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## David Lazarus

*Read more on page 47*

BONEFISH & TARPON JOURNAL

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## FEATURES



## ARTICLES



### BTT'S MISSION

To conserve and enhance global bonefish, tarpon and permit fisheries and their environments through stewardship, research, education and advocacy.

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Boca Grande, FL – February 3
Key Largo, FL – February 11
Naples, FL – February 18

# Setting the Hook

## MAINTAINING THE MOMENTUM

### A Note from the Chairman and President

Tom Davidson
Chairman

Matt Connolly
President

Successful conservation organizations are blessed with a talented professional staff and a deeply committed cadre of volunteers working in a partnership forged on mutual respect and trust. Bonefish and Tarpon Trust is particularly fortunate in this regard. Our small staff serves under the able leadership of Dr. Aaron Adams, an internationally respected marine professional.

In the world of charitable endeavors, the optimal supporter is someone from whom you hope to receive wealth, wisdom and work. In most instances, few individuals are able to provide all three of these assets simultaneously, but in BTT's case such enthusiasts are the rule not the exception. The deeply committed talents and generosity of volunteers fuels BTT's successes. It is a humbling experience to witness legendary anglers, guides, captains of industry, celebrities and professionals of all stripes working harmoniously as volunteers advancing the causes of the fishery. Consider for example the yeoman's work of guides, lodges and anglers in the Keys, the Gulf States, Southeast Atlantic, the Bahamas, Mexico, Belize and Cuba tagging fish and collecting samples of DNA to assist in our further understanding of these extraordinary fish. As a result of these selfless individuals volunteering so freely of themselves, BTT is able to optimize its staff resources and maximize its funding focus on the acquisition of science-based knowledge, education of the public regarding resource friendly practices, and the advocacy of fact-based public conservation policies.

The work of our singularly focused staff is greatly augmented through our committed and hands-on volunteers who provide leadership in such organizational activities as fiduciary oversight, brand development, marketing, membership recruitment, fund raising, event development and strategic scientific goals. A unique example of volunteer leadership occurs through the celebrity cast, production professionals and sponsors that make possible BTT's award-winning TV series *Buccaneers and Bones*—an extraordinary entertainment and educational vehicle that doesn't cost BTT a nickel thanks to volunteers Tom Brokaw, Michael Keaton, Yvon Chouinard, Lefty Kreh, Tom McGuane, new Buccaneer Liam Neeson, and corporate partners Orion Multimedia, The Outdoor Channel, Hells Bay Boatworks, Costa del Mar, Patagonia, Take me Fishing and The Orvis Company. A single individual can make a huge difference, such as BTT board member/and officer Jeff Harkavy who recently chaired BTT's sellout Symposium held at IGFA in Ft Lauderdale. Jeff's untiring energy brought together scientists, angling legends and conservationists from eight nations for a critical exchange of scientific knowledge and angling knowhow.

While new partnerships are launched each year, one of the most important in BTT's history has just been sealed. BTT and the University of Miami's Rosenstiel School of Marine Science are collaborating on a joint venture to raise $35 million to carry out bonefish and tarpon research and fishery restoration.

Beyond your generous support of BTT and spreading the word to convince others to join, for which we are deeply thankful, you might ask what more can you do as a single individual for bonefish, tarpon and permit? You can make a most significant contribution as an angler by making certain that you and others practice fish-friendly, speedy catch and releases. Our research has confirmed the importance of keeping these special fish in their natural element with quick, seamless releases. Hopefully with your conservation and continuing financial support we can enhance fisheries for the benefit of future generations.

Finally, we are please that our efforts are being recognized by the IGFA, which in 2012 presents BTT with its prestigious Conservation Award. It's a reflection of teamwork.

Tom Davidson is a Founding Member and Chairman, and Matt Connolly is President of Bonefish & Tarpon Trust


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# The Florida Keys Initiative

Photo by Dr. Aaron Adams

DR. AARON ADAMS
is Director of Operations for Bonefish & Tarpon Trust

The Florida Keys are recognized as the birthplace of flats fishing and the center of the universe for modern flats-fishing aficionados. Despite this long history and the continued fervor of flats anglers in pursuit of the Big Three, we find ourselves fighting for the health of the flats that have provided so much to so many for so long. With our new Florida Keys Initiative, Bonefish & Tarpon Trust is ramping up the fight to protect these valuable fisheries, their history and culture.

Although still a world-class destination for flats fishing, the Keys habitats and fisheries are not being cared for as they should. Water flowing from the Florida Everglades, for example, is highly altered and contains a slew of nutrients and contaminants. Furthermore, the when, where, and how much of fresh water flows from the Everglades is greatly altered from its natural pattern. These changes, in turn, impact the habitats of the Florida Keys, which in turn affect the fisheries. The same challenges affect fisheries around the US and indeed around the world, but the importance of the Keys internationally to flats fishing makes this an especially important fight.

Above Photo by Stephan Gian Dombaj

Photo courtesy of NASA

The first step in the Florida Keys Initiative in 2012 is to fund a project that will examine any changes in the types, amounts and locations of bonefish prey. Such changes could be affecting where and when we find bonefish. This study will be completed by year's end and will help steer future work. BTT also plans to fund the first-ever study to determine the economic value of the Florida Keys flats fisheries. Believe it or not, despite the immense importance of flats fisheries to the Keys, such a definitive study has never been done. The results of the study can serve as leverage as BTT pushes for more conservation attention for bonefish, tarpon and permit and their habitats.

As is always the case, BTT will work closely with Florida Keys guides to chart the course of this initiative as well as to help complete the research to ensure that our advocacy will be effective for protection of the Big Three.


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Aaron Adams, from Bonefish & Tarpon Trust, prepares for the hunt. WIL ATKINSON
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# Symposium A Huge Success

DR. AARON ADAMS
is Director of Operations for Bonefish & Tarpon Trust

Photos by Pat Ford

Held on Nov. 10-11, 2011, at IGFA headquarters in Dania Beach, Florida, the two-day symposium followed a high-paced format, with multiple sessions each day on research and conservation presentations by scientists from the United States, Caribbean and Pacific. Panel discussions were held on bonefish, tarpon and permit by the most notable anglers and guides in the world of flats fishing, casting demonstrations by a who's who of experts and the latest data provided on best handling practices for catch-and-release fishing.

More than $120,000 was raised for BTT's mission from the event's sponsors and auction. Special thanks for IGFA for hosting this event.

The grand finale took place at the "Evening with the Legends Banquet." Bonefish & Tarpon Trust started the gala by presenting three inaugural conservation awards:

- The Flats Stewardship Award was given to former Florida Fish and Wildlife Conservation Commission Chairman Rodney Barreto for his efforts to protect bonefish, tarpon and permit. In addition, Barreto coined the phrase "rock stars of the flats" to describe bonefish, tarpon and permit.
- Lefty Kreh was presented with the first "Lefty Kreh Sportsman of the Year Award" in recognition of his leadership and innovation within the fishing community and for his lifelong commitment and efforts to promote the conservation of bonefish, tarpon, permit and other coastal game fish.
- Former NBC news anchor Tom Brokaw received "The Curt Gowdy Media Memorial Award," a prestigious award given to a literary or media icon who, like Curt, has helped to significantly raise awareness for the need to nurture and protect our precious fisheries.

The festivities culminated with appreciation for angling greats Bill Curtis, Lefty Kreh, Flip Pallot, Stu Apte, Chico Fernandez, Sandy Moret, Mark Sosin, Ralph Delph, Steve Huff and Rick Ruoff. Andy Mill did a fantastic job as emcee, pulling some great fishing stories from the memories of these legendary anglers. There was more information presented on flats fishing under one roof than ever before.

If you weren't able to make it to the symposium, you can read the program at http://www.tarbone.org/publications/symposium/2011/

Symposium Chair and BTT board member Jeff Storm Harkavy and Flip Pallot present Lefty Kreh with the Sportsman of the Year award.

Steve Huff and Sandy Moret share a story with Andy Mill.

BTT Chairman Tom Davidson, former FWC Commissioner Rodney Barreto, Symposium Chair Jeff Storm Harkavy, and BTT President Matt Connolly present Mr. Barreto with the Flats Stewardship award.

The Expert Permit Panel: Will Benson, Greg Vincent, Dexter Simmons, Jon Ain (moderator), Bob Branham, Paul Tejera, Mike Holliday, Carl Ball, Raul Navarette.

BTT board member Bill Klyn accepts the Curt Gowdy Conservation Media award on behalf of Tom Brokaw, who had to cancel his appearance.

The Expert Bonefish Panel: Chico Fernandez, Paul Tejera, Russ Fisher (moderator), Joe Gonzalez, Bill Curtis, and Tim Klein.

The Expert Tarpon Panel: Dr. Jerry Ault, Steve Huff, Stu Apte, Bob Rich, Ralph Delph, Paul Tejera, Tim Hoover, Flip Pallot. Not pictured, Andy Mill (moderator).

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# Buccaneers & Bones

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The Buccaneers take notes while Lefty Kreh tightens Tom Brokaw's loops.

(above) Michael Keaton casting to tailing bones.

(above) A meeting among great teachers as angler Lefty Kreh and guide David Pinder Sr. reminisce.

Kreh arrives among bonefish regalia.

Sunrise at Deep Water Cay signals a call to action for the flats boats.

Buccaneers race to the flats.

8-weights ready for action.

(above) Liam Neeson follows instructions from Meko Glinton as he reels in a bonefish.

Dr. Aaron Adams knows to keep the fish in the water.

(left) Yvon Chouinard at his best - holding a tight line with a grey ghost while wading the flats.

(above) Chouinard checking his reflection in the mirrored scales of a bonefish.

Adams, Chouinard, and Klyn leave the docks at Deep Water Cay.

Keaton and Dr. Adams discuss their strategy for the day.

Perry Demeritte helps Chouinard find a winning fly.

(above) The motley group of Buccaneers after a successful week of production.

(above) Richard Bentley, Meko Glinton, and Liam Neeson are all smiles on the flats.

Keaton gets tips from a master.

Photos by Orion Multimedia

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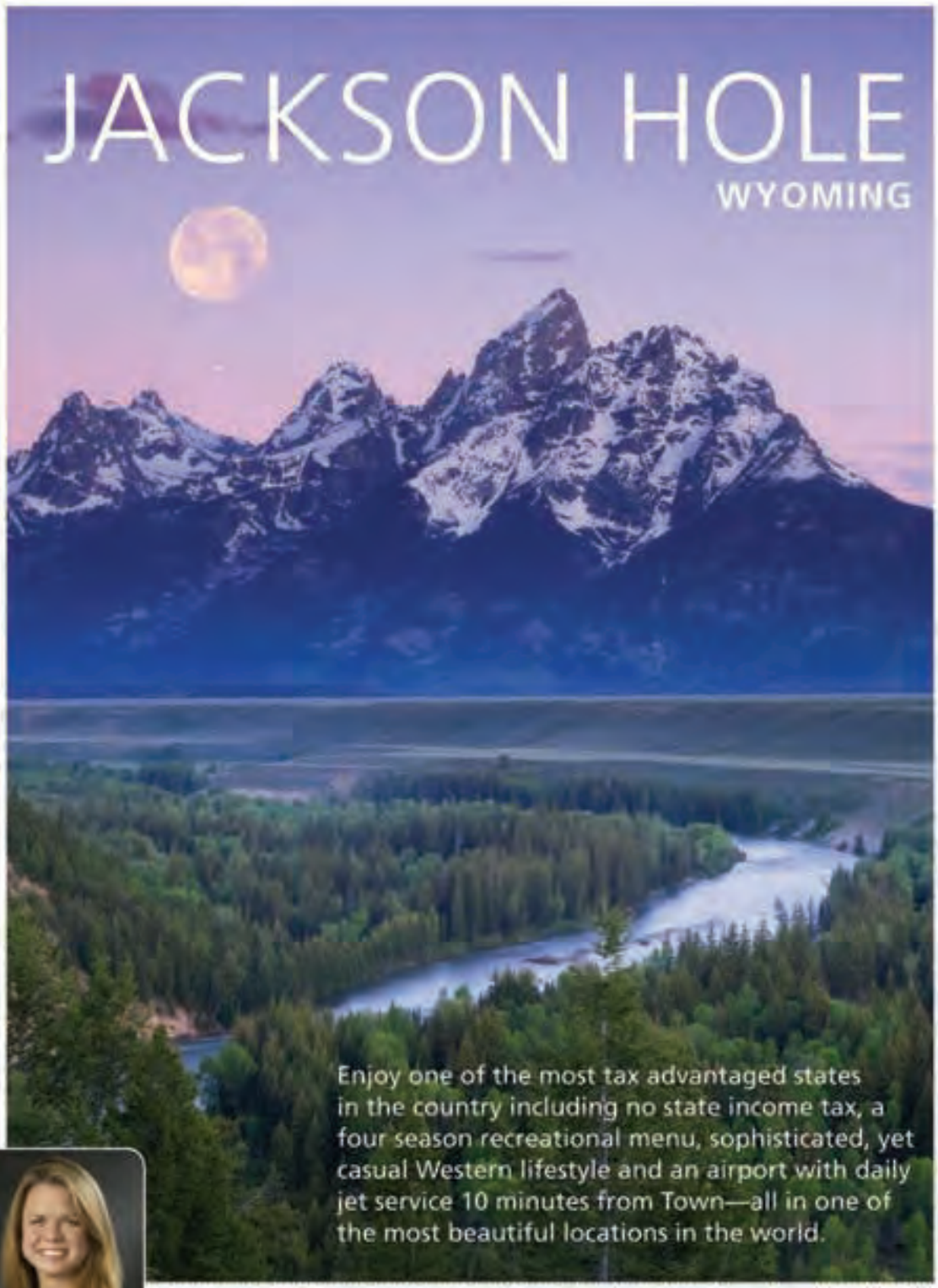

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The **Science** of Angling

# What *do* bonefish eat?

DR. AARON ADAMS
is Director of Operations for Bonefish & Tarpon Trust
Photos by Dr. Aaron Adams

## *"What are they eating?"*

That's one of the most-asked questions at fishing shops, lodges and from one wading angler to another. Often this question is in reference to a fly or lure. But rather than relying on possible guess-work from fellow anglers, you'd be better off determining what prey items bonefish eat where you're fishing and then to imitate those prey with flies or lures.

Whether tying their own or buying flies from a shop, most anglers know that the flies used to fill a fly box can make or break a trip. Lodge recommendations for flies aside, anglers can best prepare for a trip by learning more about how habitat and location influence bonefish diet and using this information to select their flies. After all, many times it's found that lodge fly selections are often based on a collection of conventional bonefish patterns that may be generally effective but not the most effective.

Many anglers merely fill their fly boxes with a selection of old standards for bonefish such as Gotchas, Crazy Charlies, Clouser Minnows and the like that tend to be pretty effective in many locations. This is especially true for smaller bonefish in schools and small roving packs. But anyone who has fly fished for bonefish enough knows that there are plenty of times and places where those old standards just don't cut it, and that large bonefish can be more picky about which flies they'll eat. A little knowledge of how location, habitat and bonefish size influence their diet can go a long way toward having the best selection of flies for your next trip.

### What Are They Eating?

The answer to the question, "What do bonefish eat?" is that "it depends." It depends on a combination of location, habitat and bonefish size.

The first thing to know about bonefish is that they are good at adapting to their surroundings when it comes to finding a meal. Although their mouths are under their snout (called an inferior mouth), which reflects the dominance of bottom-dwelling prey in their diet, they are also able to eat a variety of small fish. For example, bonefish in Los Roques appear to focus on glass minnows much of the time. But bonefish in other locations also eat fish—the amount and type differing by location and bonefish size, and to a much lesser extent by season.

### Where Are They Eating?

A handful of studies on bonefish diet reveal some of the variation in bonefish prey that occurs among locations. The perceptive angler can use these studies to narrow the search for the most appropriate flies for the occasion. A complete list of bonefish diet items would take up half of this Journal, so we'll focus on the top handful of prey items for each location, with special attention to those we can imitate with flies.

Pink shrimp and other species in the Common Shrimp family are high on the menu of bonefish in locations where they are available.

Toadfish are a favorite of large bonefish wherever they occur, especially in the Florida Keys.

**Florida Keys** — It's been recorded that these bonefish eat more than 80 prey species. The first order of business is to disregard prey that isn't appropriate for imitation with a fly or lure,

Snapping shrimp are a favorite of bonefish.

like clams. Second, focus on the handful of prey that are highest on the bonefish menu such as swimming crabs, snapping shrimp, common shrimp, mud crabs, worms (polychaetes) and toadfish. An advantage to eating the crustaceans (crabs and shrimp) is that they provide a big bang for the buck in terms of calories. But one of the top prey items for large bonefish in the Keys is toadfish. The most productive bonefish patterns for the Florida Keys typically imitate toadfish, swimming crabs or shrimp.

**Turneffe Island, Belize** — Bones at Turneffe have an almost entirely different diet than their Keys brethren. The top prey items hereabouts are reef crabs, snails, clams, sea urchins and small shrimp. I have yet to see an effective clam or snail fly, so the most effective are typically imitations of reef crabs or small shrimp. While I'm not aware of it having been used on Turneffe, I and other anglers have had success using small urchin flies for bonefish and also permit.

**Grand Bahama Island, Bahamas** — Clams and worms are high on the menu, especially on the south side of the island. But swimming crabs, snapping shrimp, mantis shrimp and small fish are also abundant in bonefish stomachs, especially on the north side of the island. A good start for fishing GBI is a crab pattern, with shrimp patterns a close second. Patterns that imitate small gobies can also be effective.

**North Andros, Bahamas** — Worms and clams are high on the list of prey, but these bonefish also eat a lot of swimming crabs, mud crabs, common shrimp, mantis shrimp and fish. Swimming crab and mantis shrimp patterns should be abundant in your fly box when traveling to North Andros, but also make sure you are carrying some flies that imitate small fish because they're favorites of large bonefish.

This is a common color pattern for gobies found in bonefish habitats.

Among these locations you can see some similarities. Swimming crabs are typically in the bonefish diet as are numerous species of shrimp. Fish — present in bonefish stomachs in every location except Turneffe — represent one of the most overlooked bonefish prey. You can use this information to create a core selection of flies for your travels, with variations to adapt to local conditions.

## Where Do They Live?

One of the major factors causing the patterns in diet among different locations is habitat. To a great extent, bonefish diet will reflect the habitat because the habitat influences the types of prey that live there. You won't find many snapping shrimp on open sand flats, for example, but you will find them in seagrass, algae and other habitats in which they can find shelter. Many sand flats do harbor mantis shrimp, which are the main builders and occupants of the nickel- to quarter-size round holes in sand flats. Each of the locations listed above provides a different set of habitats and therefore offers a different suite of prey for bonefish. You can create an effective group of fly boxes for your travels by using location as the first level for fly selection and then considering habitats that follow.

They're not sexy, but worms are a staple of bonefish diet, especially on mud and sand bottoms.

**Mud Bottom** — The major prey items available to bonefish on mud bottoms are clams, worms, snails, a few species of small shrimp and assorted gobies. It is in mud bottoms where you often see the feeding holes of bonefish that have been digging for food. The worms and clams that dominate the diet of bonefish on muddy bottoms provide good nutrition, but they come with a lot of sediment and shell as well. A small shrimp or crab fly looks like a gourmet meal to them. This is generally the case at The Marls west of Abaco.

Sometimes in muddy bottom areas you will find bonefish tailing slowly, even gently in shallow water. Oftentimes these fish won't eat typical bonefish flies—they either ignore them or move away. This is a perfect situation for a worm fly, which is most likely what these fish are slurping out of the bottom.

These shrimp mounds are obvious at low tide and indicative of good live bottom and a prime place for flies imitating shrimp, swimming crabs or gobies.

Ghost shrimp make the ski mogul-type mounds on the flats.

A top-side view of a mantis shrimp burrow.

Mantis shrimp are a favorite of bonefish, particularly larger fish.

**Sand Bottom** — This can range from flat and featureless to a complex mix of mounds and holes. Don't spend too much time on the featureless sand bottom and instead focus on the complex bottom because that is where the prey live. Those round holes indicate mantis shrimp are present whereas ghost shrimp make most of the mounds (similar to ski moguls). Gobies and snapping shrimp are often associated with little pieces of structure like algae or mantis shrimp holes, and mojarra (in The Bahamas they call them shad) move among the shrimp mounds feeding on the bottom.

**Seagrass** — Seagrass provides the most shelter, nutrients and food for things that bonefish like to eat, so this is where bonefish have the most varied diet. Nonetheless, crustaceans and fish are at the top of the list, dominated by mud crabs, swimming crabs, snapping shrimp, mantis shrimp, common shrimp, gobies and toadfish.

**Algae**—Algae-covered limestone provides shelter, nutrients and food for many bonefish prey, even if not to the extent of seagrass. Algae bottoms provide bonefish with a variety of prey items, with swimming crabs and small fish (such as gobies) at the top of the list. Also present in good numbers are mantis shrimp, snapping shrimp and mud crabs.

Green reef crabs and their tan cousins are standard prey items for bonefish on rubble-and-seagrass flats.

**Rubble** — Limited primarily to the back sides of coral reefs such as at Turneffe Island, rubble can be encountered on many Caribbean islands. These bank-barrier reefs have shallow back-reef rubble zones, which are a mixture of coral rubble, seagrass and scattered live coral. The dominant bonefish prey in rubble habitats are reef crabs, snapping shrimp, urchins and mantis shrimp.

Swimming crabs such as this one are common in numerous shallow habitats. A favorite of bonefish, they can be imitated with a variety of fly patterns.

**Mangroves** — You've likely seen the photos of flats dotted by small mangroves, with bonefish tailing without a care in the world. Although snails and worms are available in these habitats, the bonefish slide into these shallows on a rising tide to get at the abundant swimming crabs, mud crabs and fiddler crabs that find shelter in these areas. Crab flies are number one on mangrove flats.

## Bonefish Size

The final piece to the puzzle has to do with size. The limited research that has been done reveals that bonefish diet changes with size. A small study I conducted on the west side of North Andros provides some clues. In this study, bonefish with less than 16-inch fork length ate primarily worms and clams, with a few small shrimp and clams mixed in. Bonefish larger than 16 inches ate swimming crabs, pink shrimp, spider crabs and fish (gobies and mojarras). It appears that at least some of this pattern was due to

habitat: The small bonefish lived primarily in shallow muddy areas, probably to avoid sharks; bonefish larger than 16 inches appeared capable of avoiding sharks and therefore made use of a wider variety of habitats that offered more prey.

Bonefish use their hard tongue (top) and roof of the mouth (bottom) as crushers to break the shells of the crabs, shrimp, clams and other hard-bodied prey that they eat.

Anecdotal information from guides and anglers also points to more fish in the diet of large bonefish. For example, I watched large bonefish in Andros eat mojarra, and a guide in Abaco, Buddy Pinder, saw a bonefish regurgitate a partially digested mojarra. Chico Fernandez once saw a large bonefish regurgitate a small yellowtail snapper when the bonefish was boated for a photo.

The next step entails identifying which fish are most likely to be available to large bonefish in a given location and habitat. If you assume that gobies, mojarras and toadfish are the most likely fish that large bonefish will be eating, it pays to have a few appropriate flies in your fly box on any trip.

## Tying It All Together

By now you have put the pieces together. You've seen that the flies that will work best for Turneffe are patterns that imitate the reef crabs and small shrimp that make up much of the bonefish diet. Grand Bahama Island, in contrast, has a good mixture of mud, algae-covered limestone and mangrove flats that call out for crab and shrimp patterns. Using these examples as a template, you should be able to create a short list of fly patterns that will be appropriate for your next trip.

This approach is successful because each bonefish destination offers a variety of habitats, and since habitat influences what prey are available, the strategy is just as applicable in Belize as the Bahamas. It always pays to carry some of the old standards that have proved their effectiveness over time, but adding a few more patterns as discussed will likely pay dividends.

## Healthy Habitat = Healthy Populations

To a great extent, a bonefish's diet will reflect its habitat— bonefish will eat what is available, but probably with preference for the best prey. And what a bonefish eats will be reflected in the bonefish's condition, which in turn influences the ability of bonefish to grow, avoid predators and spawn. Knowledge of bonefish diet therefore is not only important to anglers wishing to catch bonefish, but also represents important information for bonefish conservation. Healthy habitats are more likely to support healthy bonefish populations because they provide more prey. Keeping track of bonefish diet and the types and amount of prey that are available on the flats is one metric we can use to monitor the health of bonefish populations.

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# Hunting Permit

MARSHALL CUTCHIN

Photo by Will Benson

Ask any top fly-fishing guide to give you a short list of his best tips for catching permit, and you will receive a handful of suggestions that are applicable almost anywhere in shallow salt water. "Watch the fish" is likely to be key advice. So is, "Know where your fly line is at all times." The fact is, most permit guides want you to do the same things you do when fishing for tarpon or bonefish—only better. Part of the reason, of course, is that the stakes are higher. A client I once "inherited" from other guides who had failed to put him on fish told me that it cost him exactly $9,957 to catch his first permit. For most of us, that is meaningful. It certainly was to me.

During more than 12 years of guiding in Key West, I watched fly fishermen make more mistakes on permit than on any other species, perhaps because there are more mistakes to make with this finicky and often exasperating fish. From that, I've developed a sort of Top 10 list of the essential skills, techniques, and tactics necessary to pursue permit. Starting with the least-critical dos and don'ts and graduating to the tips that will make the greatest difference in your permit fishing, these suggestions are also increasingly difficult to master. Learning not to stand on your fly line when a fish runs usually takes only one hard lesson. Figuring out how to set the hook on a permit can take a lifetime. But it is always best to know how deep the water is before you wade in. And taking the time to ingrain the following principles into your approach may mean the difference between having to swallow a bitter pill on your flight home and savoring the sweet taste of success after catching a most difficult fish in a most beautiful place.

## *Use a Properly Matched Fly Rod*

...and be sure you are holding it. Sure, you can keep a fully rigged permit rod in the gunwale rack for the occasional stray fish that interrupts your tarpon fishing, but when you see a permit, you will want to keep your eyes solely on that fish. They are quite difficult to see, especially for the inexperienced. So, if you want to catch a permit, stand on the bow with a permit rod in hand. Although these fish can weigh up to 50 pounds, line and rod weight are determined as much by the need to calmly deliver heavy flies—often in a stiff wind—as they are by the size of the fish. The standard is a 10-weight rod with a weight-forward floating line. Some anglers feel the need to overload with an 11-weight line to help turn over bulky permit flies, and many prefer to use a saltwater taper, which has more of its belly weight toward the tip.

But in any case, once you figure out the best rod and line combination, learn to tie solid knots—and test them. A pigtail at the end of a leader section where a knot has just failed has sent many good anglers into a downward spiral of self-defeat. And finally, make sure you don't get sunscreen on the fly line, leader, or fly. Permit have highly developed sense of smell, which they use to every advantage.

## *Expect the Unexpected*

Many anglers catch it their first permit while tarpon fishing or, say, after stepping down to take a bite of sandwich and suddenly spotting the glint of a tailing fish. You might even see a fish upon first approaching the flat, so be on the bow and ready to cast before the boat even gets into position. And when leaving, don't reel up a before the skiff's motor is going down. Many times, you might be stalking permit in two feet of water and notice, as you are about to leave, that there are fish hanging on the edge of the adjacent channel. Permit can appear seemingly out of nowhere. On windy days and in off-color water, for example, fish that normally wouldn't come to within 50 feet of the boat might suddenly swim right under the bow. Be ready to take advantage of any opportunity, no matter how unorthodox.

## *Learn to Cast Heavy Flies in Strong Wind*

Most casting instructors will tell you to open up your loop when throwing oversize or heavy flies. The technique, sometimes described as "chuck and duck," keeps the fly from abruptly bouncing at the end of the backcast and actually increases your

awareness of where the fly is (which is doubly important when you think about the potential impact of lead eyes against the back of your head). Worry less about picture-perfect casting form and more about delivering the fly on short notice, no matter what the wind direction.

## Adjust Your Strategy

Be ready to change your strategy to fit the situation. Just when you have perfected a technique for catching permit, they will change their behavior and leave you whimpering. Although there is nothing like having a few permit under your belt to calm your nerves and increase your confidence, anglers who find early success with one technique can get shut out when conditions change. Don't fixate on a specific strip length, or the supposedly best tide and wind direction, or what your buddy told you after catching four three-pound permit in Belize last year. One of the best tips for all kinds of saltwater fly fishing is "Be there and be square." Proper tackle, well-tied knots, sharp hooks, line management, and all the other mechanics of the sport constitute being "square." Being "there" simply means showing up on the flat and keeping your mind on the here and now.

## Find a Good Guide

...and work as hard as he does. The best guides will have seen a lot of fish caught on flies and know instinctively when the fish has taken the fly and when it has refused. They typically will see the fish long before you do and can tell you how it is behaving, which is critical. Beyond these core skills, effective guiding for permit takes serious physical effort that usually entails covering large amounts of territory both by motor and pushpole. You'll know you are really permit fishing when you're casting into a 15-knot wind at the end of the day. But before you decide it isn't worth the effort, remember that your guide has been pushing an 800-pound boat and 400 pounds of people around in the same wind for the past eight hours. In Key West, for example, the prevailing southeasterly wind means you are poling into a blow the last few hours of every day in order to keep the setting sun at your back. If the guide is still pushing you upwind, it's because he thinks you can still catch fish. Be sure you put out an equal effort on the bow.

## Learn to See Permit

Permit are not harder to see than other fish; they are just different. Standard advice is to look for the darkest part of the fish—their coal-black, forked tails. This is especially true when trying to spot smaller permit. But the longer you pursue permit, the more you will begin to look for the whole fish. Permit are generally larger than bonefish; yet they typically frequent darker-bottom flats and don't cast a telltale shadow as often. Head-on, however, the dark band that runs down their back from just behind their head to their tail is a dead giveaway. This is why a permit can seem to suddenly appear and then disappear as he first turns toward and then sideways to the angler. Also, despite previously published claims to the contrary, permit do in fact mud, and their muds are especially visible when they hold in current on dark, grassy bottoms or move across the current on a favorite flat, leaving short "smoke trails" each time they dig into the bottom.

## Place The Fly Where The Fish Can See It

It is often true that you don't want bonefish or tarpon to see the fly until they stumble across it. If you use the same strategy with a sinking fly for permit, such as the standard Merkin, it will more often frighten them than stimulate the fish's feeding behavior. After all, crabs don't jump up off the bottom when they see a 30-pound permit moseying toward them. Try to drop the fly far enough away from the fish that the splash will not spook it but close enough that it will first notice the fly when the pattern drops through the water column. This will vary from 2 to 15 feet, depending on the depth and clarity of the water, the speed at which the fish is moving, and whether it is actively feeding or tailing. If you are tempting fish with a floating fly or shrimp-type streamer, which are usually stripped, this rule does not hold, as you typically want the fish to see the fly only after it has been in the water for a second or two.

## Don't Strip Until You Assess the Situation, and Don't Give Up

Although you normally want a permit to first see a weighted fly as it sinks to the bottom, you sometimes may have to strip the fly until the fish notices it, especially if your cast lands a little too far away. But you'll be amazed at how many fish will still see the fly drop from 10 or 15 feet away. If the fly is close to the fish and it still fails to notice it, give the fly a very short strip, and then pause again. If the permit swims off because it seems mildly irritated or just uninterested, wait for him to get 10 feet away, then strip out and pick up the fly, and cast again. There are worse ways to spend your time than repeatedly throwing at a seemingly disinterested permit. Many times I have seen anglers make more than a dozen casts to me same fish before it finally took the fly. Keep in mind that a permit that does not leave the flat after seeing your fly once or twice is staying for only one reason: to eat.

## Feel for the Fish

Learning when to set the hook by *feeling* for the fish is a technique that is almost essential to permit fishing, although it is often useful with bonefish and other species as well. Always try to find out whether the fish has eaten the fly by removing the slack and feeling the tension in your stripping hand before lifting the rod tip—unless of course, you hear your guide yell, "He ate it!" Once you've decided the fish has eaten, you want to quickly

and smoothly bring the fly line tight. There are many reasons for not swiftly lifting your rod tip or yanking back hard on the line, but the number one reason is that you want the fly to remain in the fish's "cone of interest." If the fish is still examining the fly, you want to avoid imparting any unexpected movement to it, just in case the fish does not have it in his mouth. Secondly, the interior of a permit's mouth is not soft, but it is rubbery. A permit running with a fly after the take will generally set the hook himself, and snatching the fly too early in the sequence risks yanking it out of the fish's mouth or getting a poor hook placement.

## *Study Permit Behavior*

This is the most difficult aspect of fly fishing for permit, and the most important. Permit are generally slower and more deliberate than either tarpon or bonefish. Yes, they will attack a fly like a starving jack in certain circumstances. But permit normally examine their prey more carefully than other fish do, and waiting for a permit to make a decision about your fly can be agonizing compared with the quick response typically required to hook redfish or bones. Inexperienced permit anglers often err by lifting the rod or striking hard as soon as a permit starts to tip up on a fly. Again, this causes the fly to move when the fish least expects it, probably spooking him.

In addition to becoming a student of the species in general, learn to recognize the pace at which any individual permit is feeding, and make note of the variations in behavior that are determined by the immediate environment. For example, a fast-moving permit coming head on — even if it is stopping at regular intervals — usually gives you only one chance to make your cast, and you want your fly to land in front of the fish and within its field of vision. A tailing or mudding fish often requires that the fly land very close to its head because it is looking down and may be surrounded by a cloud of silt. A fish hanging on the edge of a channel in eight feet of water is not expecting a fly to drop at all, so strip it erratically to keep his interest. And all three situations are different from a line of fish cruising across a sea-grass flat, where throwing closer to the fish than normal is necessary just to keep the fly from disappearing in the grass. Remember, they all will eat, but each requires a different presentation of the fly, and that is something best learned by spending plenty of time on the water.

MARSHALL CUTCHIN was a guide in Key West and is now publisher of Midcurrent.com. This article first appeared in *Saltwater Fly Fishing* magazine and on MidCurrent.com.


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Mote scientists have been studying Southwest Florida's fish species since the Lab opened its doors in 1955. Many stocks of our most popular species have declined over recent decades because of habitat loss, increased fishing pressure and the occasional Florida freeze. Mote has been working to understand critical habitat needs and develop restoration methods for some of the state's most important species.
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- Mote studies have provided critical knowledge about the habitat needs of wild snook through ongoing tracking projects in Charlotte Harbor and Sarasota Bay.
- Mote, in conjunction with Bonefish & Tarpon Trust, developed the first study of permit designed to uncover crucial information about the species' life history and its status.
- Mote researchers are studying the effects of the Deepwater Horizon Oil Disaster on the Gulf's shark and billfish species as part of a long-term study of shark populations in Florida, the Gulf and Caribbean.
- Together with our research partners, Mote is working on studies of tarpon genetics to better understand the movements of this important recreational species to ensure its status in the wild.
- Mote hosts the biennial William R. and Lenore Mote International Symposium in Fisheries Ecology with Florida State University, to bring together scientists, conservationists and resource managers to explore how marine species interact and what the implications are for management and conservation.
- Mote-sponsored kids fishing clinics and adult catch-and-release research tournaments for snook and sharks help support research programs and get anglers involved in supporting and protecting the species they love.
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# Project: PERMIT

DR. AARON ADAMS
is Director of Operations for Bonefish & Tarpon Trust

Photo by Dr. Aaron Adams

Permit are often referred to as one of the most elusive game fish in the Atlantic Ocean, captivating and confounding saltwater flats anglers. Little is known about this mysterious species such as spawning and migration patterns, the health of the population and what regulations are needed to ensure adequate stock for future generations. We are now into the second year of Costa's® Project Permit, which is designed to begin filling in all these answers.

So far in Florida from the Panhandle to the Marquesas, more than 600 permit have been tagged. The distance between tagging and recapture locations have ranged from ¼-mile in a three-week time span to 43 miles with three months between tag and recapture. As the amount of tagging effort increases, we hope to get more recaptures so we can get a better handle on permit movements.

An important partner in Project Permit is the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute. They are helping to distribute tagging kits and in providing fin-clip kits for genetic testing. The genetics data will be helpful in determining if there are different sub-populations of permit in various regions of Florida.

We will be adding a new level to the project in 2012 by supporting a graduate student at the University of Florida. He or she will work closely with guides to get more fish tagged, to place "reward tags" in some fish worth $100 to spur more interest in reporting recaptured tagged, to examine the duration that tags stay in permit and to test a new satellite tag to closely track movements.

In the fall of 2011, Project Permit expanded to Mexico and Belize thanks to Costa® and new support from Sunbrella®. So far, two lodges in Belize —El Pescador and Belize River Lodge—and numerous locations in the Yucatan Peninsula of Mexico are now tagging permit.

The success of the tagging program relies heavily on angler participation throughout Florida and the Caribbean. It's not presently known how far permit move on a regular basis. Do they move long distances like tarpon or mostly stay close to home like bonefish? Figuring out this basic information is the first step toward formulating a strong comprehensive plan for this fantastic game fish.

"Anyone who has permit fished before can tell you about the art and skill needed to catch them," said Al Perkinson, vice president of marketing for Costa. "It's something we want to make sure future anglers have a chance to try, which is why the data from this tagging program are so important. Our objective is to help form policy that protects and conserves permit for our children and grandchildren to enjoy."

Photo by
Capt. Joe Gonzalez

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The Everglades in May
Signed "Wm. Goadby Lawrence" lower left
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# Tarpon Nursery Habitats

DR. JON SHENKER
is Associate Professor of Marine Biology in the
Department of Biological Sciences at the Florida Institute of Technology

I'm always envious and excited when I see an angler casting a fly to a tarpon, watching the fish explode skyward and the battle that ensues. But I also get excited when I find my tarpon—tiny tarpon—and can learn about how they live in their nursery habitats. The growth and survival of these small fry is the key to sustaining the recreational fishery.

Thanks to support from Bonefish & Tarpon Trust, the Florida Fish and Wildlife Conservation Commission, the hard work of my students and colleagues and the knowledge shared by anglers and guides, we now have a much better understanding of the early life stages of tarpon and their nursery habitats. There are still many questions yet to be answered, and strategies must be developed to protect and even expand the nurseries, but the directions to be taken are becoming clearer.

## Baseline Beginnings

We've long known that tarpon around Florida spawn offshore during summer months, but how and when they got to their nurseries were unknown. Early studies by my lab showed that tarpon larvae, called leptocephali (see Figure 1), migrate through inlets into the Indian River Lagoon about 20 to 25 days after being spawned, and that hurricanes and storms greatly increased their abundance.

Figure 1: An inch-long tarpon leptocephalus larva.
Photo by Matthew Wittenrich

Spawning activity peaks around the full moons in May, June and July, although we've captured larvae as late as October. Actual spawning has not yet been observed, but my personal world record tiniest tarpon—⅛-inch long and two days old—offers a clue about spawning. This larva was captured along the western side of the Florida Current offshore of Fort Lauderdale, about two days drift north of Marathon in the Florida Keys and two days after a June full moon. During that same full moon, one of Jerry Ault's satellite-tagged adult tarpon migrated offshore of the Keys for a couple of days. That's a convincing argument that at least one group of fish spawn offshore in the middle Keys, and I expect we'll ultimately find schools of tarpon spawning offshore around many parts of the south Florida coastline.

Once the larvae reach the right size and age, they have to enter into a coastal nursery habitat or they drift farther off into the ocean and die. The inch-long leptocephali begin to metamorphose as they enter into an estuary. They shrink over a three- to four-day period as they change shape into a small, transparent minnow-like fish, but are obviously becoming a tarpon as the long dorsal fin filament is visible (see Figure 2). In the

Figure 2: A ¼-inch metamorphic juvenile tarpon.
Photo by Sven Kupschus

Indian River Lagoon we've captured many of these tiny tarpon as they moved through culverts into mangrove-lined mosquito control impoundments.

## Habitat Characteristics

Mangrove marshes are the primary nursery habitat for the juvenile tarpon from the Indian River Lagoon to the Florida Keys and the Everglades, and up the southwest coast of the peninsula. Our initial studies in the Indian River Lagoon found large numbers of juveniles in mangroves from 20 miles north of Sebastian Inlet down to the southernmost habitat. Abundances varied widely among marshes, but many sites seemed to be used every year for a decade or more at a stretch.

An intriguing feature of the nursery habitats is that they included both natural mangrove systems and manmade

sites such as mosquito control impoundments, mangrove-lined ditches and restored habitats (see Figure 3). Through our research, we've been able to determine the environmental characteristics that each of these habitats has in common: They were generally stagnant, shallow bodies of water with an extensive mangrove fringe. Water in these habitats was very murky, with low oxygen levels and a lot of physical structure such as mangrove roots and fallen branches.

Figure 3: Juvenile tarpon and their habitat in the Pelican Island National Wildlife Refuge, Indian River County. Photo by Jon Shenker

Tarpon are ideally suited to use these stagnant habitats. As anglers know well, they rise to the surface and gulp air into their swim bladder and can transfer the oxygen in the air to their blood. This ability to breathe air enables them to live in habitats where most other predatory fishes cannot survive—as with stagnant mangrove marshes. Tarpon also have a great tolerance for variable salinities, ranging from fresh water to hypersaline conditions, and can withstand rapid fluctuations in salinity caused by major rainstorms and floods in the marshes.

After working in the IRL, the next step was to conduct a survey of the much larger and most important juvenile tarpon habitat in the United States: the Everglades. We surveyed a wide range of habitats throughout the Everglades and received tremendous amounts of information from anglers, fishing guides and other scientists who work in that tremendously complex and vast region. We found juvenile tarpon throughout the Everglades, ranging from the Chokoloskee-Everglades City area in the northwest portion of the region to the Flamingo region in the south.

Juvenile tarpon were observed in many areas of the Everglades, ranging from tiny mangrove-lined ditches and creeks to shallow open areas (see Figure 4). Juveniles were found in ditches with extremely poor water quality, like Snake Bight Creek. They utilized the mangrove-lined fringes of bodies of water like Coot Bay, Bear Lake and Mud Lake. Small creeks and stagnant ponds around Hell's Bay was an important habitat. Perhaps the greatest number of small juveniles was observed in the shallow ponds and creeks around Gopher Key Bay, deep in the middle of the Everglades.

In all cases, the smallest juveniles were found in structurally complex habitats that provided protection from predators and an abundance of food.

A study by one of my students, Zack Jud, documented the feeding habits of these tarpon. The smallest juveniles can utilize many types of food sources, ranging from aquatic insects and mosquito larvae to copepods (planktonic crustaceans) and other planktonic animals. As they grow, their diet shifts to mosquitofish, sailfin mollies, shrimp and other small crustaceans that are abundant in marsh habitats.

Figure 4: Narrow channels deep in the mangrove marsh are excellent juvenile tarpon habitats. Photo by Microsoft Bing Maps and Jon Shenker

## New Challenges

Perhaps the greatest natural environmental challenge for juveniles in these habitats is cold weather. Although juveniles have been documented in marsh habitats as far north as South Carolina, they rarely survive the winters north of Cape Canaveral. Even juveniles in southern habitats aren't always safe; the severe cold winter of January 2010 caused massive mortality of juvenile tarpon as far south as the Everglades.


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The other big threat to juvenile tarpon is human destruction of habitats. The enclosure of tens of thousands of acres of marsh into mosquito control impoundments in the 1950s and 1960s removed a huge amount of habitat from fish productivity. Construction and filling in of coastal mangrove habitats further eliminated nursery habitat. Subsequent realization of the value of these marshes to fisheries has led to reconnection of most mosquito control impoundments to the Indian River Lagoon, and our studies have shown that fishes begin moving into the marshes within hours of reconnection. Regulatory controls have protected remaining marshes from being filled in for construction, but the region has experienced an overall loss of juvenile habitat.

Human activities can cause significant and long-lasting impacts. The Everglades, like much of coastal Florida, may be subjected to major environmental changes in coming decades. Ongoing and planned restoration of water flow in the Everglades will impact the salinity regime of the habitat, and some ecosystem models suggest that the amount of mangrove habitats may shrink, squeezed coastward. Conversely, projected increases in sea level due to global warming may move the mangrove fringe northward. The balance between these two processes is not known, but the quantity and quality of suitable nursery habitat for juvenile tarpon may well be altered.

## New Directions

With this newly gained knowledge on juvenile tarpon habitat requirements, we're now ready to move into the next phase: habitat restoration and protection. We've already observed rapid colonization of newly reconnected mosquito control impoundments and other restored habitats in the IRL. But perhaps the most intriguing case is a new marsh habitat in St. Lucie County. This marsh was created behind the oceanfront dunes in 2005-06 and was an entirely new habitat, something that didn't exist before. Jud's surveys showed that it supported a large and healthy population of juvenile tarpon within several years of its construction. Given the ability of tarpon to rapidly move into restored or newly constructed marsh habitats, efforts to expand restoration projects may significantly enhance juvenile production of this wonderful species.

# Juvenile Tarpon Habitat Initiative: *Applying Research to Conservation*

*Using the information from the research on juvenile tarpon by Shenker and his colleagues, the next step is to take action to identify, protect, and restore these critical habitats.*

DR. AARON ADAMS
is Director of Operations for Bonefish & Tarpon Trust
Photo by Dr. Aaron Adams

## Need for Action

Mangrove and marsh habitats, which juvenile tarpon require, are under threat worldwide. For example, approximately 35% of mangroves have been lost globally and continue to be lost at a rate of 2% per year. In Florida, approximately 50% of mangroves have already been lost and degradation of these habitats continues. Since the amount of available habitat is one of the most important factors in determining population size for fish, the loss of these critical habitats has direct and immediate effects on tarpon and the fisheries they support.

Juvenile tarpon mangrove and marsh habitats can be impacted in two ways: by direct loss and by degradation. Direct loss occurs when mangroves or marshes are completely lost due to habitat conversion to development (e.g., roads, commercial and residential construction). Indirect impacts result from changes in water quality that degrades habitat quality. For example, alteration of freshwater flow patterns into mangroves and marshes changes the types and abundances of species of fishes and invertebrates that are able to reside in these affected habitats. These alterations can impact juvenile tarpon directly by causing such poor conditions that the tarpon leave or by causing declines in numbers of juvenile tarpon prey. These factors result in slow growth rates and poor condition for the juvenile tarpon.

## Habitat Characteristics

Juvenile tarpon depend upon shallow, backwater habitats for at least the first year of their lives. Common characteristics include mangrove and marsh vegetation and creek beds that provide structure and protection from bird predators; a mixture of depths, primarily shallow with some deeper pools for fish to congregate when water levels decrease; tidal exchange through narrow, shallow passages that keeps predatory fish away; freshwater inflow; and calm backwaters.

## Action Plan

Bonefish & Tarpon Trust is initiating a new program to identify, protect and restore critical juvenile tarpon habitats. This will require collaboration with other non-profit organizations, government natural resource management agencies, sponsors and anglers. Immediate action items include:

- Identifying and mapping habitats appropriate for juvenile tarpon
- Identifying priority locations for protection and restoration
- Identifying locations suitable for land acquisition
- Designing and completing habitat restoration
- Conducting an educational campaign to highlight the importance of these habitats for the fisheries

It is important that tarpon anglers and corporate sponsors become involved in this program through donations, advocating for restoration with natural resource agencies and becoming involved with restoration projects as they come to life. Stay tuned to www.tarbone.org for updates.

Board Member Profile

CHRIS PETERSON

# A Hell of a Challenge

BY DOUG KELLY

Photo by Hell's Bay Boatworks

The old adage, "Where there's smoke, there's fire," causes most people to run the other way when a company is nose-diving. But Chris and Wendi Peterson did just the opposite. When Hell's Bay Boatworks went belly up six years ago and the previous owner left a legion of angry creditors in its wake, the husband-and-wife team became intrigued. They took over the company, restored confidence in the brand and haven't looked back.

In this interview, Chris describes the climb to restore the reputation of Hell's Bay Boat Works and why the company is active in the conservation of our inshore resources.

**Q** What's been the biggest challenge in rebuilding Hell's Bay?

**A** Without a doubt it's effectively managing employees and personalities. It's like placing five Picassos in one room and trying to coordinate their talents simultaneously. We've evolved to where the company now has not only a creative pool of master craftsmen, but we've also attained the ability to harness all that different energy for our common goal of building superior boats.

**Q** Given the bankrupt status of Hell's Bay about five years ago, what motivated you and Wendi to do this?

**A** Wendi and I were doing other business projects at the time, but when an opportunity presented itself to buy HB out of bankruptcy we looked at all the angles with our business hats and an underlying love for boating and fishing. We ultimately decided it was what we wanted to do and we now look back with no regrets.

**Q** How do your boats differ from the original Hell's Bay designs?

**A** Some of those concepts are still there, such as how the design eliminates hull slap. We're not an assembly line, and the fact that our boats are created and designed with the fallibility of human minds and hands means that there's always something that we feel can make the boats better. Even with 10 different models between 16 and 18 feet, R&D goes on virtually every day in our plant. For example we'll take a boat with a flat bottom that poles in only inches of water and see how we can make it run smoothly in a chop.

**Q** Does any on-the-water moment come to mind about the quality of your boats?

**A** During a Keys tournament I was far up Snake Bight near Flamingo with redfish all around us. Three other Hell's Bay boats were also nearby and we all cleaned up on release points even as the tide ran out. When back at the dock, a guide who used to own one of our boats said to me, "Son of a gun, I saw you catching fish and it was just too shallow for my skiff – looks like I need to go back to a Hell's Bay."

**Q** Recognizing that mixing business and family members often doesn't work out very well, how do you and Wendi manage it?

**A** Wendi is very involved in the day-to-day operation and coordination of employees. She prefers staying behind the scenes; whereas Wendi eschews interviews and publicity, I'm more of the out-front personality. In essence I envision a big picture of what needs to be done and Wendi takes the pieces of that picture and puts it all together. It's worked out beautifully for us.

**Q** With hundreds of worthy groups out there vying for research dollars and industry partners, why did you choose BTT?

**A** We selected four main organizations to support: BTT, CCA of Florida, IGFA and the Guy Harvey Ocean Foundation. Each is really involved in the science behind the advocacy, and they also advocate. BTT's work is important because they don't just talk about what needs to be done to improve our fisheries – the group is proactive.

**Q** What's your favorite quarry?

**A** Tarpon. I learned to saltwater fly fish for bonefish, but tarpon are tougher and the techniques very specialized. For me it's the most challenging of all inshore game fish. But I have to say that any day with water under my feet is a great day.

**Hell's Bay Boatworks: 1520 Chaffee Drive, Titusville, FL 32780, 321-383-8223, www.hellsbayboatworks.com**

Doug Kelly is a contributing editor for *Florida Sportsman* magazine as well as director of the Florida Sportsman Fishing & Boat Shows.


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- Obtain membership brochures you can leave on the table at a doctor's waiting room or lodge table; perhaps a fly or tackle shop you visit will put our brochures near the register counter.
- Give a membership yourself in a friend's name as a birthday or holiday gift. It's a good bet he'll renew and become an ongoing member—see the benefits chart below.

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# The Economics of Fishing

DR. AARON ADAMS
is Director of Operations for Bonefish & Tarpon Trust

DR. TONY FEDLERS
is a fisheries economist with experience studying fisheries far and wide

Photo by Pat Ford

Although knowledge about the biology of bonefish, tarpon, and permit is essential for effective conservation, that information often doesn't turn the heads of the people in charge of enacting conservation and management measures, or the politicians who make important decisions about our fisheries. What does turn heads, especially these days, is dollars. As in, how many dollars fishing for the Big Three generates for local economies, how many jobs these fisheries support, how many tax dollars are generated.

## Dollars = Attention

Realizing the need for economic data on the fisheries, four years ago BTT began funding studies to document the economic value of fisheries for bonefish, tarpon, and permit. The results have definitely turned some heads. For example, in The Bahamas, the recreational fishery for bonefish is worth $141 million per year, with much of that value in the Out-Islands, where the fishery is a major part of the economy. This information has spurred a new campaign to halt the illegal netting of bonefish that has occurred in some locations. A positive outcome.

The fishery for tarpon also generates a lot of dollars. In the Charlotte Harbor area of southwest Florida, for example, local anglers generated more than $110 million for the local economy. Imagine how much larger that number would be if the expenditures of non-resident anglers was added. And a conservative estimate of the tarpon fishery in the area of Stuart, FL, is that local tarpon anglers have an economic impact of $13 million.

And here's a big number for you—$991 million. That's the economic impact of recreational fishing in the Everglades. That's right, nearly $1 billion per year. And bonefish and tarpon are a big part of that number—anglers in the Everglades region used a substantial number of their fishing days targeting bonefish (18% of their fishing days) and tarpon (20%).

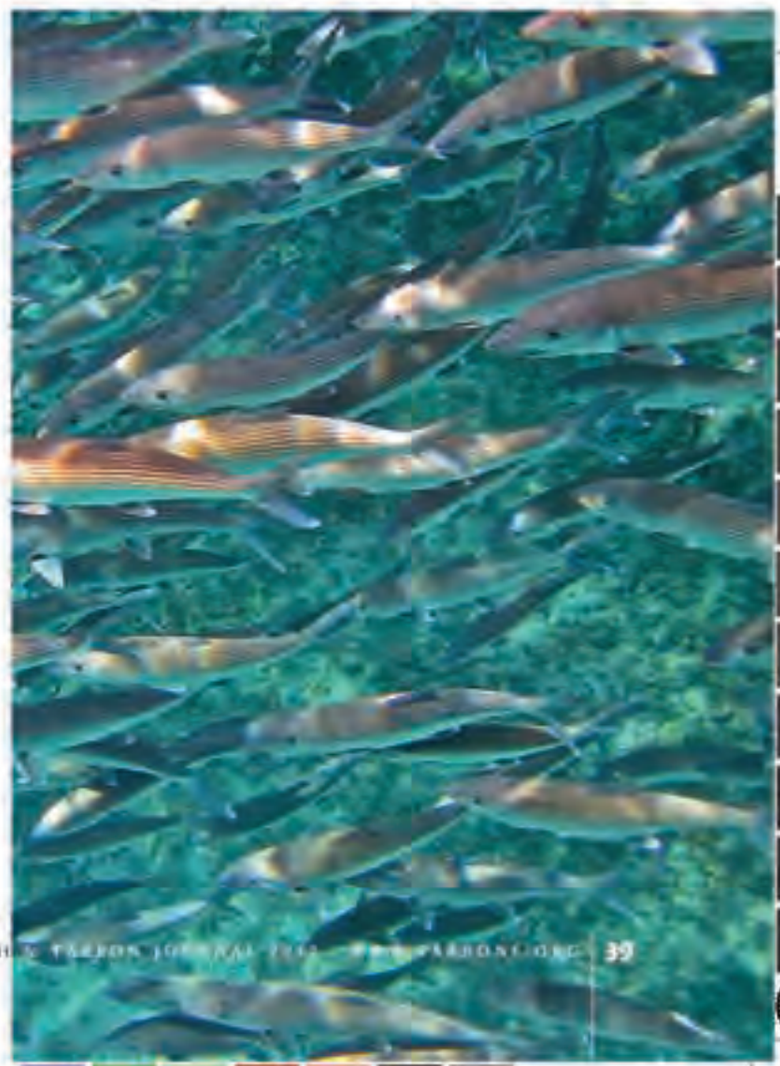
Now think about all of the other places that anglers fish for bonefish, tarpon, and permit—whether their home waters or on trips to fishing destinations. Do a little mental math, and the numbers really start to add up. These are the types of numbers that should get the attention of resource managers and politicians alike, and get them to recognize the importance of these fisheries.

## Coming Full Circle

The problem is that we've been borrowing against the bank when it comes to our fisheries. With each piece of habitat that is lost, we're reducing the ability of these fisheries to remain healthy. And with declining health, the economic value of the fisheries declines.

Think about it another way—the habitats are the assembly line that has been putting out a perfect product, and we are decreasing the quality of the product by messing with the assembly line.

Explaining the fish and habitats to people outside of the fishery often results in blank stares. But everyone understands the economic numbers. The goal is to use the economic data to leverage the conservation measures that are needed to keep the fisheries healthy and to restore those that need help.



# Bonefish
## No Longer Just Creatures of the Flats

DR. ANDY DANYLCHUK
is an Assistant Professor of Fish Conservation in the Department of Environmental Conservation at the University of Massachusetts Amherst
Photos by Dr. Andy Danylchuk

Bonefish are one of the most sought-after flats species in the world, drawing thousands of anglers to tropical coastal waters to stalk the wary but powerful gray ghost. To be successful, anglers often peruse countless magazine articles, skim internet blogs, converse with friends and consult with fishing guides about how to see, cast to, hook up and hopefully land a bonefish while wading or being poled around in shallow turquoise water.

To some, being on the flats is also a holistic, Zen-like experience that immerses them in a beautiful and dynamic environment that is home to countless other marine species that also use the shallow mosaic of sand patches, seagrass beds and mangrove creeks for food and shelter. Until just a few years ago, it was commonly thought that these shallow flats and adjacent habitats were the only places required by bonefish for survival —to feed and to avoid sharks, barracuda and other predators. Following this conventional wisdom, anglers, scientists and resource managers focused their conservation attention on the flats.

Thanks to a growing pool of evidence based on Bonefish & Tarpon Trust-funded research, we now know that we need to adjust this conventional wisdom: Bonefish are no longer just creatures of the flats. They also require deeper waters for spawning.

Much of this evidence comes from a series of studies that used acoustic telemetry—surgically implanted transmitters that send out sonic pings that are detected by underwater listening stations—to monitor the seasonal movement patterns of bonefish. The first of such studies was conducted in the Florida Keys by Dr. Jerry Ault, which provided some clues that bonefish were moving away from coastal flats. However, it was not until a multi-year, multi-investigator project on Eleuthera, Bahamas, used acoustic telemetry to document that large numbers of bonefish make direct

movements offshore at very specific times of the year. This study showed that bonefish increase their home range in the fall and winter months to include deeper water. (In contrast, their summer home range tended to be much smaller and oriented to shallow flats.) The winter movements included transitional habitats—areas up to 20 feet deep—where they formed large pre-spawning aggregations before moving offshore to spawn. While in the pre-spawning aggregations, our team observed very unique activities such as fish nudging each other's bellies, and a porpoising behavior occurring just as the large schools of bonefish began moving offshore under the cover of darkness. You can see a video of this behavior at http://www.youtube.com/watch?v=Id0vO1DUxgs.

Incredibly, these offshore movements of bonefish were to areas in close proximity to deep-water drop-offs (in excess of 1,000 feet), coincided with the new and full moons, and occurred at night. This is in complete contrast to their movements in association with the daily tidal cycle that are typical when bonefish inhabit the flats.

Following these offshore movements, bonefish promptly returned to tidal flats where they spent the rest of the year. But amazingly we tracked some of our tagged fish for over 500 days and they repeated this offshore movement pattern in successive seasons, which emphasizes the importance of these areas.

A similar study was conducted on Andros, Bahamas, and the patterns of bonefish movement were similar. From October through May in association with new and full moons, bonefish moved away from their typical flats habitats toward deeper water areas up to 40 miles away, and then returned to their home flat.

Why would bonefish risk moving offshore to spawn? One possible benefit is that it increases the dispersal of their fertilized eggs, especially with the high tides and associated strong currents that happen near full and new moons. (Like most marine fish, bonefish eject eggs and sperm into the open water, where fertilization occurs, and then the larvae that hatch from the eggs float in the ocean for a period of 42 to 72 days.) This behavior is typical of many marine fish.

Ironically, the pre-spawning aggregation sites used by bonefish—embayments adjacent to deeper water— are desirable locations for developers seeking to build marinas. Since we now know that the bonefish we pursue on the flats also require these embayments as part of the spawning process, our conservation plans for bonefish must be adjusted to include these important locations.

Imagine what would happen if a pre-spawning aggregation site was dredged for a marina. Do we know whether the bonefish would find another aggregation site? Perhaps bonefish are like other fish species (like salmon or Nassau grouper) and return only to the same spawning location year after year. Perhaps the decline of bonefish in some areas is related to coastal development and loss of pre-spawning aggregation sites (as well as changes in water quality and disturbance of their more typical flats environments). Given that many coastal communities in the tropics rely on the income generated by recreational angling and that bonefish likely play an important ecological roll in connecting coastal habitats, it is imperative that we proceed with caution when developing coastlines and think beyond the flats when it comes to the conservation and management of bonefish.

As bonefish become an even more popular target among recreational anglers, it will be critically important to work not only protect bonefish through the use of best practices for catch and release, but to also protect the corridor of coastal habitats that support all life stages of bonefish and at all times of the year.

Now that the spawning patterns for bonefish have been established, the next step is to use this information to identify pre-spawning sites in other locations so that these sites can be incorporated into conservation plans and protected. These efforts are now beginning, but need to be expanded.

# Spawning Bonefish, the Next Step:

## Tracking the Bonefish of Abaco

ZACK JUD is a PhD student in the Marine Sciences Program at Florida International University

Connecting the flats where we fish for bonefish with important pre-spawn and spawning areas is critical to managing and protecting fisheries. Although important bonefish flats may be protected from habitat destruction and harvest, migration corridors to pre-spawning locations and the pre-spawning locations themselves have not been afforded the same level of attention and protection. Even if these areas are only used during a small part of the year, habitat loss or harvest here could have far-reaching impacts since studies in Eleuthera and Andros suggest that a pre-spawning location is used by bonefish from a large geographic area.

With the findings from Eleuthera in hand, the next step is to work with fishing guides to identify pre-spawning sites in other locations so that guides and lodges can work to protect these important sites. Examining maps and aerial photos, we can identify embayments with close access to deep open ocean waters that are potential pre-spawning locations, and narrow the list of potential sites using observations by guides that include reports of large schools of bonefish near new- and full-moon phases during spawning season.

In October of 2010, a team of scientists and guides led by BTT's director of operations Dr. Aaron Adams took to the flats of Abaco in an attempt to determine where that island's bonefish go to spawn. The study stemmed from a conversation at the Abaco Science Alliance Conference the previous winter. At the conference, several local guides mentioned that they had recently spotting a huge school of bonefish milling around near the south end of the island in a bay immediately adjacent to blue water. The guides had also seen schools of bonefish migrating south along the outside edge of The Marls in fall months, the fabled network of flats and mangrove islets located along the west-central coast of Abaco (and one of the island's most important bonefish fisheries). Although nearly 40 miles separated The Marls from the reported aggregating site, the location reported by the guides was the only spot along the entire western coast of Abaco that matched the characteristics identified in Eleuthera—a shallow bay in close proximity to deep ocean waters.

Photo by Pat Ford

Our group consisted of six BTT-collaborating scientists haling from Mote Marine Lab, Florida International University, University of Illinois, University of Massachusetts and Cape Eleuthera Institute as well as 12 dedicated guides from the Abaco Fly Fishing Guides Association (who collectively donated more than 40 guide-days to the project). We spent a week tagging bonefish along the western side of Abaco using a mix of high-tech acoustic tags and low-tech dart (spaghetti) tags with the hope of identifying movements between The Marls and the potential pre-spawn area at the southern end of the island.

We surgically implanted acoustic tracking tags into 25 bonefish (an additional 339 were dart-tagged throughout the island). Half of these fish were tagged in The Marls and the other half were tagged near the bay where the potential pre-spawn schools had been spotted the previous fall. Each tag emitted a unique

series of ultrasonic pings, almost like underwater Morse Code, allowing us to identify individual fish if they did in fact migrate to the potential spawning area. We set up a listening array consisting of 25 high-tech underwater acoustic receivers scattered throughout a 10-square-mile area surrounding the potential aggregating location. These receivers would detect the arrival of any tagged migrants from The Marls. At the same time, they would track the day-to-day movements of the local bonefish that we tagged nearby.

If bonefish from The Marls used the potential pre-spawning location, we expected to detect one or more of the acoustically tagged Marls fish at this location in the fall or winter. In many ways, detecting a tagged Marls bonefish at the southern end of Abaco was a bit of a needle in a haystack—not only had we been able to tag only a dozen bonefish in the Marls, but the acoustic receivers only sampled the bay. They didn't provide complete coverage, so a bonefish could conceivably swim through the bay without being detected.

What were the chances that one of the bonefish that we tagged in the Marls would be detected at this potential pre-spawning location more than 35 miles away? To a betting man, the chances were pretty small. But a betting man would have lost, because that's exactly what happened. After retrieving the underwater acoustic receivers in May at the end of the spawning season and downloading the data, we found that an 18-inch female bonefish that was tagged in The Marls migrated nearly 40 miles to the potential spawning area. It was disappointing that we only detected one tagged bonefish from The Marls, but since relatively few bonefish had been acoustically tagged, we were aware of this possibility from day one.

Photo by Dr. Andy Danylchuk

Although we don't know when the fish left The Marls, it first appeared at the northern edge of the acoustic listening array on December 1. The fish spent two days swimming through the array, and on December 3 it left the array *at the exact location of the reported pre-spawn aggregation*. This was just two days before the December new moon, exactly when we'd predict spawning activity to occur. We feel that there is a strong likelihood that this fish traveled from The Marls to the southern end of Abaco to spawn around the December new moon.

In addition, the behavior of two bonefish that were tagged on a flat near the potential pre-spawn site further suggests that spawning was occurring around winter new moons. Both of these fish suddenly disappeared from our shallow-water listening array for several days around the new moon in December and January. We suspect that these bonefish moved offshore to spawn. Their movements coincided with the movement of The Marls bonefish, which strengthens our belief that these movements were associated with spawning.

Although our preliminary findings in Abaco were limited by the small number of fish we tagged, the movement we observed is critical. It demonstrates connectivity between the world-class fishery in The Marls and other parts of the island. If bonefish are in fact moving toward the southern end of the Abaco to spawn, we are concerned that disturbance or habitat degradation at the pre-spawn site or along the migratory corridors leading to it could have devastating effects on the bonefish fishery throughout the island. Unfortunately for bonefish, shallow bays with nearby deepwater access are prime candidates for marina and resort development.

We hope to repeat this work in the fall of 2012, once again with the help of the Abaco Fly Fishing Guides Association and local lodges. We are optimistic that future tagging efforts on Abaco will reveal additional details about spawning movements, which in turn could lead to enhanced protection for the fishery.

A complete listing of the guides, scientists, lodges and sponsors who made this study possible can be found at http://www.tarbone.org/news-a-events/375-bonefish-migration-in-abaco.html.

# The Search for Juvenile Bonefish

CHRIS HAAK
is a PhD student in the School of Marine Science at the University of Massachusetts Amherst, where he is advised by Dr. Andy Danylchuk

Photos by Chris Haak

When we think of bonefish habitat, the first image that comes to mind is one of the shallow water, white sand and mangrove-fringed tidal flats that so frequently grace the covers of fly-fishing catalogs and magazines. Although this picture represents the primary habitat we fish in, it is only one of many habitats relied upon by bonefish over their life cycle.

As do many species of fish, bonefish inhabit different surroundings over the course of a lifetime, moving between distinct environments as they develop from fertilized egg to mature adult. This means that if we hope to ensure the long-term health of bonefish populations, we must identify and conserve not just one, but a range of habitats encompassing the entire life cycle of the species. While protecting large areas of tidal flats and creeks will help ensure that adult bonefish are protected, other life stages may still be vulnerable to habitat loss or degradation.

Fortunately, a number of studies in recent years have helped to identify many of the habitats relied upon by bonefish throughout their life cycle. For example, we now know that pre-spawning aggregations of bonefish use deeper embayments before heading offshore to spawn, and that bonefish larvae remain in the ocean for up to 72 days before moving inshore and transforming into juveniles. But finding out where juvenile bonefish of six inches or less dwell has remained a mystery despite years of efforts. But we're making progress.

Work on other fish species has already shown that the juvenile stage of fishes generally suffers the most from environmental degradation. This is very likely true for bonefish as well and identifying juvenile bonefish habitat is critical to ensuring successful conservation.

Over the past decade, exhaustive efforts to locate juvenile bonefish have occurred in the Florida Keys and

Belize. During those previous studies many juveniles were captured along windward sandy beaches, but the overwhelming majority of these fish were found to be Albula species B (aka Albula garcia). In contrast, the bonefish caught in the recreational fishery are almost entirely a different species—Albula vulpes. Given the importance of identifying juvenile bonefish habitats, efforts were renewed in The Bahamas during the summer of 2011.

The study, based out of the Cape Eleuthera Institute, is still in its early stages, but more than 140 juvenile bonefish ranging from less than one inch to nearly five inches in length have already been captured. Preliminary genetic identification of these juveniles indicates that they are the elusive *A. vulpes*.

Some strong trends are becoming apparent, allowing us to begin making generalizations about juvenile bonefish habitats on Eleuthera. Nearly all the juveniles collected so far have been found in relatively large, sheltered coastal embayments comprising a range of water depths with both windward and leeward exposures. The overwhelming majority of these fish were collected in calm, shallow water (averaging just over a foot deep) over bottoms dominated by fine sediment and near mangroves. Although they were often found close to the traditional flats habitats used by adults, juveniles did not appear to use these habitats, preferring instead to remain close to areas of deeper water.

Nearly every bonefish we collected was in the company of greater numbers of mottled mojarra (a common, schooling baitfish often found in shallow coastal waters) of similar size to the bonefish. Both the mojarra and bonefish exhibit very similar coloration on both their backs and sides, with markings similar to the part marks apparent on juvenile salmon. It's possible that juvenile bonefish may be reducing their risk of predation by blending in with considerably larger schools of mojarra. This behavior, known as social mimicry, is also seen in other species. Since both species are bottom feeders and feed by mudding (stirring up fine sediment from the bottom to unearth small prey), they may benefit by their combined feeding efforts. Whatever the purpose, the association with mojarra may also explain why we don't observe schools of juvenile bonefish, because they are in fact dispersed among schools of mojarra rather than in large schools on their own.

If continued research confirms our preliminary findings, conservation action will likely be needed because the habitat characteristics required by bonefish (large, sheltered water bodies with relatively deep access to open water) are the very same qualities that make locations ideal for marinas and resort developments.

If continued research confirms our preliminary findings, conservation action will likely be needed because the habitat characteristics required by bonefish (large, sheltered water bodies with relatively deep access to open water) are the very same qualities that make locations ideal for marinas and resort developments. Marina development and the disturbances that accompany it such as dredging, mangrove destruction and reduction in water quality could all pose a substantial threat to settling and juvenile bonefish, and might explain the relative absence of *A. vulpes* juveniles locations with extensive coastal development.

Sampling will continue on Eleuthera and other locations through at 2012, hopefully bringing us closer to understanding this critical life stage, and leading to more effective conservation measures.

ARTIST OF THE YEAR

# David Lazarus

BY STEPHEN O'BRIEN, JR.

David Lazarus was born in London, England, in 1952, and counts among his early artistic experiences a fascination with the art of scrimshaw. The miniature scale of this medium suited him well, as it enabled him to travel with a studio the size of a cigar box. Eventually settling on Nantucket, Lazarus established himself as one of the island's premier artists.

Over the past 10 years, Lazarus has devoted more time to painting in oils. "The looseness of pushing paint around, after having engraved miles of tiny lines, has been liberating as well as challenging," Lazarus explains.

Lazarus has had one-man exhibits at several galleries including the Old Spouter Gallery and South Wharf Gallery on Nantucket Island and Stephen O'Brien Jr. Fine Arts, LLC, in Boston. In addition to his increasingly popular oil paintings, Lazarus' wildlife prints are among the finest etchings being produced today.

David reminds me a little of a modern-day Frank W. Benson in terms of his brushwork. His work is bright, vivid and full of light. His impressionist style allows him to move the paint around the canvas and place it just so. His paintings are a high-wire act with risks and rewards. Sometimes the paint can get a little muddied and he literally discards those works into the trash. But when he nails them, which is more often than not, the results are amazing. My wife Cinnie and I collect his works personally and they are amongst my favorites in our permanent collection.

STEPHEN O'BRIEN
Owner of Stephen O'Brien Jr. Fine Arts, LLC, in Boston

## Bonefish Catch-and-Release Science:

# Past, Present & Future

DR. STEVEN J. COOKE, DR. CORY D. SUSKI & DR. ANDY J. DANYLCHUK

Steve Cooke is an Associate Professor of Environmental Science and Biology at Carleton University

Cory Suski is an Assistant Professor in the Department of Natural Resources and Evironmental Sciences at the University of Illinois at Urbana-Champaign

Dr. Andy Danylchuk is an Assistant Professor of Fish Conservation in the Department of Environmental Conservation at the University of Massachusetts Amherst

Photo by Dr. Aaron Adams

At the first BTT symposium in 2001, we delivered a presentation on bonefish catch-and-release. In hindsight, the presentation didn't have much in the way of data on bonefish because the science on bonefish was just getting started. Instead we borrowed concepts and patterns developed using other marine and freshwater fish and considered how that information might be relevant to the catch-and-release of bonefish. We knew it was a reach, but we had to start somewhere. We made a lot of assumptions: barbed hooks worked well for trout fishing, so surely there would benefit bonefish; providing bonefish with extra oxygen during recovery from stress should increase survival; if we let bonefish go closer to cover, such as mangrove roots, they would be able to hide from predators until they recover. What a long way we have come. We now have real data based on bonefish research supported by BTT for bonefish-specific catch-and-release best practices.

## History

The first bonefish catch-and-release scientific article was published in 2004 and confirmed what many anglers knew already: If there were sharks hanging around, there was a decent chance that fish could be eaten after release. That paper identified a problem but did little to suggest solutions. Thankfully, almost all the work on bonefish since that initial study has focused on solutions, such as handling strategies or fishing gears to maximize bonefish survival after release. Arguably, the Common Bonefish *(Albula vulpes)* is now one of the best-studied marine species with respect to catch-and-release, with now more than 10 scientific articles published since 2004.

## Hook Type

What happens to a bonefish that has the line break and swims away with a hook in its mouth? Will the hook come out on its own? What should an angler do if the bonefish they just caught is deeply hooked? Are barbless hooks better for the fish?

To address these questions we quantified the impacts of hook location and duration of hook retention on the survival and feeding of bonefish, and compared barbed versus barbless hooks. We took wild bonefish, exercised them to simulate angling, implanted fishing hooks in their mouths in various locations (some fish were hooked in the lip, some in the esophagus, some fish had barbless hooks, etc.), and the fish

were then held in a tank at the Cape Eleuthera Institute for two weeks. The study showed that hook retention for bonefish resulted in little physical or behavioral impairment despite the range of treatments that were applied. All bonefish survived the two-week observation period in the lab regardless of hook size (#4 vs. 1/0), hook location (lip vs. esophagus) or hook type (barbed vs. barbless) and were subsequently released back into the ocean. Forty-seven percent of the bonefish lost their hook within five days after hooking, and almost three-quarters of bonefish hooked in the lip lost their hook during the two-week holding period. Hooks located in the lip were more likely to be ejected by the end of the two-week study compared to hooks located in the esophagus. There was no difference in shedding rates between barbed and barbless hooks. Based on this study, we recommend that anglers should consider cutting the line and leaving the hook before releasing a bonefish if it is deeply hooked —especially if anglers are using barbless hooks.

Oxygen—Just like humans, bonefish have specific oxygen requirements that need to be met to keep them happy, healthy and vigorous. When we interact with bonefish through angling, we have the potential to impact their access to oxygen, which is something that frequently goes unnoticed. Previous research has shown that angling is essentially exercise for fish and can result in changes to their physiology—their heart rate goes up, they consume a great deal of energy and they also produce wastes such as lactate, similar to what we would produce if we were exercising.

To minimize the likelihood of predator attacks on angled fish, anglers sometimes choose to hold fish in a livewell for short durations to allow for safe recovery before releasing the fish. Similarly, bonefish caught during live-release angling tournaments are sometimes held in livewells prior to the weigh-in, and this holding period can last for several hours. We used

Photo by Ian Davis

blood physiology and behavioral observations to identify what dissolved oxygen concentration bonefish need and, more importantly, if it's possible to give bonefish too much oxygen.

Results showed that recovery from exercise was slowed by low oxygen conditions compared to having bonefish recover in regular seawater. Perhaps more notable was that recovery was also slowed for bonefish held in high oxygen levels compared to normal seawater. This is because hyper-oxygenated water (water with above normal oxygen levels) caused physiological disturbances that persisted for several hours. We also studied the behavior of bonefish under different levels of oxygen, with similar results.

Photo by Ian Davis

Based on this work, we recommend that the dissolved oxygen concentrations during holding do not deviate from natural seawater, such as in a flow-through livewell.

## Release Environment

Since we know that sharks eat bonefish, especially those that are tired after being caught, an obvious question for those that stalk bonefish on the flats is whether a bonefish released into thick cover such as mangrove prop roots will be able to avoid predation by sharks. To address that, our research group compared the behavior and survival of bonefish released near cover (mangrove roots) or away from cover. It turns out that there was no benefit provided by mangrove roots, largely because bonefish tended to swim away from those areas. Moreover, the likely predators include juvenile lemon sharks that were

able to move into the mangrove areas with ease. So, even though in principle the idea of releasing bonefish close to cover should reduce predation, we did not observe that pattern in the field.

Interestingly, the most important factor in determining whether a bonefish was attacked by a predator after release involved the amount of air-exposure time. Bonefish exposed to air for short periods (seconds or not at all) tended to survive while those that were held out of the water for extended periods were unable to avoid predators after release.

Fortunately, with the help of BTT we have come a long way since 2001, and scientifically tested best-practices for bonefish catch-and-release.

## Future Knowledge

This has been a summary of the more interesting and important findings related to research on bonefish catch-and-release, and questions remain. For example, are there better ways to assist recovery of bonefish after they are caught to reduce post-release predation? We also don't know if different species of bonefish respond to catch and release in the same way as *Albula vulpes*.

At the population level, we're still unaware of what amount of post-release mortality could be detrimental to the population—something critical to determine, especially as the popularity of bonefishing increases.

Fortunately, with the help of BTT we have come a long way since 2001, and scientifically tested best-practices for bonefish catch-and-release (including what to do and what not to do) are conveniently summarized and available on the BTT website as well as printed on a small card that would fit nicely in a fly box. Contact BTT for a copy of the card or to suggest handling practices for bonefish and other flats species that should be tested as a way to increase the sustainability of our sport.

# Increasing Membership in the UK & Europe

PAUL SHARMAN
is Editor of *Fish and Fly Ltd.*
Photos by Paul Sharman

In the early spring of 2011 as the newly appointed representative of the BTT in the United Kingdom, I joined BTT operations director Dr. Aaron Adams to lead the first-ever group of UK-based anglers on a Travelling Angler trip to the Jardines de la Reina area of Cuba. We enjoyed the generous assistance of Avalon Cuban Fishing Centers.

There are many passionate flats fishers from Europe and the UK who travel the world in search of bonefish, permit and tarpon using a wide variety of destination travel firms based in the region. Often they travel to locations that are different from those visited by US-based anglers, such as Cuba. Currently there are only a handful of BTT members in Europe, so we are beginning a campaign to both educate anglers about BTT and recruit more members.

We are also encouraging corporate sponsorships from those companies actively engaged in the retail of tackle and trips to European flats anglers. These sponsorships would help support current and new research and conservation programs, especially in areas like Cuba.

If you can help with this effort please contact BTT via our web site www.tarbone.org

# *Journey of the Silver King:*

# Tracking the Travels of Atlantic Tarpon

DR. JERALD S. AULT & DR. JIANGANG LUO
Jerald S. Ault is a Professor of Fisheries and Director of the Tarpon & Bonefish Research Center,.

Jiangang Luo is a Senior Research Scientist at the University of Miami's Rosenstiel School of Marine and Atmospheric Science
Photos by Jiangang Luo, unless noted

## *Ten years ago to today–what have tarpon taught us?*

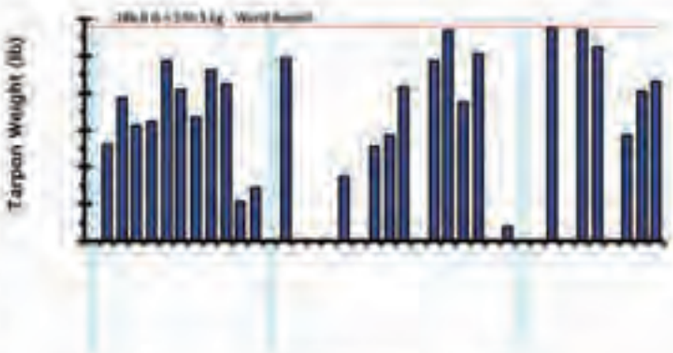
Ten years ago, tarpon was the subject of a conversation between University of Miami scientists and Bonefish Tarpon Trust (BTT) founding board members Stu Apte, George Hommell, and the late Billy Pate. The discussion centered on the collective concern about the declining numbers in this historically prominent U.S. fishery. Billy noted that when Homosassa, Florida, was discovered as a fishing location in the early 1960s, it was not unusual to see several hundred fish at 200 pounds during a season, but an angler was lucky to see two that size today. Port Aransas, Texas, once considered "tarpon capital of the world," had also seen dramatic declines since the heydays of the 1930s-1940s.

What could possibly be happening to this precious fishery resource? Some of the discussion covered coastal development, energy extraction, prey and habitat loss, and water management. Billy, however, focused his attention on the poorly quantified, but substantial tarpon harvests throughout Latin America. He offered a sage and prophetic question: "Are our tarpon their tarpon?" Together we began an exciting and unparalleled exploration into the journey of the 'Silver King.'

## *Tarpon Science Background*

Fascination with the 'Silver King' stretches back at least five centuries, to Michelangelo's painting on the Sistine Chapel of 'Jonah and the Great Fish'. It turns out that "great fish" was an Atlantic tarpon!

Tarpon inhabit Atlantic coastal waters from Brazil to Nova Scotia (5° S to 40° N), and from Angola to Senegal (15° S to 15° N). They grow to several hundred pounds over their ~80 year lifespan. Historically, the bulk of world record fish have come from places like Florida, Texas, and Venezuela; however, these days the largest tarpon seem to be coming from Africa. These and more details on what we know about tarpon are summarized in '*Biology and Management of the World Tarpon and Bonefish Fisheries*', a book that originated from the Bonefish & Tarpon International Symposia held in 2003 and 2006.




Atlantic tarpon angling records by location.
Current all-tackle world record of 286.5 pounds was caught in 1997 in Guinea Bissau, western Africa.

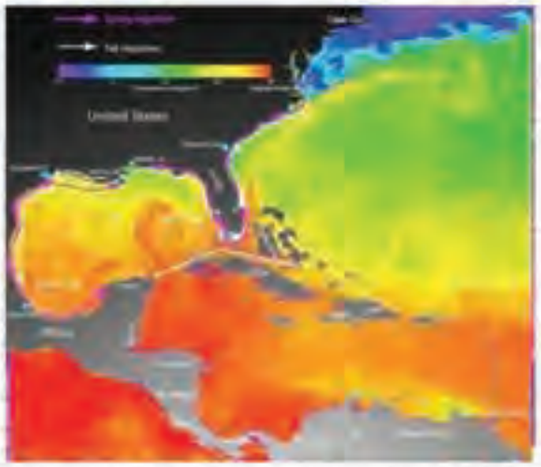
Tarpon declines in historically productive areas can be traced to two likely factors: fishing ethics and the tarpon's vulnerability to harvest due to its long life span and slow growth. Fortunately, recognition of the Silver King's ecological and economic role has prompted a critical transition from "hang 'em high" to catch-and-release in much of its range. Plus, data collected by BTT scientists has provided an extremely accurate weight estimate from measuring the fish's length and girth. Get your own Tarpon Weight Calculator Card by emailing or calling BTT, or download the new iPhone app from the BTT web site.

Perhaps the most vexing issues are nested in questions like: Where do the biggest tarpon come from and where do they go? What proportion of the tarpon traveling through Florida each year were born there? Do populations migrate internationally? Seasonal availability patterns have long led folks to speculate that tarpon migrate, but this issue lacked specific proof and was generally met with skepticism. To address this issue and Billy Pate's original question, a new high-tech direction was undertaken by BTT scientists to better understand the mysteries of the Silver King.

## State-of-the-art satellite technology

The Atlantic tarpon satellite-tagging program (ATSTP), a collaboration between the University of Miami (UM) and BTT, began in 2001 with the overarching goal of providing the science necessary to sustain productive tarpon fisheries. The objectives were to determine and protect seasonal migratory patterns, critical spawning and feeding areas, and regional over-wintering areas. We have used state-of-the-art satellite-based Popoff Archival Transmitting (PAT) tags on migrating tarpon in Florida, the southeastern US, and Gulf of Mexico, and the Caribbean Sea, to address these objectives.

PAT tags gather detailed data on a tarpon's use of the environment over relatively long time periods. After a specified amount of time, tags detach from a fish and "pop-up" to the ocean's surface to transmit the stored data to the ARGOS satellite network, and then on to UM for analysis. The information from this tagging effort are greatly changing the way we think about the Silver King.



Migrating tarpon reliably follow a temperature band of 79°F and can appear overnight like magic. This shows seasonal migrations (April to October) from 2001-2010 using PAT-tag technologies. The white wedge represents the suspected northern boundary to seasonal migratory areas for Atlantic tarpon during November to March.

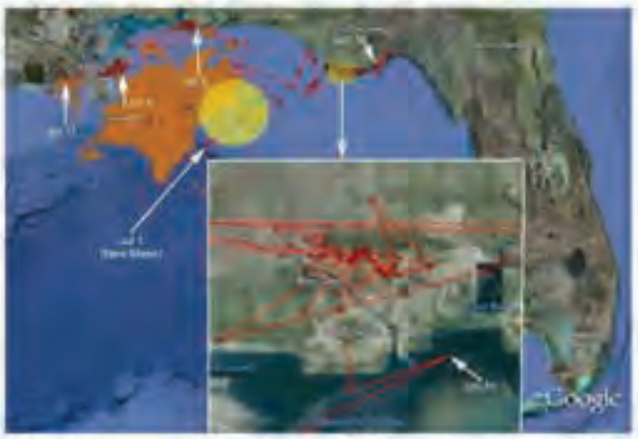
## Early returns from PAT tags

Tarpon undergo extensive, long-range migrations, which are associated with specific water temperature (centered on 79 oF). During these travels, tarpon track mullet, menhaden, and other seasonal prey. But they are in turn pursued by their own predators, including bull, hammerhead, tiger, and mako sharks. Some individual tarpon migrations are in excess of 2,500 miles! In general, tarpon schools enter waters of Florida and the Bay of Campeche, Mexico, beginning in spring (March-April) to feed and spawn. Some of the tarpon that initially arrived in Florida then travel northward along both the Gulf and Atlantic coasts in early June to the rich estuarine and coastal environments of the Mississippi River and Chesapeake Bay by late July, where they likely feed on the abundant menhaden, crabs and shrimp. As coastal waters cool in the fall, the schools begin the southward component of their migration, moving through Florida and Texas waters from late September through early December. We also discovered that tarpon are capable of diving to 486 feet, either during spawning or perhaps to feed in ocean frontal systems. But tarpon spend most of their time in shallow waters, within 30 feet of the surface.

Capt. David Mangum prepares to release tarpon T187, a 192 pounder carrying a SPOT5 tag, near Apalachicola, FL.

## New Research Focus in 2011–Technological Advances

In 2011 we greatly expanded our studies on the identification of spawning and overwintering areas, and also initiated an evaluation of the potential effects on tarpon from the Deepwater Horizon (DwH) oil spill. Because we want to obtain more precise information on tarpon movements and habitat use, we are employing new tagging technology. The PAT tags that we have been using provide important information, but have limitations. PAT tag data are not real-time—we get all of the data stored on the tag only after the tag pops off the fish and floats to the surface. And although they give us detailed



Map of movement track of tarpon T187 from June 3 to July 11, 2011. The insert map shows the period from June 7 to June 18 while the tarpon was in the wetland tributaries of the Apalachicola River. The orange polygon indicates the area of DwH oil spill in 2010. The yellow circle indicates the possible spawning area.

information on water temperature, time of day, light levels, depth, and salinity, the location estimates from PAT tags remain a bit fuzzy (accurate within about 60 miles).

In 2011, we tested SPOT-5 (Smart POsitioning and Temperature) satellite tags that have enhanced tracking technology. SPOT tags transmit real-time geographic positions when the tarpon either rolls at the surface or jumps. The passing ARGOS satellite network picks up the transmissions and determines the tag location within 1000 feet.

In 2011, more than 40 tarpon were tagged, about half with standard PAT tags and half with SPOT-5 tags. Tags were deployed mostly at eight locations:(1) Whitewater Bay, Everglades National Park and the Florida Keys; (2) Miami, FL; (3) St. Lucie, FL; (4) Boca Grande, FL; (5)Georgetown, South Carolina; (6) Apalachicola, FL; (7) Belize; and (8) Trinidad, British West Indies. Results obtained so far from the SPOT-5 tags have been enlightening.

## New Insights into Tarpon Travels

The SPOT-5 tags are providing some very useful information on the use of both coastal and offshore habitats by tarpon. For example, a 192 pound tarpon was tagged with SPOT-5 tag number T187 late in the afternoon of June 2, 2011, after being caught by a fly angler in Saint George Sound, Apalachicola, Florida. It was the largest tarpon we tagged this year! Four days after being tagged, the tarpon spent 10 days in the lower Apalachicola River and wetland creeks before once again heading offshore. The tarpon bolted 100 miles offshore, where it was detected on July 1, near the new moon, on a likely spawning run.

After the likely spawning event, the tarpon zigzagged along the coast, eventually ending up almost exactly where the Deepwater Horizon oil spill disaster occurred in spring 2010. This fish gave us great insight into how tarpon use estuarine, coastal, and offshore habitats, and underscore the need for a comprehensive conservation plan for tarpon.

Photo by Stephan Gian Dombaj

## Movement Strategies

Tarpon apparently use two modes of movement, probably to avoid predators, take advantage of different habitats and resources, and maximize the efficiency of their migrations: (1) a fast speed strategy across open coastal waters between rivers or bays; and (2) a slow speed strategy when they "lay up" in and around rivers and shallow bays that appear to have fewer predators. For example, immediately after being tagged at Bahia Honda, FL, a 120 pound tarpon, T184, moved quickly and reached Islamorada on May 22nd, **before** slowing down and hanging around the Grassy Key-Marathon Key area until June 9th. This tarpon alternated the fast and slow movement patterns for the next month, eventually ending up in the Ten Thousand Islands area when the tag stopped transmitting on August 1st.

As part of the 'slow' mode of movement, tarpon showed a higher use of rivers during their seasonal migrations than we previously thought. They traveled significant distances up freshwater rivers and tributaries (>50-75 miles upstream), and then "laid up" in and around these rivers and bays during their migratory journeys, spending considerably more time in river systems than we previously thought. For example, a 156 pound tarpon, T179, tagged on April 27, 2011, near Broad Key, Florida moved quickly to the St. John's River near Jacksonville, Florida and remained there 4 days, before moving to the Altamaha River on May 16th, where it remained—between the mouth and 20 miles upriver—through July 4th when the tag came off the fish.

## Where do we go from here?

The environmental insult of DwH may have long-term impacts on tarpon fisheries and the functioning and dynamics of the super-valuable fisheries of the Gulf of Mexico and surrounding waters. Our data have clearly shown that tarpon move into the spill area during summer, and they primarily use near surface waters where risks have not been evaluated for tarpon

surface waters where risks have not been evaluated for tarpon or any other species. Risks to migratory and spawning behaviors may be of two types: acute mortality from direct encounters with the toxic oils and dispersants; or insidious chronic effects on reproductive population dynamics (spawning, larval survival, juvenile success in nursery areas), growth, and death rates. These would include effects on the food chain due to the disruption of sensitive microscopic organisms and baitfish at the base of the food web that provide food for tarpon and other large fishes. Focused study and new data are urgently needed to understand these effects on tarpon. This will require improved communication between the public, scientists and managers; stronger state-federal and public fiscal support for the science; and improved legislation to protect the fishery.

SPOT-5 tag performance holds great promise for future ATSTP research, by providing even more immediate and detailed data on tarpon movements. We also discovered in 2011 that we can convert our current stock of PAT tags into a version of the SPOT tags, so they can provide real-time positions when the tag is exposed to air. This will greatly expand our capabilities to address some of the most perplexing questions that remain. Future ATSTP research will address several priority items: locations of tarpon overwintering habitats; locations of tarpon spawning grounds; how fisheries in strategic habitats in Florida (i.e., Whitewater Bay and Boca Grande) are sustained and contribute to the productivity and dynamics of regional tarpon fisheries.

**SPOT-5 tag performance holds great promise for future ATSTP research, by providing even more immediate and detailed data on tarpon movements.**

To address these issues, more intensive and strategically located satellite-tagging research is required around the Florida, the Gulf of Mexico, the southeastern U.S., and the Caribbean. Only by continuing this work can we answer the late Billy Pate's original question "Are our tarpon their tarpon".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