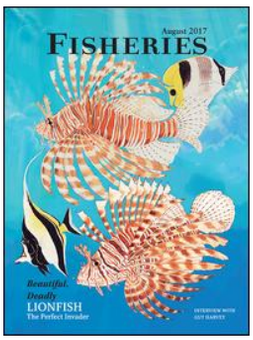

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Tracking Fish Movements to Inform Conservation

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A dart-tagged Bonefish ready for release in the Bahamas. Photo credit: Bonefish and Tarpon Trust.

Tagged Bonefish being released in the Bahamas. Photo credit: Bonefish and Tarpon Trust.

Bonefish *Albula vulpes*, Atlantic Tarpon *Megalops atlanticus*, and Permit *Trachinotus falcatus* form the core of the "flats fisheries" in the Caribbean, western Atlantic, and Gulf of Mexico. The annual regional economic impact for these fisheries are high: US$465 million in the Florida Keys, part of a US$1 billion fishery in the Florida Everglades, more than US$141 million in the Bahamas, and more than US$50 million in Belize. Flats fisheries are composed of anglers fishing on their own, as well as anglers who rely on professional guides, and attract anglers from around the world. In the Bahamas, Belize, and other Caribbean locations, the occupation of professional guide is passed along generations—in some instances, three generations of a family are active guides.

In locations with an established flats fishery, Bonefish, Atlantic Tarpon, and Permit are mostly catch and release, either by law—as in the Florida Keys and Belize—or as part of an evolving fishing ethos. In other locations, such as Cuba, the flats fishery occurs in protected areas where the species are catch and release only—outside these protected areas these species are harvested, in some cases very intensively. In all locations, enforcement of regulations remains a challenge.

Despite their economic importance, until recently there were large gaps in our knowledge of these species' ecology. Recent research has made considerable progress, but numerous basic questions remain. For example, what portion of the Atlantic Tarpon population migrates seasonally versus exhibits fidelity to a locale? Similarly, although spatial management is used as a management tool in some locations, we do not know enough about Permit movements to evaluate the effectiveness of this approach. The limited knowledge is especially disconcerting because a recent International Union for Conservation of Nature assessment classified Bonefish as near threatened and Atlantic Tarpon as vulnerable due to steep population declines from harvest in recent decades and habitat loss/degradation. Permit have not been assessed.

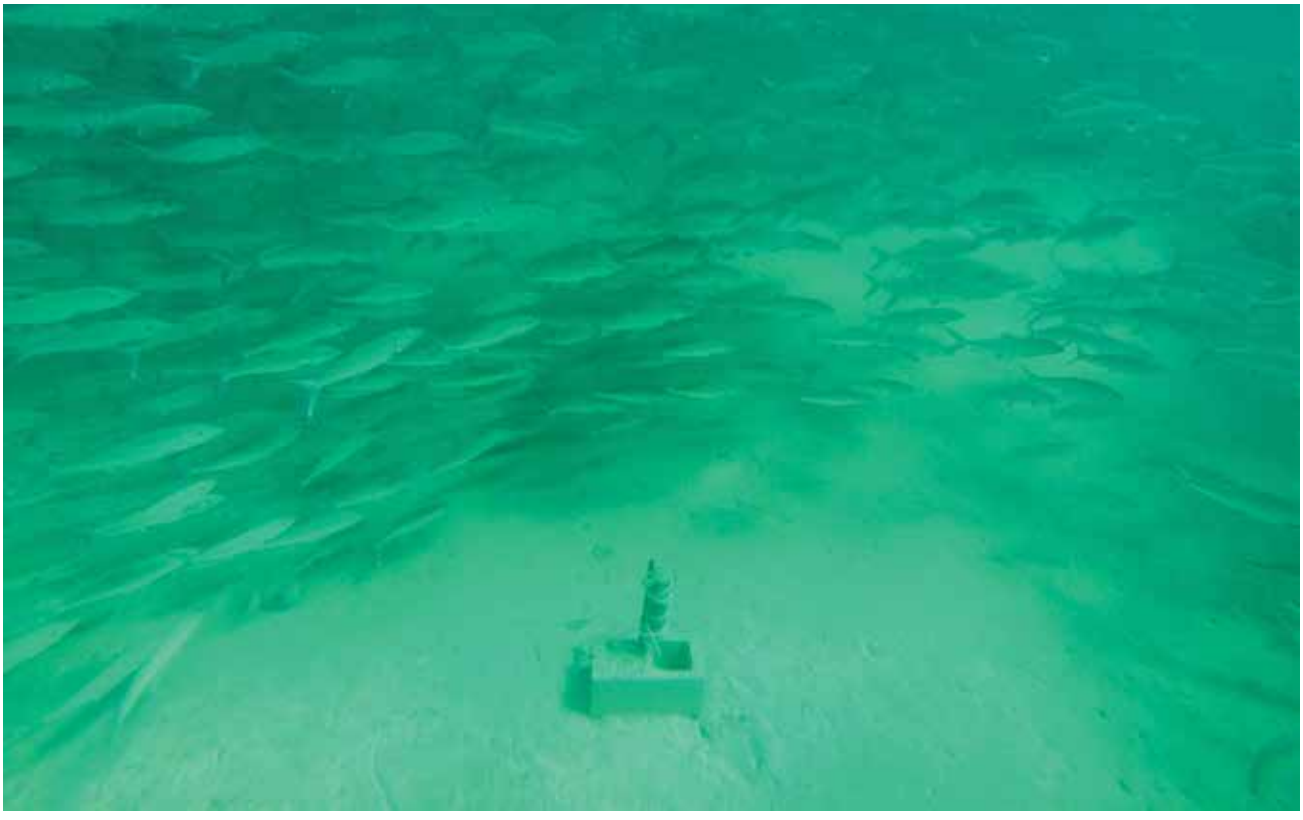
Bonefish and Tarpon Trust (BTT), a science-based nonprofit that focuses on Bonefish, Atlantic Tarpon, Permit, and to a lesser extent Common Snook *Centropopus undecimalis* and other species that use flats habitats, regularly assesses the status of knowledge for each species, the current and anticipated threats, and conservation needs. This information is used to prioritize research and conservation funds. BTT then funds and conducts research to address these priorities, working with collaborators (universities, nongovernmental organizations, resource management agencies) as well as guides, anglers, and other fishery partners.

Although harvest, often illegal, of Bonefish occurs, the top threat to Bonefish and the fishery they support in most locations is habitat loss/degradation. This is true in the Bahamas, where we have been working with collaborators and partners to identify Bonefish habitat use and movements, with project results applied to habitat conservation. Using mark–recapture, acoustic tracking, and the knowledge of guides and anglers, we have learned much about Bonefish habitat use and movements.

Acoustic receivers ready to be deployed at prespawning sites in the Bahamas. Photo credit: Bonefish and Tarpon Trust.

Bonefish in holding pens waiting to be tagged in the Bahamas. Photo credit: Bonefish and Tarpon Trust.

Retrieving the seine net after tagging is complete in the Bahamas. Photo credit: Bonefish and Tarpon Trust.



A prespawning school of Bonefish circles an acoustic receiver set at the prespawning site in the Bahamas. Photo credit: Bonefish and Tarpon Trust.

Cannulation to determine sex and reproductive stage of a fish captured from a prespawning aggregation. Photo credit: Bonefish and Tarpon Trust.

Conventional wisdom was that Bonefish inhabit only shallow flats, but recent research in the Bahamas has changed our understanding. Tag–recapture using dart tags (>13,000 Bonefish have been tagged with a 4.6% recapture rate) has revealed that adult Bonefish generally inhabit small home ranges: more than 72% of Bonefish were recaptured within 1 km of the tagging location and, of these recaptures, 69% were caught at the exact location of tagging. Initial work by Danylchuk et al. (2011) revealed that Bonefish migrate from the shallow flats to offshore spawning sites. Bonefish collect in shallow, protected bays in prespawning aggregations and move offshore at dusk where they dive to greater than 30 m to spawn in water greater than 1,000 m depth. Subsequent work has identified numerous additional spawning locations. A combination of dart tagging, acoustic telemetry, and guide knowledge has helped us to identify spawning migration pathways and connect spawning sites to home ranges. Roundtrip spawning migrations of more than 200 km are common.

BTT has shared this information with nongovernmental organizations, Bahamas government agencies, and our fishery partners for incorporation into management strategies. This has already resulted in the creation of six new national parks for habitat protection. We anticipate application of study results to upcoming park designations.

Given the sensitive nature of the information, BTT does not share the data in the public domain. Guides and anglers are very protective of fishing locations and the associated knowledge of fishing these locations. There are also concerns that poachers may use the information to target Bonefish for harvest. Much of the illegal harvest in the Bahamas, for example, is done with gill nets targeting spawning migrations.

An important aspect of the partnerships with guides and anglers is that as they participated in the research and learned the results, they became advocates for conservation of the fishery and habitats. The guides became the leading advocates for the parks during the public meeting process where the park proposals were presented and discussed. And many have become the lead advocates for education that is necessary to inform others about the link between healthy habitats, the Bonefish population, and the economically and culturally important fishery they support.

BTT and collaborators are conducting similar work on Bonefish in other locations, including Belize, Mexico, and Cuba, as well as on Tarpon and Permit to fill information gaps on fish movements that are directly applicable to habitat conservation.

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