focus your efforts on the portions of the flat fed by these cuts. Second, when hooked, permit will probably hightail it right back through the reef into deeper water, and you should be prepared for this.

Once on the flat, permit will cruise, often with their dorsal fin above the water, occasionally stopping to feed, digging their noses into the bottom and flipping their large forked tail into the air. Prey items for permit in these areas include small clams and snails, sea urchins, crabs, and mantis shrimp. After feeding along a stretch of flat, the fish usually head back through the reef to deeper water. In my experience, for any particular flat, permit will feed in the same general pattern. They will cross the reef in specific areas, travel along the flat in the same direction, and feed more actively on some sections of the flat than others, often at the same time in the tidal cycle. Intriguingly, an individual permit's feeding pattern will often persist on the flat for a few days, and as long as you don't spook a fish while trying to catch it, you can return the next day and have a decent shot at finding the fish again until conditions change.

(Continued, pg. 26)



WHAT WAS YOUR FIRST FISH ON THE FLY?

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A classic view of a backreef rubble flat.



Gray Pitho Crab.

Once you've spotted a permit, the challenge is to present the fly close enough so the fish will see it, but not so close that you spook it. When feeding on the bottom, a permit's circle of vision is limited; they seem to focus on a rather small section of bottom just in front of or directly below their swimming path, so getting the fly close is paramount. This is especially true on the rubble flats where the waves and uneven rubble bottom can limit a permit's range of vision. One option is to cast your fly directly in front of a slowly cruising fish. This approach requires a soft landing of the fly. A second option is to anticipate the path of a cruising fish and cast the fly along this path, well ahead of the fish. As the fish approaches the fly, give it a small twitch. While this approach works well over deeper seagrass, it can be tough on shallow rubble flats. The small waves rolling across the flat will move your fly out of the fish's path, or the fly will settle to the bottom and sink into one of the crevices, never seen by the fish. There is nothing quite as maddening as waiting for a permit to pass by before wading over to un-snag a fly wedged in the rubble.

The third, and best, option is to cast directly in front of or to the side of a feeding, tailing fish, making sure the fly lands so that the waves and current carry the fly toward the permit. Let the fly drop to the bottom. If the permit doesn't react, give the fly a slight twitch, and let it rest. Remember, most of the prey you're imitating won't move much once they think they've been spotted.

Too much movement to a fly will often send a permit in the other direction. To keep the fly from getting snagged in the rubble, use lightly weighted or even unweighted flies.

In all cases, small waves rolling across the flat or wave-induced currents can make fly presentation difficult. There are times when the sea is calm, and the water surface is like a mirror, but the permit are very wary and easily spooked under these conditions unless it's dawn or dusk. It's challenging under all conditions, which is part of what makes fishing for permit on backreef flats so much fun.

If you are lucky enough to hook a permit, you will be faced with the challenge of keeping your leader in one piece as the fish heads to deeper water – probably directly through the coral reef. Of the numerous permit I've hooked on the fly on backreef flats, I've lost most to leaders that were cut on corals.

There are two strategies that have worked, though neither reliably nor frequently. The first is to use a 20-pound or higher test leader and to clamp down on the drag once the fish is hooked. If you are lucky, you'll be able to turn the permit before it reaches the reef and play the fish on the flat or one of the nearby channels. The second strategy is to use a light drag and let the fish run

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Mantis Shrimp.



A mixture of rocky bottom, algae, and seagrass is typical of rubble flats.

through the reef to deeper water.

If you are lucky, the leader, fly line, and backing will make it through unscathed. Once the fish is outside the reef, tighten the drag and wear it out. Once the permit has tired it will come to the surface, and you can work the fish back over the reef onto the flat. Although the second strategy has worked the best for me, it is in bringing the fish back over the reef where I have lost many, due either to bad luck or impatience. Take your time, even though all of your senses will tell you to hurry.

Shoreline Rubble Flats

Shoreline rubble flats lie immediately next to or close to the shoreline, and aren't associated with a protective reef. I believe shoreline rubble flats are formed when large amounts of coral rubble are deposited on and near shore during strong hurricanes. The coral likely comes from reefs farther offshore or from rubble deposited in deeper areas during prior hurricanes, but the hurricane waves are powerful enough to move large amounts of coral rubble to shore. Shoreline rubble flats tend to be smaller than backreef rubble flats. Because they are not protected by reef, shoreline rubble flats are best fished when winds are blowing offshore or seas are calm.

Shoreline rubble flats are the easiest to find and access by the do-it-yourself angler and are common to find as you drive around a Caribbean island. The topography of the land often continues into the water, so pay particular attention to stretches of flat land where the road passes near the water. The road may provide shoreline access to a wadeable shallow-water rubble flat. Flats that are adjacent to busy roads or walkways will be most productive at dawn and dusk, when traffic is low. Fish that are resident in busy areas sometimes adjust to the activity and are not so easily spooked. That doesn't mean these fish will be easy to catch – they might not spook easily, but they might still be picky eaters or wary of poorly presented flies because the flats are accessible enough to be heavily fished.

Fly fishing strategies for fishing these flats will vary. On the narrow flats that parallel the shoreline, I prefer to walk the shoreline searching for signs of fish. Walking on the shore provides a higher vantage point to see fish at a greater distance without worrying about splashing sounds from wading in the water. I can also quickly move to a location down the shoreline should I see tailing fish. And walking the shoreline is definitely easier than negotiating the uneven surface of the submerged rubble. Don't be surprised to see fish right up against the shoreline, especially at high tide or at dawn or dusk. *(Continued, pg. 30)*

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Green Reef Crab.



Sea Urchin.

If you don't see fish after a pass along the shoreline, you may want to wade the middle of the flat just in case fish are there but not visible from shore.

If you don't see fish on your first visit to a flat, try again at a different time of day or at a different point in the tidal cycle. I know of a few flats where large schools of bonefish cruise the rubble zone in the last hour-and-a-half of the incoming tide but are completely absent at other points in the tidal cycle. Still other flats have feeding fish at dawn and dusk, seemingly regardless of the tide.

Gamefish Prey of Rubble Flats

The mixture of rubble, seagrass, and scattered corals supports a diverse mixture of prey. Many of the same species that occur in seagrass also live on rubble flats. However, a few species are especially important prey on rubble flats.

Reef Crabs and Porcelain Crabs

Members of the Spider Crab family (Majidae), feed along the bottom and scurry for the underside of shells and rubble when chased. Reef Crabs (Green Reef Crab (*Mithrax sculptus*) and Tan Reef Crab (*Mithrax coryphe*)) and to a



lesser extent Pitho Crabs (Gray Pitho (*Pitho aculeata*) and Pitho Crab (*Pitho mirabilis*)) top the list and are eaten by bonefish and permit.

The carapace of reef crabs are triangular with rounded edges, while the Pitho crabs are teardrop-shaped, with their eyes at the narrow end of the teardrop. All four species grow to one inch, but are often smaller. The abundance of each species varies among locations, but the Green Reef Crab is usually the most common in shallow rubble flats mixed with seagrass.

When choosing a fly to imitate spider crabs, your choice of color can be simplified to the basics: dark green, brown, or tan, depending upon the species. The Pitho crabs listed here are tan to gray in color, the Green Reef Crab is dark green, and the Tan Reef Crab is tan.


Porcelain crabs (*Family Porcellanidae*) also inhabit shallow rubble flats. The Lined Porcelain Crab (*Petrolisthes galathinus*) is especially abundant on finger corals growing on rubble/seagrass flats. The Lined Porcelain Crab is small (2/3"), medium green, with an oval carapace, and oversized, flattened claws.

When fishing flies that imitate these small crabs, the action you give to the fly should be minimal. All species of walking crabs remain close to shelter and don't scurry over long stretches of open bottom when chased. At most you may want to give the fly a couple of twitches to get the attention of the bonefish or permit, and then let the fly sit still.

Mantis Shrimp

Mantis shrimp live in holes among the rubble or shells, or may excavate a burrow in the sand. Most mantis shrimp are colored to match their habitat. When living among sparse seagrass with coral rubble or open sand bottom, the Golden Mantis (*Pseudosquilla ciliata*) is tan in coloration. The Rock Mantis (*Gonodactylus oerstedii*) is usually dark green or black, but also varies to match its habitat, and is mostly found among rock and coral crevices. Mantis shrimp usually don't venture far from their burrows, and are most active at night, but enough are active during the day that permit eat them. When chased, their defense posture is to turn and face their adversary while retreating backward toward their burrow. While these species of mantis shrimp can reach four inches, usually only the smaller mantis shrimp are eaten by bonefish and permit.

Sea Urchins

Yes, you read that correctly – permit and bonefish eat sea urchins. I've watched them do it, and urchin spines show up in permit and bonefish diet studies done on rubble habitats. This is definitely the most untapped prey group by fly anglers. Urchin flies are tough to fish – urchins live on the bottom, their tube feet keeping them attached – but they are eaten enough by permit and bonefish that urchin flies should be more common, at least for anglers who fish rubble flats. If urchins are present on the flat, you'll find out by picking up small pieces of rubble – you'll find small urchins on the underside – or you'll see the tips of the spines sticking out of holes or crevices. It's the small urchins in the genus *Echinometra* that are permit and bonefish prey. Common colors are red, black, and purple. Permit and bonefish will use their noses to try to dislodge urchins, but sometimes they get lucky and find urchins that have been dislodged from rubble by wave action. 



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Shining a Light on Juvenile Bonefish

PETRA SZEKERES

M.Sc. Candidate, Fish Ecology and Conservation Physiology Laboratory, Carleton University

Photos by PETRA SZEKERES

Light pollution is one of the fastest growing forms of pollution worldwide, increasing at a rate of 6% per year globally. Despite this growing number, it is also one of the most overlooked forms of pollution. This is especially troubling given the negative impacts of light pollution on many species.

What is light pollution? Light pollution is the pollution of the naturally dark night sky by means of inefficient and wasteful lighting, where up to 60% of the light is scattered up into the night sky rather than directed downwards for its intended purpose. In addition to being inefficient, this has negative consequences in the natural world. This is because nearly all living organisms have evolved in the presence of normal day-night cycle, which help to control metabolism, growth and behaviour.

Consequences of light pollution can extend from the individual level to entire ecosystems; these implications range from disturbances to predator-prey relationships, orientation, foraging, migration, reproduction, and communication. Ecological light pollution has previously been shown to affect different mammals, birds, reptiles, amphibians and insects. And

now we know that it affects fish as well.

Near-shore freshwater and marine species suffer from excessive artificial lighting due to coastal development, while offshore species suffer from lighting on bridges, oil platforms, fishing vessels, and cruise ships. Species that inhabit near-shore systems are particularly vulnerable to inefficient lighting caused by coastal development, especially in places like the coast of South Florida, where much of the available shoreline has been developed. To make matters worse, species in the tropics and sub-tropics may be even more sensitive to changes in natural lighting, as these latitudes experience little

variation to day and night-cycles throughout the year. Light pollution along the Florida coastline is a possible stressor for juvenile life stages, since they cannot readily relocate to unlit areas, and could experience higher predation risks if they attempt to leave their near-shore nurseries.

Exhaustive efforts to locate juvenile bonefish along the Florida coastline have been met with little success over the past 10 years, although they are still found along the far-less developed shorelines of The Bahamas.

Juvenile bonefish (*Albula vulpes*) are one such juvenile species in Florida that rely on near-shore habitats where they spend their time in shallow water, and are therefore directly subjected to coastal lighting and development. Exhaustive efforts to locate juvenile bonefish along the Florida coastline have been met with little success over the past 10 years, although they are still found along the far-less developed shorelines of The Bahamas.

To learn whether light pollution affected juvenile bonefish, and thus might explain the lack of juvenile bonefish in the Florida Keys, we conducted an experiment that considered two factors. Firstly, researchers considered the physiological stress of fish by examining their glucose levels from a blood sample (glucose is considered a reliable indicator of fish stress). Glucose levels become elevated when an organism experiences a “fight or flight” moment and they need a jolt of energy to help them combat the threat.

To assess glucose levels, researchers used three treatment groups: (i) night control; (ii) constant light; and (iii) intermittent light. Night control did not experience any artificial lighting, only lighting that occurred naturally. In contrast, the constant light group was exposed to constant light using a high-pressure sodium light to simulate a streetlight; and the intermittent group was exposed to intermittently on-and-off H4 halogen light, to simulate the headlights of a passing car. These two light sources were chosen because they are the most ecologically relevant sources of light pollution that juvenile bonefish are likely to experience along the coastline of the Florida Keys.

Secondly, researchers conducted behaviour experiments on juvenile bonefish to determine whether their activity levels were altered during periods of light exposure. This was completed with the above three treatment groups, as well as an additional treatment of a day control, which was simply looking at fish activity during the day.



Lighting rig and holding tank.



Capturing juvenile bonefish.



Juvenile bonefish were collected from nearby near-shore, shallow habitats and transported back to the wet lab at the Cape Eleuthera Institute (CEI), where they were left to acclimate in large flow-through tanks before the experiments began. Results suggest that the fish that did not undergo any light treatment and remained in darkness (i.e. the night controls) had the lowest levels of blood glucose, and thus lowest levels of stress. This group behaved as a baseline, or control group, and their blood glucose is what you would expect for a fish in normal conditions.

By contrast, both the light treatment groups (constant and intermittent) had higher blood glucose than the control group, suggesting they experienced elevated stress during the light exposures. The constant light treatment had glucose levels 25% higher than the controls on average,

while the intermittent light treatment had glucose levels 33% higher than the controls on average. Additional analyses are ongoing, so stay tuned.

For assessing whether light pollution had an impact on the behaviour and activity of juvenile bonefish, they were individually put in long tanks and videotaped for the duration of each trial. During video analysis, the distance the fish travelled was quantified, as well as the number of times they turned, burst-swam or froze. Preliminary analyses suggest that light pollution did not affect juvenile bonefish activity levels; however, analysis is ongoing. Future research to address the consequences of light pollution on juvenile bonefish may give us insight into their uneven distribution, and give managers the information necessary to implement mitigation strategies to alleviate the effects of scattered near-shore light pollution. 🐟

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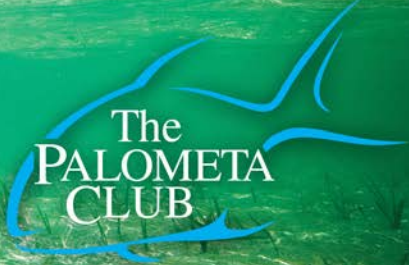
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The Guides Know

TOM KARROW

Ph.D. Candidate, University of Waterloo
 Research Fellow, College of the Bahamas



Photos by TOM KARROW

“Ground Truthing.” Learning from a master while on the flats of Northern Grand Bahama. Stanley Glinton pointing out vital habitat to verify mapping efforts.

Throughout Bonefish & Tarpon Trust’s conservation efforts in the Bahamas, working with fishing guides has been a main focus. Matching the guides’ on-water knowledge with scientific research has made the progress we have achieved thus far possible. To further this collaboration with guides, in 2014, BTT undertook an ambitious project; formally documenting the historical knowledge of senior Bahamian guides to put today’s Bahamian fishery in a historical context. Are there as many bonefish as there used to be, are bonefish now as big as they used to be, have the habitats changed, do the guides know about any spawning locations? The answers to these questions will provide important information for conservation and for the future of the Bahamas fishery.

This project expands on similar efforts by BTT in the Florida Keys, where BTT scientists worked with fishing guides to identify the areas most important to the fishery so that BTT can focus on these areas for conservation and ensure access in light of pending changes to management. In the Bahamas, I am working with long-time guides to establish an historical population baseline, identify the locations where the fishery occurred, and identify important areas such as spawning sites. This historical information provides a baseline for comparison with today’s fishery, which is vital for assessing the health of the fishery and the extent that the fishery has changed.



Ansil Saunders highlighting key bonefish habitat on Bimini.


The first phase of this project took place in 2014, when more than 20 guides on Grand Bahama were interviewed. The guiding experience of participants ranged from seven to 50 years, (the most years by the legendary David Pinder, Sr.), and they came from all across the island.

The interviews with long-time Grand Bahama guides revealed that the bonefish population today is smaller than they feel it was historically. And although younger guides indicated that bonefish have become more abundant in recent years, the population is still not what it once was.

This difference in perception by older and younger guides is an example of the “Shifting Baseline Syndrome,” which essentially means that the younger guides with less experience perceive today’s fishery as “normal,” when in reality someone with a longer experience can point to changes that have occurred. This is a common inter-generational problem – each new generation accepts their experience as normal, and fails to incorporate the experiences of previous generations. This is a great example of why this study is needed – so that we can ensure that the knowledge of previous generations of guides is not lost, and is used to protect and improve the fishery.

In contrast to the bonefish population, all guides agreed that the permit population has increased significantly in recent years. No one knows why this is occurring, but there are no complaints.

In 2015, I interviewed guides on Bimini. Although there were only four guides, they had over 50 years of experience. As on Grand Bahama, the Bimini guides have seen a significant decline in bonefish numbers over time, and an increase in permit abundance in recent years.

This ongoing study is now shifting to Abaco, the Exumas, and Andros. Through formal consultation and collaboration with Bahamian guides, chronicling their experiences and knowledge, a better understanding of fragile ecosystems and the precious fisheries resources we all love will result. Perhaps more important, by engaging the guides and using their knowledge to conserve the fishery, they are becoming more involved in conservation of the bonefish fishery, which can have only positive results. 



Meeting guides at Deep Water Cay in 2014. Meko Glinton, Harry Rolle, Mervin Thomas, Shervin Tate and Joseph Pinder discussing habitat threats with Dr. David Phillips and Tom Karrow.



Legendary guide David Pinder, Sr. on Grand Bahama talks with Tom Karrow about bonefish populations in the 50's.



Tom Karrow and Ansil Saunders discussing habitat mapping on Bimini. Participatory mapping will then be added to a GIS for scientific scrutiny.



Working with Joseph Pinder at Deep Water Cay on Grand Bahama on Permit habitat in the East End.

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The Bahamas Initiative

JUSTIN LEWIS, M.S.

Bahamas Initiative Program Manager, Bonefish & Tarpon Trust

The Bahamas Initiative is a collaborative multi-year effort by Bonefish & Tarpon Trust (BTT), the Fisheries Conservation Foundation (FCF), and Cape Eleuthera Institute (CEI) to conserve and protect bonefish populations and habitats in The Bahamas. Since the primary threat to the Bahamas bonefish fishery is habitat loss and degradation, the first goal of the Bahamas Initiative is to use scientific information to identify bonefish home ranges, juvenile habitat, spawning locations, and spawning migration pathways. In conjunction with fishing guides, lodge owners, collaborating NGO's, and The Bahamas Government, the information from the scientific effort is applied to habitat conservation plans. In an important recent victory, BTT and Bahamian collaborators worked with The Bahamas Government to establish eight National Parks specifically designated to protect bonefish spawning habitat from development. We are now working to identify and protect other critical bonefish habitat.

The overall objectives of the Bahamas Initiative are:

- 1** Determine the population health, economic and biological value of the Bahamas fishery to contribute to conservation of the fishery and habitats.
- 2** Engage fishing guides, lodge owners, and students in conservation education using research as an education tool.
- 3** Assist fishing guides, lodge owners, and the Bahamas government in the formulation of a fishery conservation plan for bonefish and their habitats.

BONEFISH TAGGING

The purpose of the bonefish tag-recapture program is to identify bonefish movements, home ranges, and habitat use. The bonefish tag-recapture program started in 2009 and is in its sixth year. Over 11,000 bonefish have been tagged and close to 600 recaptures have been reported. By analyzing the tag-recapture data, we have been able to determine that bonefish have small home ranges, as the majority (72%) of recaptures occur within a kilometer of where the fish were initially tagged.

The recapture data also shows that bonefish are able to travel long distances, particularly around the new and full moons during spawning season, which runs from October to April. One fish that was tagged in a south Abaco spawning school was recaptured 18 months later on the north side of Grand Bahama, a total distance of 136 miles traveled. There are also examples of



Photo by Justin Lewis.

bonefish making long distance trips from the marls on the West side of Abaco to southern Abaco, which is more than 140 miles round-trip. This information has significant conservation implications. If there was a human disturbance such as a hotel or marina development on or near a bonefish flat, it could displace resident fish on that flat due to loss of habitat, poor water quality, or lack of food. In the case of migration pathways, if a causeway or fisherman's net blocks them, it could negatively impact local populations. Since each spawning site serves a large portion of an island's bonefish population, the loss or damage of a spawning site could have island-wide impacts.

YETI'S BONEFISH & TARPON GENETICS PROGRAM

In 2014, BTT initiated a three-year bonefish and tarpon genetics study, in collaboration with the Florida Fish and Wildlife Conservation Commission, to determine the extent that bonefish and tarpon populations within The Bahamas, wider Caribbean and the United States are interconnected. Genetic samples come in the form of small fin clips for bonefish and a single scale for tarpon, which will be used for genetic analysis. Our efforts to collect genetics samples are going well, and we continue to collect samples to achieve our goal. The information gathered will help us determine the connectivity of bonefish and tarpon populations throughout the region, so it is important that we collect as many geographically diverse samples as possible. The results of this will help us determine the extent to which management has to be local or regional. If we find that most bonefish on one Bahamian island are spawned on a different Bahamian island, focusing on local conservation won't be sufficient – conservation would have to be Bahamas-wide.

BONEFISH SPAWNING

Working with our Bahamas Initiative collaborators, guides, lodges and colleagues at the University of Massachusetts Amherst and Florida Institute of Technology, we have identified four spawning sites on the Islands of Abaco, Eleuthera, and Grand Bahama. We are closing in on another site on South Andros. (Continued pg. 38)

Private island paradise.



Exhibit A.

Photograph by Benjamin Gossett

Anglers have come to Deep Water Cay since 1958 for its legendary flats fishing and to take their places alongside their fathers and grandfathers and some of the world's most famous anglers.

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Studies on bonefish spawning behaviour in Abaco and Eleuthera have shown that prior to spawning, bonefish group up in protected bays that are close to open water. This is called a pre-spawning aggregation, with schools ranging from a few hundred to upwards of 10,000 fish. During the day, fish will be tightly packed, swimming in slow circles together throughout the water column. As the sun goes down the fish become more active, gulping air and porpoising (jumping out of the water). This behaviour is believed to prepare them for deep water. Once the sun sets, they head offshore to depths of 180 feet or more. After an hour or two at depth, they quickly rush toward the surface, which we believe is when they release their eggs and sperm in what is called broadcast spawning.



BTT's Bahamas Initiative Manager, Justin Lewis, teaching a student in Grand Cay, Abaco best handling practices for bonefish. Photo by Cassandra Bonnie Abraham.



Justin Lewis, discussing the fishery on Grand Bahama Island with the guides and lodge owner of East End Lodge. Photo by Ian Davis.



BTT and Fisheries Conservation Foundation (FCF) working together to catch bonefish for an acoustic telemetry study in Grand Bahama Island. Photo by Justin Lewis.

Recent studies on Grand Bahama identified multiple pre-spawning aggregation sites and the pathways bonefish use to get to and from these sites from their home ranges. This was done through a combination of tag-recapture, acoustic telemetry, and visual observations.

These sites are key to the continued health of the bonefish populations in The Bahamas. Pre-spawning aggregation sites are vulnerable and under threat from proposed marinas, sand mining and commercial fishing. We have to maintain spawning sites if the Bahamas bonefish fishery is to remain healthy.

In the fall of 2015, The Bahamas government announced the designation of 18 new national parks. Eight of the parks were chosen for the purpose of protecting bonefish and their habitats, as well as the many other species that utilize the flats. This victory was a direct result of research and conservation efforts of BTT and our collaborators. To date, only 10 percent of the Bahamian marine environment is protected, which means there is still a lot of work to be done.

JUVENILE BONEFISH


Very little was known about juvenile bonefish until 2012, when BTT partnered with the University of Massachusetts Amherst and CEI. The three-year study discovered that juvenile bonefish prefer large, shallow, semi-protected bays of sand or silty-sand, and were found to co-occur with another small inshore fish called a mottled mojarra. Juvenile bonefish and mojarra look very similar, making it hard to distinguish from one another. By mixing with schools of mojarra, bonefish are likely able to avoid being eaten, a behaviour known as social mimicry.

Unfortunately the inshore areas that juvenile bonefish utilize are also sought out by developers for resorts and marinas, and are under threat from infrastructure development, like roads, that could fragment vital juvenile habitat or increase polluted runoff. If a juvenile nursery is disturbed or destroyed by one of these factors, it could negatively impact the health and sustainability of the local population far into the future.

EDUCATION & OUTREACH

Education and outreach are essential components of a successful conservation program. Many of our outreach efforts are aimed at fishing guides, lodges and anglers to inform them about the work we are doing around The Bahamas. It is also crucial that Bahamian youth know how important bonefish and their habitats are to the Bahamian marine environment and economy. Over the past year, education and outreach has increased threefold, with plans to grow even more over the next few years. This includes giving presentations, hosting field trips, presenting to schools and participating in camps.

LOOKING FORWARD

Moving forward, we will continue to conduct science in support of conservation in The Bahamas. We are expanding tag-recapture and spawning site identification to other islands and are collecting as many genetics samples as we can. The information from this work will help us protect bonefish populations and their habitats in The Bahamas for generations to come. Our education and outreach efforts targeting anglers, guides, lodges, and schools will continue to grow and expand in conjunction with our research efforts, all in an effort to preserve the bonefish fishery. 

If you are interested in participating in YETI's Genetics Program, please contact info@bonefishtarpontrust.org to request your bonefish or tarpon genetics kit.

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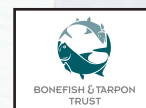


BTT is a membership-based organization, and our members are our lifeblood. Since our founding in 1998, we have grown to include concerned anglers from over 20 countries, researchers from throughout the world, and guides committed to working with BTT in order to educate anglers and gather data while on the water. Nearly 90 cents out of every dollar you donate goes directly to our mission: research, outreach and education.

Our continued success can only be guaranteed by your generous support.

We have celebrated so many victories, but there is so much more work to do. We need your support to do it! A stronger membership base equates to added research dollars and more voices to benefit bonefish, tarpon, permit, and their valuable habitats.

Please help us in our mission by joining, and urging your friends, guides, lodges, and fishing clubs to join. Depending on the level selected, members will receive new BTT items that include a T-shirt with artwork by Derek DeYoung, new BTT hats, rods and reels, plus big discounts on orders from Patagonia. Please fill out and mail in the form below or go to www.btt.org and click "Join BTT" to become a member today.



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Photo: Aaron J. Adams, Ph.D.

Bonefish & Tarpon Trust has embarked on a multi-year effort called the Bonefish and Tarpon Genetics Program, generously sponsored by YETI Coolers. The goal of this program is to determine the extent that local populations of tarpon and bonefish throughout the region are related. For tarpon - this covers the Caribbean Sea, Gulf of Mexico, and southeastern United States; for bonefish - the Caribbean Sea, Florida, and Bahamas. For each species, we want to answer the question: does the region have a single population, multiple independent populations, or multiple connected populations? Knowing this information is essential for helping BTT prioritize the research and conservation actions that will be most effective.

HOW CONNECTIONS HAPPEN

Based on our knowledge of bonefish and tarpon, there are two ways that populations in different locations can be connected.

Tarpon can be connected by adult migration or larval transport. Tagging studies have shown that some adults migrate long distances, which provides a regional connection, but some adults stay close to home, which suggests local sub-populations. We don't know yet which is more common. If most tarpon have a relatively small home turf, many spawning groups may exist.

The larval connection comes because tarpon spawn offshore, and the larvae that hatch from their eggs remain in ocean currents for approximately 20 to 30 days before they change shape into their juvenile form as they enter mangrove swamp nursery habitats. Larvae could be carried back to the mangrove swamps close to the spawning area, or carried down-current to locations far away. For example, in a study in 2002, scientists collected

tarpon larvae in Sebastian Inlet, on the central east coast of Florida. They determined how many days old the larvae were by counting the number of growth rings in the otoliths (aka ear bones), and then used data on oceanographic currents to backtrack how far the currents likely carried the larvae, and from where. Many of the larvae were probably

spawned off the central Gulf of Mexico coast of Florida a few weeks prior.

There is little evidence to suggest that adult bonefish undergo the long distance seasonal migrations of some adult tarpon. Instead, bonefish migrations are associated with spawning. Tag-recapture data indicates that bonefish have small home ranges, but that they are capable of long-distance migrations to spawning sites. For example, on Abaco we've tracked bonefish migrating 140 miles roundtrip to a spawning ground. It is likely that just one or a few spawning grounds are used by bonefish on the entire island.



Taking a fin clip sample. Photo: Dan Dow.

The most likely mode for bonefish populations to be connected is by larvae. Once bonefish get to the spawning site, they move offshore to spawn. The larvae that hatch from the eggs are in the open ocean for an average of 53 days, in ocean currents that could circle them back to where their parents came from, or take them far away. Juvenile bonefish can occasionally be found as far north as New England, carried there as larvae by the strong current of the Gulf Stream. Recently, The Nature Conservancy collected a juvenile bonefish in Rhode Island. These fish unfortunately don't survive long, due to the cold water temperatures.

WHY IT MATTERS

This matters because if there is a single, large population, then a negative impact in one location (such as the loss of juvenile habitats, harvest of adults, or loss of a spawning location) would have impacts on the populations and fisheries for the entire region. For example, if a significant portion of bonefish larvae arriving in the Florida Keys and growing into juveniles and then adults are coming from Cuba, then management of the Cuban bonefish fishery is important to the health of the Keys fishery. This Keys-specific question is a big reason why we are funding the genetic program - we need to know why the bonefish fishery declined before we can figure out a way to fix it, and there is a decent chance that regional management will be a part of the solution.

For each species, we want to answer the question:

Does the region have a single population, multiple independent populations, or multiple connected populations?



Photo: Aaron J. Adams, Ph.D.



Photo: Dan Dow.

If, however, there are multiple regional populations that aren't well connected, then the best approach would be to prioritize conservation measures for each region. For example, in one region the greatest threat to tarpon might be harvest, but in another region the greatest threat might be loss of juvenile habitats. In this scenario, rather than devise a one-size-fits-all strategy, each region would have its own conservation approach.

Given recent scientific advances, genetic analysis is the best approach to address this important issue.

HOW YOU CAN HELP

We are asking anglers and guides who fish for bonefish and tarpon to collect tissue samples from the fish they catch (a scale for tarpon, a fin clip for bonefish), and then submit the samples to us for analysis.


Thank you to those who have already sent in samples – our total number of samples grows every week, so keep them coming. While the number of samples already collected is good, larger numbers are extremely important to address these challenging questions in a meaningful way.

To receive a bonefish or tarpon sampling kit, please send an email to us at info@bonefishtarpontrust.org. It's not every day that anglers are able to participate in such meaningful research, so please take part.

PATIENCE WILL PAY OFF

What will be the answer? To paraphrase Einstein – if we knew the answer it wouldn't be called research.

As anglers and guides send in samples, they often follow up a few weeks later asking about the results. Due to the nature of these studies, results will not be available until the end of the program in late 2016. The data is comparative, meaning all individuals (collected from throughout the region) must be analyzed together. Unfortunately, it is not possible to analyze smaller subsets early on. In fact, any such early analyses would likely be flawed and could suggest an incorrect result. These studies have been designed to provide the best possible information to resolve these important population connectivity questions. The results will be a critical part of management and restoration plans moving forward. It is important that we get it right – in the end it will be worth the wait.

So go fishing – *please!* And take a sampling kit with you. 



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The *Indian River* Lagoon



MIKE HODGE is a freelance outdoor writer who lives and fishes in Florida
Photos by AARON J. ADAMS, Ph.D.

Ten years ago I began my fly-fishing quest in Florida. It started in the hallowed waters of the Indian River Lagoon. Seagrass and oysters abounded. During a half day on the water, I saw enough redfish to leave town frustrated over my lack of saltwater savvy.

Over time, I honed my skills elsewhere: the waters of Homosassa, the mud and marsh of St. Augustine and the lush turtle grass of Tampa Bay. Last year, I returned to the Lagoon armed with more skill and confidence, but found few sparring partners and sketchy habitat.

So I picked up the phone in search of answers. The first call was to Frank Catino, who has guided on the Lagoon for more than 40 years and also happens to be the Mayor of Satellite Beach, a small town just east of the Indian River Lagoon. I asked about the overall water quality.

“Poor at best,” Catino said.

Most of Catino’s day-to-day fishing runs from Oak Hill to Fort Pierce. I looked south and called upon Mike Holliday in Stuart. The long-time guide’s assessment was less than rosy. “Last year, the year before, I’d say there’s a fifth of the grass that used to be there,” said Holliday, who is also a nationally known outdoors writer. “It’s a huge number. Because the grass isn’t there, you don’t have the juvenile baitfish. You don’t have the predator fish. Initially, when the grass dies, you have pinfish, mojarras, and there’s nowhere for them to hide. Then you get to winter, you get the bluefish that come in the inlets as well as the jack crevalle. They basically go across a flat and wipe it out. No forage fish. It’s horrible.”

The Indian River Lagoon stretches from Ponce Inlet to Jupiter Inlet, and nearly every inch of the Atlantic Coast watershed is struggling to maintain quality habitat.

The problems of the 156-mile Lagoon can be divided by geography, and the genesis of the water-quality issues vary by region. The central and northern sections of the Lagoon have been plagued by storm water, septic and assorted runoff issues.

One of the biggest blows came in 2011 when the Lagoon lost 60 percent of its seagrass after a massive algae bloom drew national attention to the estuary. Scientists are still searching for answers for what happened and why. The algae bloom was attributed to a combination of drought and unseasonably cold weather, and even that assessment has been debated. The overall health of the Lagoon is even more complex.

“Through the history of Florida and the European descendants, the Lagoon has been altered over and over again, causeways, dredge-and-fill canals,” said Orlando-area guide John Kumiski. “The watershed is three times bigger now than it originally was when Columbus got here because of all of the drainage that goes in there and it’s got no flow. So, if you drain all these parking lots, streets, golf courses, lawns and septic tanks into the Lagoon, all that stuff stays there. Then you remove all the native vegetation by doing all the dredge-and-fill things. Any filtering you had in there has been reduced enormously. The clammers take all the clams. The oysters are removed and sponges, too, and you have all these things that used to filter the water that aren’t there anymore. Now you have all these fertilizers and pesticides, and if you get the right environmental conditions, hot weather, yeah, things grow. There’s nothing there to remove them and you’ve got a problem. It’s a hard problem to solve. There are so many little things, and so many have been done in the past, it’s basically irreversible now. You’ve got a housing development on Sykes Creek. People live there. How are you going to fix that?”

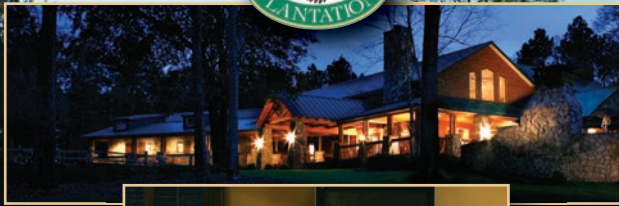
Catino attributed the huge seagrass loss to a culmination of poor water management.

“It wasn’t just that one event,” Catino said. “That event was interesting, because before that event no one cared about the Lagoon. When pelicans fall out of the sky and manatees and dolphins die, then all of a sudden you’ve got a problem. We had a problem a long time ago. Nobody cared enough to do anything about it.”

Numbers vary, but the reported 2013 death toll totaled approximately 450 pelicans, dolphins and manatees. In 2014, multiple fish kills were reported near Merritt Island, a perfect storm of carnage that led to big headlines and outrage.

Apathy is not an obstacle for those who live near the southern Lagoon, which historically has been blasted by flood-control discharges from Lake Okeechobee. The result: too much freshwater, phosphorous and nitrogen. Oysters have been a primary casualty. Some studies have estimated an 80 percent historical decline of oyster reefs in the St. Lucie Estuary. Why is this important? Because an adult oyster can filter up to 50 gallons of water in a single day.

“The sediment’s so thick that it’s built a layer up,” Holliday said. “Where the water (from the discharge) may be here for a month or two or three, the sediment’s here all the time. The philosophy is the ocean is this infinite resource we can pump all of our crap into. Over time, the path to the ocean is destroyed.” (Continued, pg. 44)



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The solution, Holliday said, starts with sending the Lake Okechobee water south where it can be stored, cleaned and routed to the Everglades.

“Water needs to go south,” Holliday said. “Everyone knows it. Everyone. The Everglades are drying up. It used to be the River of Grass. It comes down to water. When there’s not enough water, and they’re selling it, it’s like what California is going through. It’s directly related to not allowing the water to flow.”

Fellow Stuart guide Mike Conner agrees.

“The only way to change the situation, best bang for the buck, is to acquire land to store and clean water,” said Conner, one of the state’s most ardent conservationists. “All of that water is diverted and wasted in our neck of the woods, so the Lagoon is trashed. We need none of it. They (the Everglades) need all of it they can get.”

The “Send-the-Water-South” bandwagon got derailed last spring when South Florida water managers rejected the proposal to purchase land needed to store freshwater; a decision that Conner believes doesn’t leave many viable options. “Pray for drought,” he said.

Economically there’s a lot at stake. Not just for anglers, but for everyone. According to the St. Johns River Water Management District, the Indian River Lagoon accounts for \$3.7 million in annual economic value, not to mention millions in property values for anyone in the five-county area that lives within a roll cast of the Lagoon.

“You’ve got to look at the economic impact of the small-business owners,” said Catino. “Look at the people who run eco-tours on the Lagoon. There’s a lot of (non-fishing) that’s related to it. Property values go down if the Lagoon is a body of water that’s polluted or a bad health hazard. You want to live in a healthy environment. You (don’t) want to live on a body of water that’s polluted.”




The value of the area isn’t as strong.”

Conservationists often disagree about the Lagoon’s problems. For instance, some blame local runoff; others point to the Okeechobee discharges. But nearly everyone agrees that progress can be generated by individual accountability.

“If everyone who lived in the watershed cared, then it could be fixed,” said Kumiski, who helped organize the IRL Paddle Adventure, an event designed to raise money and awareness about the Lagoon’s plight. “Most people don’t care. They just moved here and it’s great. They think it’s wonderful, paradise compared to where they came from. It was a lot better 30 years ago, but they don’t know that because they weren’t here 30 years ago. They don’t understand because they don’t know what they’ve lost already.”

Can it be healed?

“Every little bit helps,” Catino said. “That’s where every individual has to figure out how they can help. I think Mother Nature can fix a lot of things if we give her a chance. We as a society have to become better stewards.” 



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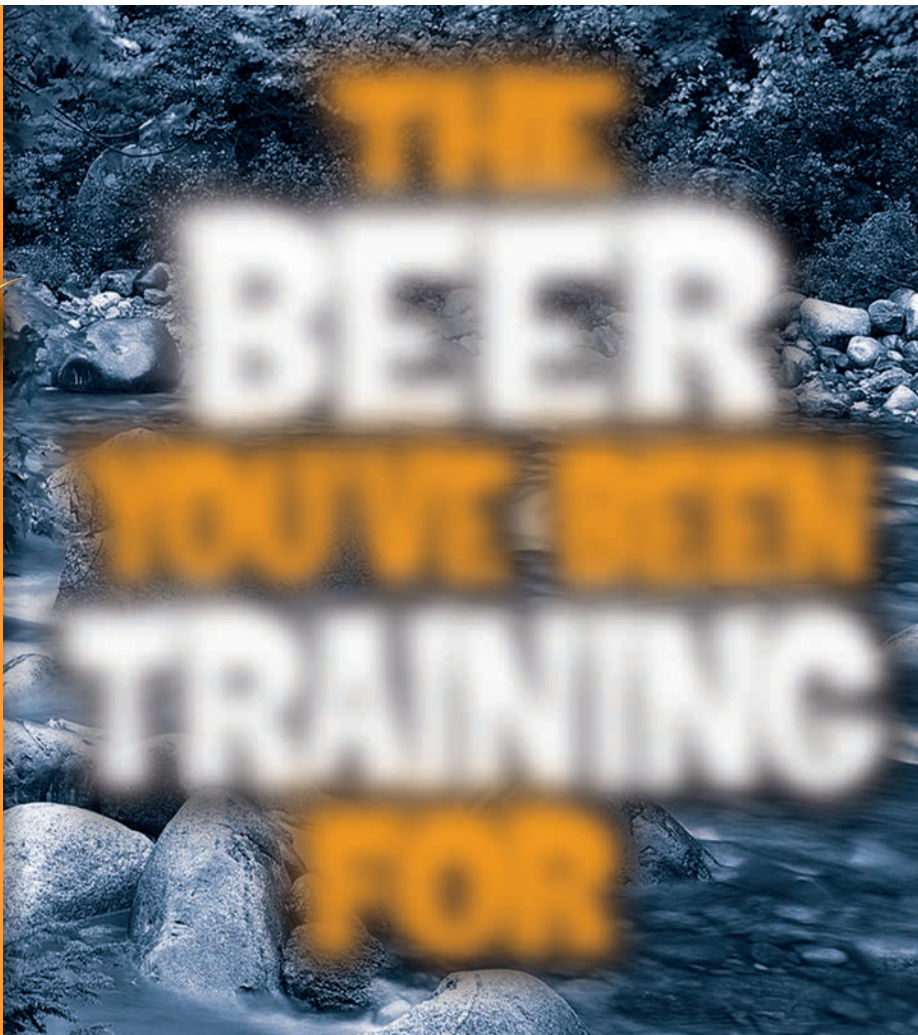
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2016 BTT

Artist of the Year

Kent Ullberg

Kent Ullberg has been a fisherman all his life, from his childhood in a remote fishing village on Sweden's Atlantic coast to his current home by the Gulf of Mexico on Padre Island, Texas. Over the years he's had the privilege of exploring fish and diving grounds such as Cocos Island, Panama, the Great Barrier Reef and others with his good friend Dr. Guy Harvey.

Ullberg states, "I will always be attracted to the sea, both as a fisherman and an artist; of all the works I have created at least half of them are marine related."

Amongst a number of other impressive works, Ullberg created "SAILFISH IN THREE STAGES OF ASCENDING," the marine conservation monument in front of the Broward Convention Center in Fort Lauderdale, Florida. In 1998 he was chosen to sculpt "SWORD DANCE," the stainless steel signature monument greeting visitors at the IGFA Headquarter's entrance in Dania Beach.

But not all of his work is monumental: sculptures run the gamut from monumental to miniature and are executed in both bronze and stainless steel. They are highly regarded for their scientific accuracy and impeccable craftsmanship. Many distinguished IGFA world record holders are proud owners of Ullberg trophies. He takes special pride in providing museum quality art into the world of his favorite sport.

Ullberg is a member of the University of Texas Marine Science Institute Advisory Board and a major contributor to many wildlife conservation efforts.



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Cuba Connections

AARON J. ADAMS, Ph.D.
 Director of Science & Conservation, Bonefish & Tarpon Trust
 Originally published in *Fly Fishing America*

Photos by AARON J. ADAMS, Ph.D.

If the plane takes the right path on the flight from Havana to Miami, a passenger sitting in the window seat on the right side of the aircraft can see the Florida Keys ahead and Cuba behind with just a turn of the head. Key West and Havana are only 90 miles apart as the crow flies, but light years apart in so many human terms. It only takes a few minutes on the streets of Old Havana, or Trinidad, or Santa Clara, however, to realize that we're more similar than different, and instill some hope for a better future for the natural resources that we share.

The image that likely identifies Cuba for most Americans is the photo of a 1950s Chevrolet on the Malecón in Old Havana. But is the engine an original Chevy, or perhaps a Mitsubishi, or maybe a mixture of engine block and parts from many different car models? Like you might expect from a large and diverse island nation, the reality is complex.

The flats fishery – where it occurs, the quality, how it is managed – is no less complex. And in some ways we are just beginning to realize that Cuba's flats fishery is likely linked to the fishery in Florida, and probably has links throughout the Caribbean.

A priority issue for BTT is to answer these questions:

- 1** How far apart are Cuba and Florida in fish terms?
- 2** And to what extent does Florida's flats fishery depend on Cuba?

habitats are in great shape. As long as these management regulations remain in place, the flats fishery should continue to thrive.



A happy angler releasing a bonefish.

However, outside of these protected areas, the situation is not so rosy. On a 2015 trip to an unprotected location on the south coast of Cuba, it took us days to find just a dozen or so bonefish, apparently because intensive netting had all but wiped out the local bonefish population. Visits to other unprotected areas found similar results.

Cuba's culture holds many mysteries for Americans. Its flats fishery is no less mysterious in the world of conservation.

Part of the impetus for YET's Bonefish Genetics Program was what we witnessed on another trip – large-scale netting that appeared to target bonefish spawning aggregations had all but wiped out the local bonefish population. We spoke with numerous guides who fish the location frequently, all of whom reported large net boats working the flats and nearby channels and targeting bonefish. Since bonefish larvae float in the open ocean as plankton for about 53 days, the trip from Cuba to the Florida Keys would be an easy one. The question is – how many of the larval bonefish coming into the Keys were spawned in Cuba? For that matter, how many of the bonefish in the Yucatan, Cayman Islands, or other locations have origins in Cuba? How many of Cuba's bonefish were spawned farther east in the Caribbean? Cuba's culture holds many mysteries for Americans. Its flat fishery is no less mysterious in the world of conservation.

To the best of my knowledge, fish don't engage in politics. They have no respect for international boundaries or the rules that those boundaries impose. Given that both Florida and Cuba are faced with conservation challenges, a priority issue for BTT is to answer these questions: How far apart are Cuba and Florida in fish terms? And to what extent does Florida's flats fishery depend on Cuba?



Education is important for the future of the fishery. Here, local kids learn fly casting – perhaps the next generation of flats fishing guides.



Shallow mangrove flats that see limited fishing pressure and no pollution.



Information exchange is critical for conservation of the flats fishery.



Crystal clear water and healthy habitats support a healthy flats fishery in the protected fishing areas.

To address these questions, BTT is conducting the bonefish and tarpon genetics program. Genetic analysis of the fin and scale samples collected by anglers in Cuba, Florida, the Bahamas, Belize, and elsewhere in the Caribbean will help us determine whether, and to what extent, bonefish and tarpon populations in different locations are connected (see the article on the genetics project in this issue of the Journal for more details).

BTT is working with colleagues in Cuba to answer these and other questions, with the goal of improving bonefish, tarpon, and permit conservation for the region. Our hope is that we can learn from each other's successes and challenges to find a strong conservation strategy for all. 🐟

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The advertisement features a close-up of a purple and blue fishing reel with yellow and blue fishing line. The reel has "OMEGA" and "MADE IN USA" printed on it. In the background, a person's hand is visible, holding the reel. The background is a soft, out-of-focus green. The hashtag "#ANGLINGINSPIRED" is prominently displayed in the upper right. The Allen Fly Fishing logo and website are at the bottom right.

Bonefish 101: GETTING SCHOOLED IN

THE RECORD BOOKS

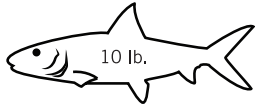
Oldest Bonefish Recorded: 21 years old (Florida Keys) and 20 years old (Bahamas)

- Bonefish are aged by counting annual growth rings of otoliths (ear bones), just like growth rings on a tree. Older doesn't necessarily mean larger fish!

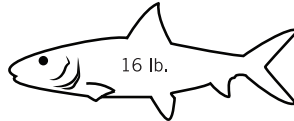
Greatest Distance Traveled: A tagged fish swam 146 miles round trip

- Pine Point, Abaco to Cormorant Point, Grand Bahama (during spawning season)

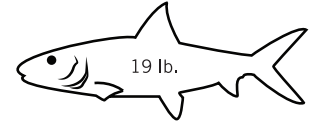
IGFA All-Tackle Records:



Roundjaw bonefish (*A. glossodonta*)
Hawaii, 2013

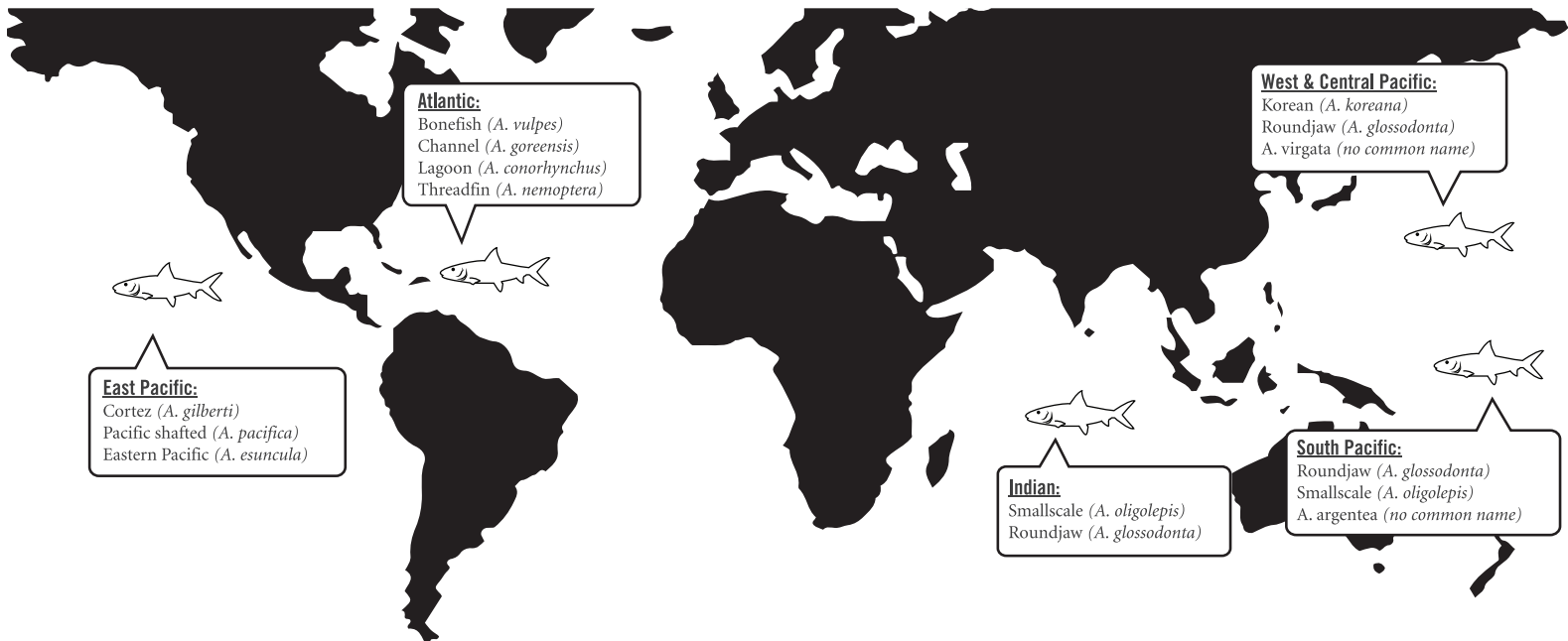


Bonefish (*Albula vulpes*)
Bimini, 1971



Smallscale bonefish (*A. oligolepis*)
South Africa, 1962

BONEFISH DIVERSITY - 12 SPECIES IN THE GENUS ALBULA



BONEFISH LIFE CYCLE



Wittenrich

Bonefish get busy in deep water

- Gulping air before going offshore to spawn likely helps with buoyancy.
- When spawning, they dive deeper in the water before rushing to the surface, and the pressure squeezes out eggs and sperm.

Bonefish have a leptocephalus larvae

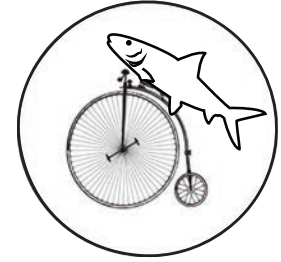
- Roughly 1,000 species have this type of larvae (including tarpon, ladyfish & eels).
- For *Albula vulpes*, this stage lasts about two months, followed by a 10-day metamorphosis into a juvenile, which looks just like a mini adult.



HOW COOL IS THAT?

Energy Saving Behaviors

- Bonefish will actively swim followed by drifting--just like you would pedal a bike, then let momentum carry you...



Body Composition

- Adult bonefish consist of 72% water, 21% protein, 4% ash, & 3% lipids.
- Most protein is stored in their muscles, similar to salmon – helping make them excellent swimmers.



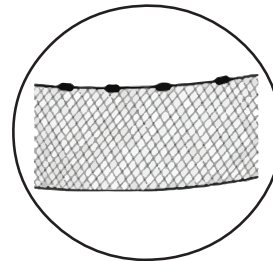
Temperature Tolerances

- An adult bonefish used to waters around 86°F can handle water temperatures up to 100°F!

THREATS TO THE FISHERY

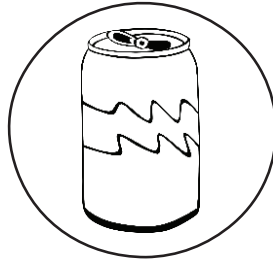


HABITAT LOSS

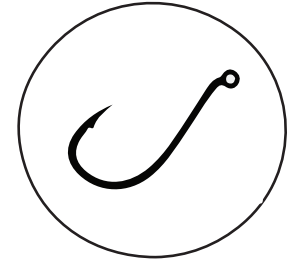


ILLEGAL NETTING

HABITAT DEGRADATION



IMPROPER HANDLING



BEST HANDLING PRACTICES

When angling, remember these tips:

- Aim to “keep ‘em wet” – bonefish cannot breath out of the water.
- When handling fish, remove sun gloves & have wet hands. Avoid oxybenzone-containing sunscreen on your hands – it removes their protective slime.
- Use the proper size tackle for the size fish you’re catching to minimize fight time. Barbless hooks make removal easier & increase fish survival.
- If there are lots of predators around – consider fishing elsewhere.

Indo-Pacific Bonefishes

What We've Learned and What's Next?

LIZ WALLACE, Ph.D.

Post-Doctoral Researcher
Fish and Wildlife Research Institute
Florida Fish and Wildlife Conservation Commission

Any serious bonefish junkie knows of (and if they're lucky has fished) the premier destinations of the Indo-Pacific. The fisheries in Hawaii and Kiritimati (Christmas Island) are well known. Good Pacific bonefishing can also be found in the Cook Islands, New Caledonia, French Polynesia, and Lord Howe Island. The Seychelles, in the Indian Ocean, are famous for bonefishing. Good fishing is also found in South Africa and Western Australia. In fact, bonefishes occur across the global tropics. Pretty much anywhere that coastal flats habitat exists, you are likely to find bonefish. Perhaps more interesting, and more important for bonefish conservation, is WHO among the bonefish family you are catching. That depends on where you fish...

On a flat near Exmouth, Western Australia. Photo credit: Liz Wallace, Ph.D.

We've learned a lot about bonefish diversity in the last few years. Eight species occur in the Indo-Pacific (Table 1). That's a lot of territory, about 2/3 of the planet, so it isn't surprising that several distinct species exist across this vast area. What makes studying diversity in bonefishes challenging is their similar appearance. Scientists refer to this as conserved morphology, meaning the features typically used to identify species (such as color, body shape, fin locations, fin ray counts) are not helpful for distinguishing bonefishes. Instead we need to use genetic analysis to positively identify species. This technique is very accurate and useful for determining species as well as for assessing population structure within a species.

What makes studying diversity in bonefishes challenging is their similar appearance. Scientists refer to this as conserved morphology, meaning the features typically used to identify species are not helpful for distinguishing bonefishes. Instead we need to use genetic analysis to positively identify species.

Understanding both species diversity and population structure is important for management and conservation.

If you fish in the Pacific Ocean, who you catch will vary among the western, eastern, and southern regions. The Korean bonefish (*Albula koreana*) is restricted to the western Pacific. Three species are restricted to the eastern Pacific, along the coastal Americas: the Eastern Pacific bonefish (*A. esuncula*), Cortez bonefish (*A. gilberti*), and Pacific shafted bonefish (*A. pacifica*). One species, *A. virgata*, is only documented



Photo credit: Liz Wallace, Ph.D.

from Hawaii. However, we don't yet know if it is a true Hawaiian endemic (found nowhere else) or if it may occur at low densities elsewhere in the central Pacific. *Albula argentea* occurs in the western and southern Pacific. Two other species, the roundjaw bonefish (*A. glossodonta*) and the smallscale bonefish (*A. oligolepis*), occur in both the Indian and Pacific Oceans. The IGFA All-Tackle record was likely a smallscale bonefish; it weighed in at 19 lbs. and was caught off the eastern South African coast. The roundjaw bonefish has the greatest range, occurring from the Seychelles in the Indian Ocean to Hawaii in the central Pacific.

What does all of this mean for the Indo-Pacific fishery? The observed level of diversity and species ranges mean multiple bonefishes are supporting the fishery in the region. In some locations, we know multiple species coexist.

For example, two species occur in Hawaiian waters: *A. virgata* and the roundjaw (*A. glossodonta*). *Albula virgata* may use deeper water habitat than *A. glossodonta* (similar to depth partitioning between *A. gorensis* and *A. vulpes* in the Atlantic). In the Seychelles, the smallscale and roundjaw bonefishes likely coexist. The fish we've analyzed have been roundjaw, but unverified reports suggest the smallscale also occurs there. However we don't have enough information yet to determine fishery composition at local scales - that will require additional data collection. This is a critical information need, as it may result in higher fishing pressure for the roundjaw bonefish (due to its broad range and use of shallow flats habitat). It is on the IUCN Red List as Vulnerable, due to high rates of habitat loss and population declines in some areas. The smallscale bonefish is currently data deficient, meaning that the essential information needed to assess their conservation status is not yet available. The six other Indo-Pacific bonefishes have not been evaluated, and additional data is needed in order to determine their status.




There are good reasons to be concerned about the Indo-Pacific bonefishes. They have received much less research attention than *A. vulpes*, the species supporting the Caribbean and Atlantic fishery. As a result, there is much we don't know about them. While the recreational fishery is low-impact catch and release, harvest of Indo-Pacific bonefishes (for subsistence and commercial sale) also occurs. The level of harvest is intense in some locations, and largely unregulated. Bonefish are easy targets for netting, since they live in shallow coastal water and can form large schools. In the Pacific island nation of Kiribati, only one spawning group is thought to remain due to overharvest (Johannes and Yeeting 2000). The roundjaw bonefish was listed as one of the top three most depleted fishes (Bunce et al. 2008).



Bonefish from the Arabian Gulf. Species unknown. Photo credit: Laith Jawad.

What is needed to conserve the premier bonefishing of the Indo-Pacific? Three important things: research, management, and you. Research is required to determine which species are supporting the fishery at local scales, and assess population structure for those species. This information is vital to establish where and on whom management and conservation actions should focus. Across the Indo-Pacific marine resource management is typically limited to reserves, and enforcement is difficult. Local action is needed to prevent further coastal habitat loss (especially mangroves) and encourage sustainable fishing practices.

release fisheries can be good conservation tools, and bonefish anglers provide significant income for local communities. However, across much of the Indo-Pacific these fisheries are poorly developed. Where feasible, the development of additional catch and release fisheries would provide an economic incentive for bonefish conservation in the region. 

What can you do? Besides supporting research and conservation efforts through a Bonefish & Tarpon Trust membership, **go fishing!** Catch and

TABLE 1. INDO-PACIFIC BONEFISH SPECIES

| COMMON NAME | SPECIES | REPORTED RANGE |
|--------------------------|---------------------------|---|
| Korean bonefish | <i>Albula koreana</i> | Western Pacific |
| Eastern Pacific bonefish | <i>Albula esuncula</i> | Eastern Pacific |
| Cortez bonefish | <i>Albula gilberti</i> | Eastern Pacific |
| Pacific shafted bonefish | <i>Albula pacifica</i> | Eastern Pacific |
| none | <i>Albula virgata</i> | Hawaii |
| none | <i>Albula argentea</i> | Western & South Pacific |
| Roundjaw bonefish | <i>Albula glossodonta</i> | Indian Ocean, Western & Central Pacific |
| Smallscale bonefish | <i>Albula oligolepis</i> | Indian Ocean & Western Pacific |

Campeche Baby Tarpon:

FISHING IN THE NAME OF SCIENCE

ALEX LOVETT-WOODSUM Director of Development & Communications, Bonefish & Tarpon Trust

Originally published in TAIL Fly Fishing Magazine

Everyone told Charles he was deranged when he announced plans to retire and relocate to Campeche, Mexico to learn Spanish and fish for tarpon. Granted, he is an enigmatic bon-vivant type who spent much of his life bouncing from place to place before settling into a successful career and life in Atlanta. His wanderlust persisted and he satisfied it with consistent fishing and hunting trips around the world. He was determined to learn Spanish and figured that in his seventies, full immersion was the only option. On many occasions he raved about his trips there and how magical the fishery was, so I had to see for myself.

I anticipated Campeche being a quaint fishing village and it turned out to be anything but. A historic walled city on the Western Coast of the Yucatan first settled by the Spanish in the early 1500s, it is a charming mix of old and new. The city is filled with fabulous restaurants, shops, gorgeous hotels and beautiful old buildings crowned by a magnificent cathedral. As you get farther outside the historic district, there is a smattering of Starbucks, Wal Mart, Home Depot and many other surprising infringements from the United States. And it is by all accounts a remarkable fishery.

My main fascination with visiting is that Tarpon Town—the very accurate moniker given to it by Raul Castaneda who runs one of the fishing operations there—is home to one of the most prolific and unique juvenile tarpon nurseries on earth. The Bonefish and Tarpon Trust side of me is fascinated by the science behind tarpon; where they come from, how far they travel in a lifetime, where they spawn, how long they live. I brought a number of tarpon scale sample kits from BTT to contribute to the genetics study we are currently conducting, which will help determine tarpon population connectivity, and in turn will aid management strategies. We know that many tarpon migrate great distances, the question is how interconnected are the tarpon that we catch in Mexico, or in Florida, or in South Carolina? It is probable that some of the tiny juvenile tarpon flourishing in and around the creeks in Campeche, Mexico are seen and caught many years later during one of the famous tarpon migrations.

Raul picks us up in his truck each morning before sunrise and we make the short trip from our hotel to the marina where guides wait in 23' pangas to whisk us off. Many of the fishing spots are along mangrove shorelines and in narrow creeks and inlets. Much of the habitat is very similar to what I see in



Photo: Pat Ford.

the Florida Keys and the Everglades, but other than hoards of small tarpon and some snook, barracuda and baitfish, there are very few other species around like sharks, making it an ideal juvenile tarpon habitat—lots of food, healthy and plentiful mangroves for shelter, and very few predators.

I marvel that the guides can pole these large boats with heavy wooden push poles since I have trouble enough with my light skiff and a graphite pole. They are good at spotting tarpon and we get to fish a variety of different habitat and scenarios, casting to large schools of tarpon cruising along shorelines, smaller groups roaming in shallow creeks and kicking up a trail of silt as they charge after our flies, and tiny silver fish rolling in the blink of an eye in tannic mangrove creeks. We get as many scale samples as we can from the fish we manage to land—holding the fish in the water and quickly and carefully pulling one tiny scale with pliers before releasing them. My guide the first day is very excited about helping with the science and at one point when there is utter chaos with both anglers doubled up for over an hour, he systematically pulls a scale from each fish and places them in a line on the chair, muttering in Spanish to remind himself the size of each of the fish for when we have time to breathe and place each scale in an envelope and record the data. Most of the fish in the inshore and creek areas are around 5-10 pounds with a few in the 15-20 pound range.



Photo: Aaron J. Adams, Ph.D.



Photo: Eric Schoenborn.

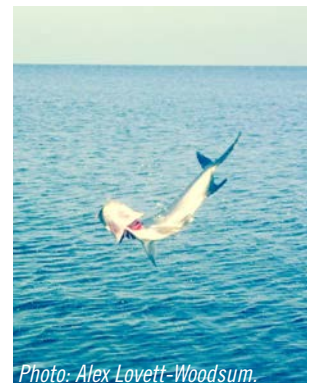


Photo: Alex Lovett-Woodsum.



Photo: Pat Ford.



Photo: Alex Lovett-Woodsum.




Photo: Raul Castaneda.

In the afternoon, the boats run straight offshore for thirty minutes. We are a bit confused the first day when the boats shut down seemingly in the middle of nowhere, with no visible land in any direction. After a few minutes of silence, we begin to see the telltale silver flash of tarpon rolling, and the unmistakable, frenetic splash of them free jumping. As far as the eye can see, there are fish rolling. The water is deep enough that the guide's arm is often submerged as he poles the boat, and yet we are surrounded by thousands of tarpon in the 15-40 pound range, which is unlike anything I've ever seen. Standing on the casting deck I am able to see down into the clear water and there are fish swimming calmly by the boat in every direction. I am not calm, and begin frantically casting in every direction.

Despite having lived there for just over a month, Charles already seems to know everyone in town ("That's my barber Elasio, he's 82!") and greets them all enthusiastically in Spanish—a work in progress. He is a magnificent tour guide, having talked to everyone and found all of the best restaurants, coffee shops, stores and anything else you could need in the city. We spend three days fishing, eating and drinking until our bellies ache. Over the course of the trip, we each catch more fish than we can count and return to the U.S. with a pile of envelopes containing tarpon scales that will be sent to the lab so their DNA can be analyzed.

A few weeks later I am back on the bow of a skiff in the Keys, fishing with Albert Ponzoa, an old friend and guide who taught me how to double haul back in the

day. We are looking for tarpon of the much larger variety in the backcountry, where sometimes all you see is a slight color change or the tiniest flick of movement betraying a laid up fish. After a slow start to the day chasing elusive rollers that always seem to be just out of range, we get in the zone and manage to jump ten fish over fifty pounds, many well over 100.

As the day is winding down and glare is making it even tougher to see fish, we catch a glimpse of a leviathan swimming towards us down deep. I manage a near-perfect cast—a rarity—and twitch the fly ever so slightly (probably just my hands trembling violently). The fish charges out of the depths, half of her massive head breaching the surface to devour my fly, and somehow I manage to set the hook properly. She violently jumps and takes off and before we know it, she is a few hundred yards away jumping in the distance and I'm about to run out of backing. Albert scrambles down from the poling platform and starts the motor just as the last of the backing is about to peel off my reel. After making the long initial run, the fish wears herself out fairly quickly and we bring her boat side. Albert grips her mouth carefully as we remove the fly and take a few quick pictures of her in the water. I am totally awestruck seeing this behemoth fish up close, staring up with those impossibly large eyes. She is by far the largest tarpon I've ever caught, and more than twice my age. As the fish swims off and disappears into the depths, all I can think about is where she came from and the many miles she may have traveled to wind up on the end of my line. Through BTT's tarpon genetics program, we should be able to unlock some of those mysteries soon. 



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Juvenile Tarpon Habitat Initiative

The Future of Tarpon

JOELLEN K. WILSON, M.S.

Juvenile Tarpon Habitat Program Manager, Bonefish & Tarpon Trust

Some of us have been lucky enough to experience catching our first tarpon – sweaty palms, shortness of breath, more jitters than a first date. When you finally make an acceptable cast, there’s that first burst through the water, a flip in the air and the fight begins. Most of you are probably picturing a tarpon the size of a surfboard, but did you know the little guys can be just as exciting and sometimes even more difficult to catch? That’s because juvenile tarpon habitat is often far into difficult to navigate mangrove-lined creeks with stagnant water and tidal mixing – think smelly, buggy and mucky. These habitats are also typically in close proximity to humans where coastal development is overtaking mangrove forests at an alarming rate and degrading essential juvenile tarpon habitat. The juvenile stage of the tarpon life cycle provides an essential link to the adult fishery, and the purpose of BTT’s Juvenile Tarpon Habitat Initiative is to identify, protect and restore juvenile tarpon habitat to ensure the future of the tarpon fishery.

Tarpon are a prized saltwater fish that can live in excess of 80 years, grow to more than 250 pounds and are sought after by recreational anglers throughout the tarpon’s geographic range.

The first step toward protecting and restoring habitats is to identify juvenile tarpon habitat requirements. Unfortunately, there is little information on what specific environmental factors make a good nursery habitat for juvenile tarpon. BTT is currently working in multiple locations to determine what habitat characteristics are essential and thus what are the best ways to successfully restore juvenile tarpon habitat.

Once we get on the right path for restoration, we can restore at a faster pace and with less monitoring.

The first juvenile tarpon habitat project for BTT was at Wildflower Preserve in Placida, FL. This was a collaboration with Lemon Bay conservancy, which owns the Wildflower property. Wildflower consists of a series of golf course ponds that were left abandoned in the 1960s, but are tidally connected to a nearby estuary through a culvert. Although juvenile tarpon were present



Photo: Jamie Darrow.

in the ponds, the goal of this study was to determine if the habitat was actually healthy. We fin clipped smaller tarpon for genetic identification and larger fish were tagged with PIT tags – similar to pet microchips – so we could track survival and growth. The PIT tags also allowed us to track tarpon movement in and out of the system using a passive antenna array that recorded the unique PIT tag identification number, date, and time of the fish swimming through the culvert. A two-year long study at Wildflower concluded that these tarpon exhibited little to no growth, which means that when they eventually left the ponds they had a higher chance of being eaten because of their small size. These results likely occurred because the altered habitat did not provide the resources needed (space, food, etc.). Habitat restoration could be the answer to this problem, and we’re doing the research to figure that out. This is bad news for the fishery since the reproductive strategy for tarpon is to produce many juveniles as only a few will survive to adulthood. Therefore, high mortality at early life stages can have an exponentially negative impact on the adult population.



Photo: Eric Haffey.

BTT’s second project – Coral Creek in Rotonda, FL – takes restoration a step further by experimenting with different habitat restoration designs to see which works best for juvenile tarpon and snook. Coral Creek is comprised of a series of six canals that were originally dug to provide saltwater access for residential home sites, but were deserted when funding fell through.



WE NEED YOUR HELP!

You can help protect the tarpon fishery for future generations by contacting BTT if you're aware of juvenile tarpon (24" and under) populations in your area. All information will remain 100 percent confidential. Please contact us at www.btt.org or jwilson@bonefishtarpontrust.org with information.

Photo: Ryan Rice.

The canals are arranged parallel to one another with a single perpendicular feeder canal that connects all of them (think of aisles in a grocery store that dead end). The six canals vary tremendously from each other, and each one is inhabited by a very different assortment of fish species. We have been tagging juvenile tarpon and snook with PIT tags so we can track their movements through the canal system using a group of antenna arrays. The goal of the Coral Creek restoration project is to determine which habitat restoration design is best for juvenile tarpon and snook survival and growth. The results of this project will help us as we move forward with more projects.

The Indian River Lagoon on Florida's east coast is an estuary that has been highly manipulated by coastal development. Mosquito impoundments were created along the lagoon to provide deeper water canals that prevent the production of mosquitoes during the breeding season. The culverts that connect the impoundments to the estuary allow larval and juvenile tarpon and snook to enter the impoundments, and they can become trapped in the impoundments as juveniles. BTT is working with Florida Institute of Technology to examine whether changing how culverts are opened and closed will increase survival of juvenile tarpon and snook. Juvenile tarpon and snook are being tagged within an impoundment, and will be tracked by antenna at the culverts to determine if they survive and are able to leave the impoundment for the estuary. The results of this research will help improve how these impoundments are managed so that they become better tarpon and snook nursery habitats.




Tarpon use a variety of habitats, including coastal, estuarine, offshore, rivers and wetlands. Photo: Matt Kimball.

Increasing reports of juvenile tarpon in wetland impoundments and coastal ponds in South Carolina have resulted in new work by BTT in that region. Based on reports, we know that juvenile tarpon are in wetland impoundments in the fall, the question is whether they can survive the winter and become part of the regional population. BTT started a study



Photo: Matt Kimball.

in 2015 with University of South Carolina that will monitor tarpon in the field, supplemented with laboratory experiments. Fieldwork will take place at the Tom Yawkey Wildlife Center (aka South Island) near Georgetown, SC, which is comprised of a patchwork of controlled impoundments that are traditionally managed for waterfowl. Three pairs of impoundments (six total) were selected for the study, and water levels in each pair will be manipulated differently – standard procedure, open to tidal exchange, kept constantly deep – to see which gives tarpon the best chances for surviving the winter. Along with the field experiment, our USC collaborators will be analyzing temperature tolerances for juvenile tarpon in the laboratory by gradually manipulating the temperature and duration. If juvenile tarpon can in fact survive South Carolina winters, BTT will extend research efforts to other locations outside of South Island that are currently inhabited by juvenile tarpon.

As we work to figure out the best ways to restore juvenile tarpon habitat, the next step is building a map of juvenile tarpon locations. BTT is excited to announce the next project of the Juvenile Tarpon Habitat Initiative – Habitat Mapping. The purpose of habitat mapping is to identify current juvenile tarpon habitats throughout the southeastern United States and the Caribbean. We can then prioritize protection and restoration of these habitats, which will help to ensure the future of the fishery. The continuation of coastal development will only diminish what is left of the already limited nursery habitat and a heavy decline at this life stage may not be evident in the adult population for decades – and restoration would be too little, too late. 

Belize - Challenges & Opportunities

MICHAEL STEINBERG, Ph.D.
New College and Department of Geography, University of Alabama

Photo: Michael Steinberg.

Belize contains all the ingredients of the ideal fly-fishing vacation destination. Within minutes of stepping off the plane, you can begin fishing in muddy, mangrove-lined, mainland rivers for snook and tarpon; then, travelling due east you can target bonefish and permit on the sand and turtle grass flats; then you might hit tarpon again around the many offshore cayes and cobalt channels; then end the day on the longest barrier reef in the Western Hemisphere with its vast array of fish species in gin clear waters. This is not an unrealistic fishing scenario, given Belize's compact geography and easy access to a plethora of diverse habitats and game fish.

Belize is equally appealing to non-angling partners given the snorkeling and diving opportunities, diverse tropical rainforests, and dozens of Mayan ruins, such as Lamanai and Lubantuun, scattered throughout the country. Belize is also easily accessible from the United States with daily flights from Atlanta, Houston, and Miami that take less than three hours from take off to touch down. So while we all might fantasize about trips to an unnamed atoll in the South Pacific, it's nice to be able to leave home in the morning and be casting to fish in the afternoon.

Given the outstanding angling and non-angling activities, it's not surprising that the tourism industry has boomed in Belize. For example, in the mid-1990s, less than 150,000 foreign tourists visited Belize. By 2014 this number had more than doubled to above 300,000. When I first visited San Pedro on Ambergris Caye in 1990, there were no cars and no paved roads. Today, San Pedro is a bustling small city with plenty of paved roads and vehicles. The number of visitors arriving on cruise ships has expanded even more. Belize hosted 986,131 cruise ship visitors in 2014, a 43 percent increase over 2013 alone. Belize's cruise ship arrivals are expected to continue to expand with the opening of Norwegian Cruise Line's \$50 million Harvest Caye development.

Partly in response to growing pressure by the tourism

industry on its marine environments, Belize has designated large sections of its coral reef and associated habitats as protected areas. These reserves have multiple purposes including the protection of the barrier reef from unregulated development, and sustaining the populations of commercial and sport fish. In total, these reserves make up more than 780 square miles. Belize also declared bonefish, tarpon, and permit as catch and release only, a proactive move that was driven by guides and lodges.

However, while the government has initiated the above actions and policies, the marine environment, including important bonefish, tarpon, and permit habitat, continues to be degraded in some locations. This degradation is driven both by the tourism industry and lack of enforcement of marine conservation regulations in marine protected areas. For example, the government has supported the expansion of the cruise ship industry because of its immediate economic benefits. As part of this effort, Harvest Caye, near Placencia, has been destroyed to create a sandy beach caye instead of a natural muddy mangrove caye. According to local guide Eworth Garbutt, the flats around Harvest Caye were once a rich permit fishing ground. Not only was the actual caye completely transformed, but so was a large swath of mangrove forest found adjacent to the caye on the mainland, where pipelines to support the new terminal were built. These mangroves were an important nursery for tarpon and a destination for local guides. Today, the pipeline blocks passage through the mangroves, and surrounding mangroves are dead and barren. As go the habitats, so go the fish.

Smaller-scale examples of tourism-related infrastructure impacting sport-fish exist as well. For example, the mangrove fringe of Rendezvous Caye, once a productive tarpon fishery located just south of South Water Caye Marine Reserve, was destroyed when the island's owner dredged a nearby sandy flat to create a beach. The island has since been abandoned, but the damage is done. Dredging for sand has also occurred on several flats on the west side of Ambergris Caye to build up nearby private islands and developments. During a trip to the caye last year, a small dredging barge worked in the background as I chased a school of small permit with guide Cesar Acosta. According to Acosta, local guides are especially concerned that the building boom will lead to dredging on the extensive sand flats that lie to the east. The area, known as the Savanna, is a feeding ground for both migratory and resident tarpon, and a popular destination for Ambergris guides. The area is unique in Belize because the shallow, clear waters and white sand bottom allow anglers to see tarpon



Tagging. Photo: Barbara Schlichtman.



Coastal damage from development. Photo: Aaron J. Adams, Ph.D.



The author with tarpon. Photo: Cesar Acosta.



Mapping work. Photo: Barbara Schlichtman.



Coastal damage from a shrimp farm. Photo: Aaron J. Adams, Ph.D.

approaching from great distances, providing ample time to foul the fly line as nerves build. These examples are indicative of a larger trend: As the value of cays has skyrocketed, more island mangroves and adjacent flats are transformed or sometimes destroyed. But as all anglers know, if the habitats are lost, so is the fishery.

The second factor that threatens bonefish, tarpon and permit is the use of gill and seine nets in Belizean waters by both Belizean fishermen and those that make the short and illegal journey from Guatemala. Although nets aren't illegal in Belize per se (a major problem in and of itself), their use in marine reserves is illegal, as is selling protected species such as bonefish often caught in the nets. So while it's commendable that Belize has created marine reserves, there seems to be little funding or political will to enforce fisheries regulations.

I have spoken with many guides who can point to specific flats that once housed huge numbers of bonefish that were emptied by seine nets. Bonefish have returned to many of these flats, but not in the same numbers as before the netting. And given bonefish site fidelity, recovery will be very slow. Nets are a major source of frustration for guides who practice sustainable, catch and release angling because one person with one net can singlehandedly diminish a productive flat or river, to the detriment of the fishery.

Gill nets are also set at river mouths during the rainy season, which impacts tarpon and snook. Nets are usually set at dusk and collected at dawn, thereby evading marine patrols in places where patrols take place. Guides I have spoken with rightfully complain that if they are expected to pay license and park fees, fees that are dedicated revenue for the Fisheries Department, then some of those fees need to be spent on patrols to enforce regulations, especially within marine reserves.


Despite the challenges, future remains bright

While I point out several failures regarding the management of bonefish, tarpon, and permit in Belize, the future, overall, remains bright for several reasons. First, even with the recent building boom related to tourism, Belize still contains vast amounts of prime fisheries habitat. If you take a flight from the international airport south to Punta Gorda, you pass over countless flats, cays, channels and rivers that support bonefish, tarpon,

and permit. Many of the best habitats are found in the extensive marine reserves and national parks, with some of these areas having never been visited by an angler. In other areas visited more frequently, guides have initiated managed access policies to limit the number of boats in specific areas so as to minimize our impact on fragile flats.

Second, Belize is home to committed guides and lodges who support sustainable sport fishing. Established lodges such as Belize River Lodge, El Pescador, Garbutts, Belcampo, and Blue Horizon have worked with BTT on tagging and mapping projects and were instrumental in designating bonefish, tarpon and permit as catch and release only. Guides from these and other lodges will also be instrumental to help solve the enforcement issues because they spend the greatest amount of time on the water and know the resource better than anyone. This model already exists in southern Belize where guides from Garbutt's Lodge assist rangers in Payne's Creek National Park, a popular permit destination. Veteran guides such as Lincoln Westby at Blue Horizon Lodge represent virtual encyclopedias of information on not only fish and habitat, but also environmental change and illegal netting. Incorporating this knowledge into future management plans can help safeguard fish stocks in Belize.

Lastly, the number of anglers visiting Belize has increased along with the general growth in tourism. As such, the economic benefits of sport fishing have also increased. While most anglers are focused on fish and not politics, it is important that we support the local guides, who are at the forefront of conservation, and remind the Belizean government and Fisheries Department that regulations should be enforced and that nets represent a direct threat to the future of fishing in Belize. We, the angling community, can have an impact on policy given the importance placed on tourism in Belize. One way to do this is to simply email the Fisheries Department at species@btlnet.net and urge them to protect fish and habitat.

Belize has become a popular sport fishing destination in recent years because of its ample habitat, robust fish populations, and excellent lodges and guides. This part of the tourism economy benefits Belizeans through the creation of high wage jobs as guides, as well as anglers, many of whom may have caught their first bonefish on a fly in Belize. Let's make sure future generations of both anglers and Belizeans have similar opportunities as we do today. 

Looking Through Water with Bob Rich

Despite the backdrop of water and fishing, Islamorada, Florida-based businessman and author Bob Rich Jr. insists he did not set out to write a fishing book when he began *Looking Through Water*. But he acknowledges the powerful and cathartic role the experience of fishing plays in the story and in his own life.



Rich began exploring his love of literature and writing at Williams College and was particularly drawn to search novels by such writers as Hemingway and Melville. Yet his career took him down a very different path, ultimately leading to his roles as President, and later Chairman, of Rich Products, before returning to writing in 2006 with his first book, *Fish Fights*.

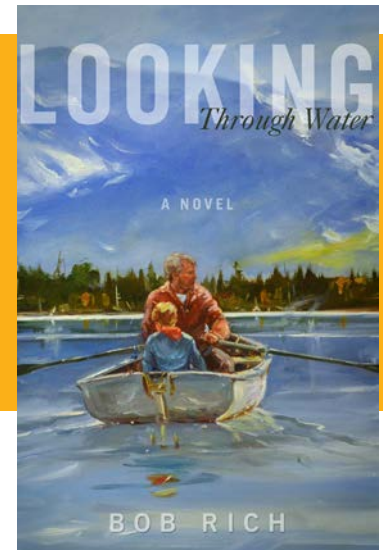
Some of Rich's favorite childhood memories stem from fishing with his father and grandfather—a passion he rediscovered later in life and one that became a central inspiration in all of his books. His first visit to Islamorada came during a period of turmoil in his personal life and helped him chart a new course for the years that followed. The journey began with two bonefish caught on the first day there.

"I'd hear 'old drummers' [salespeople] talk about their Valhalla, their place in the sun, that magic island. Islamorada was my Valhalla," Rich said, describing the flats as a place of mystery and intrigue.

Rich developed his appreciation of nature and got his first insights into how vulnerable the environment was to a host of threats during his time on the water. He has sadly watched the decline of Florida Bay and is concerned about what the future might hold. That future, he believes, will benefit from the work of BTT and its science-based solutions to the challenges facing the fishery as well as the broader engagement of all stakeholders. "There is a time when all lines must intersect, when all people who care about the resource must come together, and often it's crisis driven."

Looking Through Water is more than one man's journey to self-awareness. In his first novel, Rich tells a story that explores the raw emotions that make up the intricate tapestry of family structure. In the novel, William McKay finds himself reliving his past to help his troubled grandson, Kyle, deal with the present. The old man wants desperately to discover what is troubling the boy and hopes that sharing his own tortuous journey to self-discovery will lift him from his dark place. William's story starts on an Adirondacks lake and winds its way through Manhattan to the Florida Keys. Colorful characters from the old man's past come to life to help him tell an unforgettable story full of surprises and suspense. Fueled by nature's fury, men are yanked out of their comfort zones and thrown together to confront life and death. All proceeds from the book will go to Project Healing Waters and its work to aid in the physical and emotional rehabilitation of Veterans. The following is an excerpt from the novel.

"Great Gods and Father of all fishermen," Mrs. Reno began, "we ask for your blessing on this fleet. Keep our captains patient and our anglers humble, the beer cold and the fishing hot, and more than anything else, give us this time to enjoy the beauty of Your creation. Please bless this fleet and bring them all back safely before sundown. Amen."



Amens were murmured from the boats.

"Lines in whenever you wish, but out of the water by three thirty p.m. So without further ado, gentlemen, start your engines!" Eighty outboard motors sprang to life.

At first the skiffs were packed in tight, creating a sea of turbulence with their wakes. Then the fleet thinned out as the captains headed off in different directions, racing to get to their favorite fishing spot on the rising tide. Cole's skiff flew over the water at fifty miles an hour. They'd completely broken away from the pack when Cole threw the boat into a steep sliding right-hand turn to the west and into the beautiful Florida Bay that William had flown over just a few hours earlier.

They ran in silence for about twenty minutes, skimming over the shallow, calm waters with the rising sun on their backs. Their charging boat startled meandering fish and resting seabirds. William was consumed with the beauty of the place. He felt a million miles away from the mean streets of New York, the cold, the treachery, the banquet, the scene, the embarrassment, the gunshot, the lost love. They all seemed to dissolve now in the wake of the speeding skiff.





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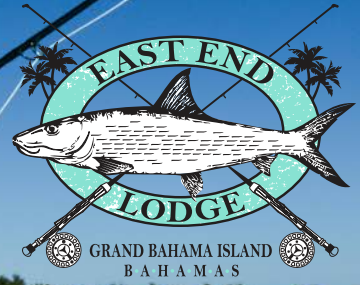
and ethical pursuit of Tarpon and all proceeds of the Tournament are donated to the BTT to help ensure a sustainable future for the Mighty Silver King.



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Tarpon Daze

WITH MONTE BURKE

Photo: Tom Rosenbauer.

One

Pete Frezza, the guide, spots the fish first, as always. It's moving from right to left on your radio dial. Rays of sunlight have just begun to pierce the bruised sky. I take a shot.

"Strip!" Pete says, with emphasis.

Then, under his breath, like a prayer: "Eat it."

The fish alters its route ever so slightly and begins to follow the fly. That great mouth opens wide and...
...a ladyfish zooms in and nails my fly, swerving away from the tarpon's maw at the very last moment.

Then the tarpon turns and inhales the ladyfish.

I'm on, indirectly at least.

The tarpon feels the pressure and jumps, leaving a hole in the water. I have no idea how to play the fish—give it slack or pull on it? So I just hold on. When it jumps again, scales rattling, the line goes limp. I reel in a chewed up ladyfish, unhook it, and then let it go. We're both dazed.

Two

Lefty Kreh has a mount of a tarpon hanging over the couch in his living room. It's a hundred-pounder. Its body is twisted, as if in the act of being angled. I ask him about a story Ted Juracik once told me, about a day in the backcountry when Lefty broke his brand new rod on his first cast. He proceeded to fish out the rest of the day with just the four-feet of rod that was left and caught a dozen baby tarpon. "It's true," Lefty says, with a chuckle. He rubs his eyes, which are the color of Bahamian blue holes. "I like 'em that size," he says. "Not the rods. The tarpon." He points to the tarpon on his wall, above my head. "Those big ones take so long to reel in. Not for Andy Mill, but for the rest of us. Maybe one day Andy will teach me how to do what he does."

Three

The mullet nervously flit and jump all around us, spooked, it seems, by everything, including themselves. It's as if they know they are the ultimate prey. If the Buddha tells you that you will be reincarnated as a mullet, you have clearly committed some grave transgressions in this life. At the very least, they keep things aurally interesting.

Steve Huff extends a finger to point out a laid-up fish. Later, I will wonder just how many fish that finger has pointed out. Steve looks young for his age. That finger and those hands are the only things that betray him. In fact, they actually seem much older, like the tattered end of a wind-beaten flag. They are calloused and deeply scarred and peeling and browned by the sun. They are the hands of a man who has never had an email address, and never will.

The fish is glowing. It appears totally serene. I cast to its nose. It sucks in the fly. Two back-burning, hand-numbing hours later, Steve has the tarpon in those hands. I am embarrassed by the length of time it took me to land the fish. Steve tells me that Billy Pate once fought a tarpon for twelve hours. That takes a bit of the sting out. I tell myself I will get better at this. Maybe one day, Andy Mill will teach me how to do what he does, too.

"If the Buddha tells you that you will be reincarnated as a mullet, you have clearly committed some grave transgressions in this life."



Photo: Dan Decibel.



Photo: Pat Ford.



Photo: Capt. Bo Sellers.

Four

I am pretty much a “love-the-one-you’re-with” kind of fisherman. When I’m flinging a Gaines popper at the shoreline of an Alabama pond for bluegills with the kids, I am pretty content. I absolutely love fishing for striped bass, bluefish and false albacore near my home in Brooklyn. The week in the spring that I spend in the Catskills in search of big, wild trout is total bliss. A DIY bonefish trip in the Bahamas is hard to beat. Slinging the two-hander on that pastoral Nova Scotia salmon river puts me in a state of near catatonia, in a good way.

But there is something else about a tarpon, something that separates it from every other species, something that keeps me thinking about them even when I’m pursuing other species. There is, of course, their stupendous size and might, and their armored beauty that evokes prehistory. But more than that, I think, it has to do with the way that the leap of a tarpon can, somewhat incongruously, both clear your mind and sear itself in there forever. 🐟

Monte Burke is the author of the *New York Times* best seller, “Saban: The Making of a Coach.” He’s also a huge fan of the BTT.

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El Pescador

A Trip of a Lifetime

BY CAPTAIN DEREK RUST

As I'm leaning into the push pole to propel my skiff forward, my phone buzzes in my pocket. Why is Alex Woodsum from BTT calling me? My customers and I are on fish, so I slip it back in my pocket and let it ring to voicemail.

At the end of the day, I drop my two weary anglers at their car and finally listen to Alex's cryptic message. "Give me a call when you can. I have some exciting news for you." I am puzzled and intrigued, so I call her right back. We catch up and chat about life and fishing and how the fishery has been lately in the Keys. After a few minutes of pleasantries and suspense, the conversation turns to its original purpose.

Somewhat nonchalantly, Alex says, "So, I called to tell you that you won BTT's trip of a lifetime contest to El Pescador Lodge in Belize!"

I am in shock. I never win anything. Alex explains that because I am a paying member of BTT, I was automatically entered to win the annual trip of a lifetime and would be traveling with Bill Klyn, star of the television show *Buccaneers and Bones* and a BTT board member.

After a bit of phone tag, Bill and I connect to talk about the trip. We talk about fishing, Belize, and then the subject turns to permit. I explain that I suffer from an unexplainable addiction to fly fishing for the black-tailed devils, and hope we can mainly target them on our trip. Thankfully Bill shares the permit bug, and we plan our trip around the best permit tides. I still can't believe this is happening.

It takes a special kind of angler to want to fly fish for permit. Some say we are not totally "right" in the head, and non-anglers certainly don't understand it. Permit anglers spend incredibly long days on the water pursuing an adversary that we rarely catch. It's considered a pretty good day when we get lots of "shots", and a great day if we manage to catch just one. Fly fishing for permit is mostly about the suffering. We wonder why we do it, question our sanity, and then are occasionally appeased by attaining the unattainable. When you finally get a permit to make a bad decision and stick it on fly, it's remarkable how fast one forgets about the countless hours of misery spent to get to that point.

Leading up to the trip, the building anticipation is almost too much to bear. I cannot

think of a better way to cap off a busy tarpon season than to fly off to Belize to chase permit as my slower guiding months approach. I distract myself from the anticipation and waiting by constructing leaders and tying more flies than I could ever need.

El Pescador is located on Ambergris Cay, Belize. The flight from Miami to Belize City is an easy two hours, followed by a 20-minute charter flight to San Pedro. Upon landing in San Pedro, we are greeted and quickly whisked off in a shuttle boat for the lodge, armed with ice-cold Belikin beers.

In no time, we are pulling up to the dock at El Pescador. A woman named Marlin greets me and guides me past the gorgeous white-sand beach to my room. After dropping our bags, we head to the bar to trade fish stories with the other anglers who are there for the week. Cocktail hour gives way to an amazing family-style dinner. With bellies full of good food and drink we all fade away one-by-one to our rooms, eager for our first day of fishing.

At 6:00 am sharp we meet our guide, Emir, on the dock. His skiff is ready to go, packed full with lunch, beer and everything else we need for the day. As we head out on the long run north towards the park, we navigate through some of the most pristine islands and flats I have ever seen. It is awe-inspiring to see nature in its undisturbed form.

Belize has just about everything you want in a saltwater fishing destination. Endless and diverse healthy habitat of green turtle grass flats, white sand flats, coral flats and mud flats. You can spend the day wading for bonefish. If you want to fish only for tailing fish, you can do that. You can strictly target and sight cast to tarpon or permit or bonefish. For the less experienced anglers, there are plenty of options to keep the rods bent with consistent action fishing for smaller bones, jacks and cudas. Belize truly is a diverse saltwater fishing paradise. The breathtaking beauty is reason enough to visit, and the fishing, diving, eco tours and other activities make it a world-class destination.

Our week brings pretty tough weather conditions. High winds and clouds make for difficult sight fishing, but we are granted some moments of beautiful clear skies on our last few days. One afternoon, Emir takes us to a flat in the middle of nowhere.



Photo: Bill Klyn.

Photo: Bill Klyn.



Photo: Bill Klyn.



Photo: Bill Klyn.



Photo: Bill Klyn.

We can see the clouds in the distance and know we have a short window with great visibility and perfect water levels. Moments after Emir starts poling, he calls out, "Permit! 11 o'clock, sixty feet! There are a few of them on the back of a sting ray." My heart races,

and I cast, dropping my shrimp fly right in front of them. As I start stripping, Emir breathlessly says, "They are following it!" I keep stripping and come tight. After a brief moment of excitement, we realize a barracuda had beaten the permit to the fly, confirmed when he cuts me off seconds later.

"Get it in fast. They are still there. Put on another fly!" Emir yells. I strip the line in like a lunatic and tie on another fly as quick as I could. I put my second cast right on the ray's back and the permit start to follow it again. Out of nowhere, another cuda swipes the fly and cuts me clean off! "They are still there. Get it in fast and retie." My tippet is all but gone at this point, and I have to try to replace it with hands shaking from adrenaline. Emir tells me to put on a crab fly instead of a shrimp because the cudas won't eat a crab fly. As I tie on a weighted crab pattern, I glance up and unbelievably the permit are still there, happily swimming and eating behind the ray.

We take our time and set up for a good shot. Once again, I put the fly in front of the ray and let it sink. I slowly start stripping it along the bottom. "They are following it!" Emir whispers. I keep stripping, come tight, and the line starts to scream off the reel. As fast as it first went out, the fish suddenly turns, and comes speeding right back at me. "It's a bonefish. Get it in fast. The permit are still there!" Emir yelled. We quickly land the bone and to my disbelief, the permit are still there, unaffected by the chaos going on around them. I make another cast at the permit and sure enough, another bonefish quickly swipes the fly up! After landing the second bonefish, I am certain it will all come together on the next cast. It has to. I lay my cast out and am again cut off by a cuda. My shoulders slump and we all shake our heads and have a good laugh as we watch the permit fade out of sight.

Despite tough conditions, Emir presents us with plenty of opportunities

to catch fish during our trip and works hard to get us in front of as many permit as possible. Clouded out periods with no visibility are spent kicked back in the boat, swapping stories while enjoying a cold Belikin. Emir tells us about being a second-generation permit guide, how proud he is that his son is following in his footsteps, and how he is damn good at it too! Bill's stories are hard to top though. Tales of his travels and adventures around the globe leave me jealous.

When the weather permits, we find abundant permit and bonefish of all sizes. We both catch our share of bonefish and are able to fool a few permit, landing two of three that we hook. Everywhere we go there are waves of bonefish pouring over the flats. You know, the way it should be. After seeing how phenomenal the fishery is in Belize, I can't help but feel a little sad thinking about the stories of the Keys bonefishing back in the day, before my time as a guide there. The days when you could find tailing fish all day long. Stories of schools of jumbo bonefish, where the small fish in the group was still a double-digit fish. The days you could easily save a tough day of fishing by catching a few last-minute bones. Times have changed in the Keys, but the future is hopeful thanks to groups like BTT. They are working to figure out what is happening to our fish and our fishery. Hopefully one day soon, I will be able to look at the flats in the Keys and see abundant bonefish and healthy habitat like I saw in Belize. 🐟



Photo: Capt. Derek Rust.

A special thank you to El Pescador Lodge for providing this year's Trip of a Lifetime trip. El Pescador goes above and beyond to make sure you have an incredible experience. The lodge, staff, fishing, food and everything else is world class, and I will be returning as soon as I can. Many thanks to BTT and Bill Klyn for providing me with an incredible experience. It truly was a trip of a lifetime.

Tarpon Spawning in the Gulf of Mexico

JON SHENKER, Ph.D.

Associate Professor, Department of Biological Sciences, Florida Institute of Technology

Photos by JON SHENKER, Ph.D.

With all due modesty, I can state that I've caught more tarpon than just about any avid tarpon angler. Most of them, however, were less than an inch long and were caught with a plankton net on 2000 pound test line. I'll never win any awards for my fishing prowess!

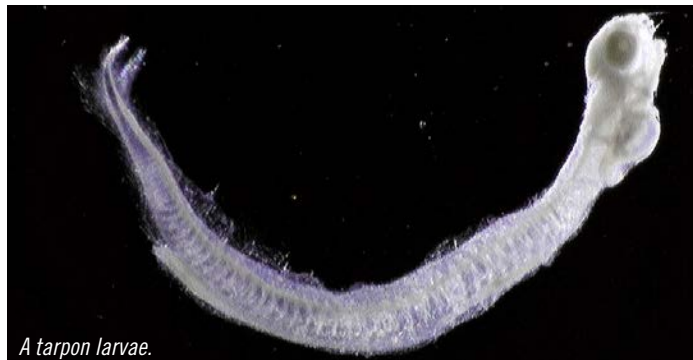
Research in my laboratory focuses on the early life history of tarpon and bonefish – when and where they spawn, how the larvae migrate to their nursery, the qualities of a good nursery habitat, and how humans can reduce or assist production of new generations of fish. One of our current projects focuses on tarpon spawning in the Gulf of Mexico. With the support of the Bonefish and Tarpon Trust, we've been conducting our own surveys in the Gulf, and analyzing data collected by other agencies, to determine tarpon spawning sites and assess how that spawning activity may impact the supply of larvae to coastal nursery sites.

Pioneering studies by Dr. Roy Crabtree found tarpon larvae in surface waters across 100 miles of the continental shelf west of Tampa, Florida. We want to refine his initial observations by finding where those larvae are spawned, and tracking their shoreward transport across the continental shelf towards shore. One of our methods has been to conduct 3-4 day research cruises aboard the R/V Bellows, an 80' oceanographic vessel from the Florida Institute of Oceanography. These cruises, supported by funding from BTT, FIO and FIT, have a second goal: training my students in fisheries oceanography and helping them determine if they really want to pursue a career in fisheries biology. Despite some intense storms and some sea-sickness, most of them handled the challenges of 24 hour operations very well.

The cruises typically began by steaming from Tampa to off of Boca Grande Pass, the pre-spawning aggregating site of huge numbers of tarpon. As we moved offshore, we took plankton samples every 10 miles until we crossed the edge of the continental shelf where water depths exceeded 300 feet. We then moved 10 miles north and repeated the sampling heading eastward.

We were able to collect 30-40 samples on each cruise. Although we collected a lot of eggs, none of them proved to be tarpon. However, we did collect newly-hatched tarpon larvae at several stations about 80 miles offshore and in depths of 180-200 feet. The larva shown here is about ¼" long, and hatched so recently that it still is living on its yolk reserves, its eyes aren't yet fully pigmented and functional, and its mouth is just developing, as can be seen with the first few long forward-pointing teeth that characterize the leptocephalus (slender-head) larvae of tarpon.

We also collaborated with Dr. Mitch Roffer (ROFF's Oceanographic Fishing Forecasting Service), who provided satellite imagery of the spawning region, and calculated the potential drift path of the larvae from the point of capture back to where they may have been spawned. It appears that the tarpon spawned at a location where the sea surface temperature made an abrupt change – perhaps off-shore migrating tarpon use a temperature change as a cue to stop



A tarpon larva.

migrating and get down to the business of spawning. Or maybe they use water depth as a cue to spawn. As we learn more about where tarpon spawn, we'll soon be able to address these questions.

We're getting a better idea of how tarpon are spawning off Florida, but what's happening elsewhere in the Gulf? The National Marine Fisheries Service has been conducting Gulf-wide larval fish surveys once or twice a year for decades, but they've never focused on tarpon. Although the samples are widely dispersed in time and space, they can provide very valuable information on larval distributions. NMFS generously provided all their samples of leptocephalus larvae (the unique type of larvae of tarpon, bonefish, eels, and a limited number of other species) to my lab so we could separate out tarpon larvae and try to learn about their spawning throughout the Gulf.

The NMFS samples revealed that young tarpon larvae were found along the entire outer edge of the shelf of peninsular Florida, with spawning occurring in May and June. Older larvae were found progressively further inshore as they migrated toward the coastal nursery habitat. What really surprised us, however, was the capture of newly-spawned larvae on the edge of the continental shelf off the Mississippi River Delta in August and September – this location was precisely where the Deep Water Horizon oil spill occurred in 2010. Older larvae were found in northern Gulf waters as well as towards peninsular Florida, so larvae from the Mississippi spawning region may be transported a long way by ocean currents.

The overall picture that's developing fits well with angler and diver observations and some of Jerry Ault's satellite tracking data: As tarpon migrate from south Florida northward during the late spring, at least some fish run offshore to deep water to spawn around full moons (and maybe new moons). Larvae produced by early spawning may supply southwest Florida nurseries, or they can get drawn into the Florida current to supply nurseries in the Keys and even southeast Florida. Adults continue to migrate northward, feeding and aggregating in places like Boca Grande Pass and Tampa Bay, making more offshore dashes to spawn. By late summer, adults are spawning off the mouth of the Mississippi River, producing larvae that supply the northern Gulf marshes and perhaps peninsular Florida habitats and Texas habitats as well.

It's not really that simple, of course – for example, we know that a lot of fish are year-round residents in some spots, including around oil platforms in the northern Gulf, but the seasonal pattern in reproduction and larval transport is valid.

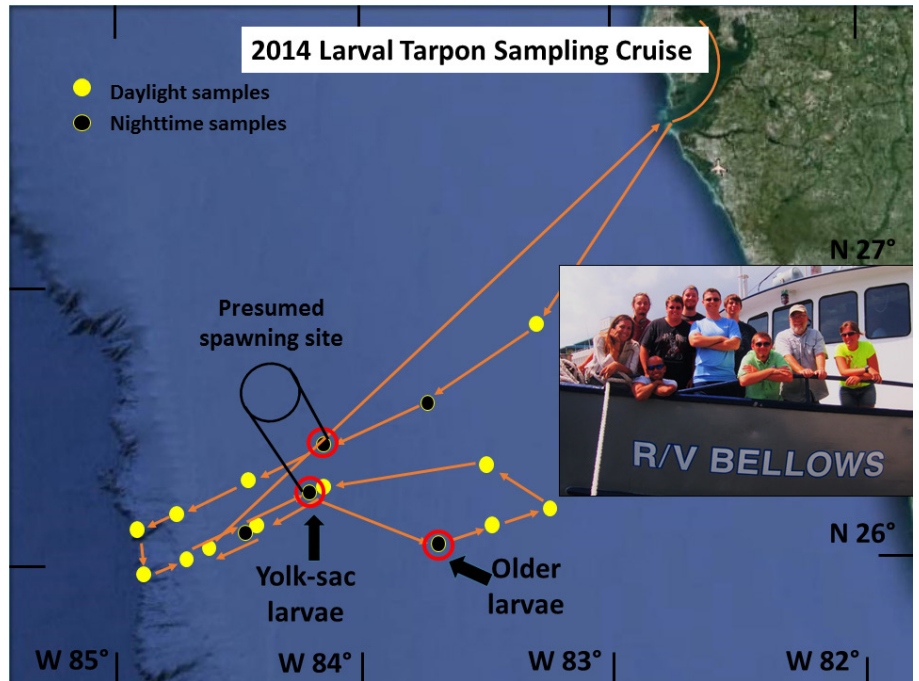
A key lesson for us: the outer edge of the continental shelf appears to be the preferred spawning habitat. How far tarpon have to migrate to reach the required depth depends on the location: in the Florida Keys, they only have to travel a few miles offshore, but the trip from Boca Grande, FL is closer to 100 miles.

Based on earlier work, we know that tarpon populations are vulnerable because of the loss of juvenile tarpon nursery habitats in mangroves and marshes. BTT is addressing this with their Juvenile Tarpon Habitat program. But now that we've learned that tarpon spawning occurs right at the Deep Water Horizon site and other prospective deep water drilling sites, impacts to tarpon spawning is now another source of worry.

Fishery biologists fully expect that a long-lived fish such as tarpon will have some very successful years of reproduction and larval recruitment, and some very poor years of recruitment. That's natural. What's not natural, and what concerns us, is the disruption of spawning from events like offshore oil spills, or proposed deep-sea mining. Coupled with impacts to nursery habitats, and we have a conservation challenge on our hands.

The big worry here is that by the time we figure out there is a problem with the tarpon population, we will be 10 years too late. This is because tarpon are slow

growing, and don't really join the fishery until they are close to 10 years old. So if spawning sites or juvenile habitats are lost, it will be 10 years before we see the result – fewer tarpon in the fishery. And by this point, it could be very hard to decipher the decade-old origin of the problem and to try to reverse the decline. BTT's efforts in research, habitat restoration, and management are critical and forward-looking approaches to define some of the major problems facing tarpon populations in the future and to implement strategies to help conserve the populations of this magnificent fish. 🐟



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 Patagonia Fly Fishing Ambassador
 Co-chair of the AFFTA Science and Policy Committee

The flats trio of bonefish, tarpon, and permit fuel our passion, tease our fishing obsession, and often leave us humbled in their wake. The flats and tropical coastal waters they cruise can be hypnotic as we gaze out looking for a sign that someone is home – a shadow across the sand, a roll at the surface, or the subtle wave of a tail. For many, time on the flats provides an escape to a place that is peaceful, disconnected, and pure. The flats are a tapestry of turquoise, greens, browns, and reflections of whatever is above. And if we are patient, skilled, and lucky, we can be rewarded by the honor of bringing one of these elusive fish to hand and then letting it go.

With the reward and power comes responsibility. As much as we'd like to count on others to take care of our precious flats fish and their habitats, we as anglers must take ownership over our actions and our words. We all make LOTS of choices when we go fishing – what gear to use, when to fish based on tides and location, and even who we fish with. As anglers,

we also like to share stories about everything and anything related to the experience.

For many, sharing is done through a picture of the trophy – proof that we were able to fool the fish into taking a fly or bait and had the skill to bring it to hand. Traditionally, these images are of our catch out of water – something we now know goes against the science behind the best practices for catch-and-release. A fish's gills don't work out of water, so why tarnish our reward after investing so much in the effort?

It's time for anglers to rethink the "hero shot" and do our best to keep the fish wet. Some of the best fish photos out there of an angler and their catch in the water are taken with nothing more than a phone camera. And as much money as we spend on rods, reels, technical clothing and travel, we should also consider a small waterproof point-and-shoot camera as part of the inventory.



Dan Pedersen



Eric English



Flemming Wilberg



Evan Cobb



Dan Decibel



David King



Lee Watts



Adrian Gray



Joe Gonzalez, Jr.

They are durable and can take excellent pictures of other aspects of your fishing escapades. Add some creativity to the mix and work to capture images of your catch with the fish still in the water or partially in the water. The fish look better, and the photos look better. Changing what is a socially acceptable “hero shot” among your friends and throughout the fishing community will help fish recover better from the capture and maintain the conservation ethic we try to uphold, while still enabling us as anglers to share our fishing experiences.

It is also important for anglers to stay informed on conservation issues and be comfortable speaking up and standing up for the fisheries and the organizations and people working to protect them. Don't be shy when you see or hear something that may not jive with what we know are best practices for catch-and-release, or what is best for the flats environment that bonefish, tarpon and permit rely on. If you see a beer can on the flats,

don't just pass it by, pick it up. If you are wading the flats and are surrounded by ankle-biting lemon sharks, it's best to move to another location rather than expose an exhausted bonefish to a gauntlet of predators while on the line or once released. 🐟

With a few simple steps, we can all enjoy the resources while working to protect and improve them. It is all a matter of using our power as anglers wisely, treating our prized catches with respect, and learning and sharing best practices for catch-and-release, as well as the overall protection of the flats.



Capt. Shane Smith



Capt. Rob Kramarz



Ken Diaz



Salt Shepherds



Capt. Joe Gonzalez



Paul Anderson

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As our band of Buccaneers return for yet another season, to the fabled waters of Deep Water Cay, Bahamas. Join us as we gather to celebrate the legendary Lefty Kreh's 90th Birthday. It's one party you won't want to miss!

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