On October 10th, 2008, Captain Manuel Botello of San Juan, Puerto Rico, began tagging dolphin for the Dolphinfish Research Program aboard his vessel *Missing Angel* with Irvin Baez, Ernie Martinez, Mario Lugo, and Fred Voltaggio off San Juan, Puerto Rico. At the time, many anglers in Puerto Rico probably thought the crew of *Missing Angel* was crazy to set a minimum size of 36” and tag any dolphin smaller than that. What followed from 2008 until 2015 was the release of 418 dolphin, of which 14 were recaptured and three additional qualifying dolphin were equipped with popup-satellite tags. This effort adds to work of the Department of Marine Sciences at the University of Puerto Rico Mayagüez, where 106 tagged dolphin generated 3 recaptures and 3 satellite tag deployments, as well as the work of Captain Josh Slayton and Adam Majchrzak of World Class Anglers in the USVIs, where 58 tagged dolphin added 2 more recaptures and a picture of dolphin movements for the region emerged (click here to see that published work). All together, these efforts set the stage to compare and contrast movements of dolphin both before and after government funded FADs were deployed in the U.S. Caribbean Sea. Our goal with this newsletter is to introduce this topic and hone in on why it’s important to better understand the impacts that FADs can have on the biology and ecology of not only dolphin but other pelagic predators such as wahoo, tuna, billfish, and sharks.
Preliminary Highlights

- Recaptures show association of dolphin for up to 2 days at same FAD
- Wahoo and dolphin maximum FAD depths less than 100 m
- Pre-FAD vertical movements show maximum dolphin depth of 164.1 m
- Satellite tagged silky shark monitored for 16 days in vicinity of FAD B, C, and D; tag surfaces 4.5 miles away
- Acoustic data show FAD attraction and re-visititation of a predator; predator revisits 10 days after initial visit

In June 2015, Fundación Legado Azul deployed the first government funded FADs in Puerto Rico off the coast of San Juan. While government funded FADs have been deployed in the USVI for the past thirty years, FADs associated with the new program in the USVI were first deployed in March and June of 2016 off St. Croix and St. Thomas, respectively. Since the Puerto Rico and USVI FADs were deployed, more than 19 boats have contributed to the tag and release 108 dolphin off Puerto Rico and 230 dolphin off the USVI by eight boats. This effort resulted in four dolphin recaptures and six satellite tag deployments on dolphinfish, one on a wahoo, and one on a silky shark. Additionally, nine acoustic tags were deployed on five dolphinfish, three wahoo, and one blackfin tuna. In this newsletter we present a portion of these data based on preliminary analyses.

Before FADs were deployed in the U.S. Caribbean, the movements of dolphinfish along the north coast of Puerto Rico (tropical Atlantic) were observed to be significantly slower than movements along the south coast (Caribbean Sea), which is likely a response to differences in water mass and current dynamics between regions. While comparable movement results have not been documented for other pelagic fish species within the region, surface drifters moved significantly faster in the Caribbean Sea than the tropical Atlantic, results that are consistent with movements of dolphin. Slower movements in the tropical Atlantic could be attributed to large riverine output leading to increased abundance of debris and current boundary formation and propagation, features of less prominence in the Caribbean Sea south of Puerto Rico. At the time of this analysis there were no studies done on the tendency for dolphinfish to aggregate around stationary or drifting fish aggregating devices in the tropical Atlantic, but now tagging data suggest FADs could retain dolphin for at least two days at the same FAD. These results are from the efforts of Captain Colin Butler and Captain Chris Berry who operate fishing charters out of St. Thomas. There have also been unconfirmed recaptures submitted that suggest dolphin FAD associations could be higher in the tropical Atlantic. The use of acoustic tags on both dolphin and wahoo show that both species utilize the FADs to depths generally less than 100 m. The maximum depth observed for a FAD associated dolphin was 74.6 m (244.75 feet) while for wahoo was 91.9 m (301.50 feet).

Figure 1 Depth use of a 73 cm (29") wahoo present at FAD D for 2 hours and 5 minutes.
Figure 2 Full 30-day monitoring periods of 3 adult male and female dolphin tagged off Puerto Rico show distinct daily movement patterns where fish extended their vertical range during dawn, dusk and night to greater depths.

Prior to the deployment of FADs in the U.S. Caribbean Sea, 6 high-rate satellite tags were deployed on qualifying male and female dolphin (>95 cm or 37”) off Puerto Rico. Maximum depths observed for those fish ranged from 111 to 164 meters (364’-538’), but a majority of the time all fish were at depths less than 30 m. In addition, all fish show distinct daily movement patterns in which fish extended their vertical range during dawn, dusk and night time periods to greater depths. With FADs now present in this region, can dolphin extend their vertical range adjacent to FADs beyond pre-FAD observed depths? Will dolphin still exhibit distinct daily shifts in vertical habitat use near FADs? Additionally, what is the maximum time dolphin will associate with FADs in the U.S. Caribbean Sea? Our team will continue to examine these questions in order to better understand how FADs may impact the biology and ecology of not only dolphin but other pelagic species at the FADs in the coming months.

The use of satellite tags on other species around the FADs has led to some interesting results. On October 28th, 2016, Captain Luis Burgos of Caribbean Fishing Academy helped our team, including DRNA field biologists Kelvin Serrano and Omar Collazo, fit a juvenile (75 cm or 29.5”) silky shark with a pop-up satellite tag that was released at FAD B. The shark was monitored for 16 days before the tag surfaced 4.5 miles away from the release site. Maximum and minimum daily temperatures suggest the shark occupied depths above the thermocline (< 200 m or 650’) with the minimum
Collaborative FAD Research
September 2018

Figure 3  A 30” female dolphin tagged with an acoustic tag was consumed by a predator which went on to be detected at a hydrophone at FAD D on October 4th and 15th 2015. It is thought that the large predator was a billfish due to the inverse relationship between depth and temperature when the animal was detected at the hydrophone. Billfish, like tuna, can keep their internal body temperature a couple degrees above ambient which is why we see the inverse relationship between temperature and depth in the acoustic data.

temperature of 23.5°C or 74.3°F observed 13 days into the monitoring period. The depth use and observed retention of this juvenile silky shark around FADs B, C, and D show the presence of FADs can increase the vulnerability of these sharks to fishing pressure associated with the FADs. A published study done with time-lapse cameras observed the continuous daily presence of fishing activity around FADs B and D to be an average of 1 to 1.75 hours per day with an average of 3 to 5 distinct boats visiting daily. Combine this with observations that visiting vessels engage in a variety of fishing tactics including trolling, hand-lining, jigging, live baiting, and spearfishing and it becomes apparent that while FADs can increase recreational fishing opportunities, it is also possible that FADs can increase the bycatch of juvenile silky sharks due to their observed associative behavior with the FADs. Further evidence of FADs affecting the presence of predatory animals comes from a dolphin that was tagged and released with an acoustic tag, by Captain Luis Lagrandier of Puerto Rico Sport Fishing Charters, and was ultimately consumed presumably by a billfish (Fig. 3). The predator went on to visit FAD D the day after the dolphin was eaten and again 10.5 days later. The acoustic data show both FAD attraction and re-visitation for this predator, which are additional observations showing the impact of the FADs on the biology and ecology of pelagic fish in the area. In the coming months, working with recreational, charter, and commercial fishermen in the region, our team plans to deploy 9 more acoustic tags and 6 satellite tags in order to continue to investigate pre and post-FAD dolphin movements in the U.S. Caribbean Sea.
Getting large FADs deployed off San Juan, Puerto Rico, to stay in place near San Juan Bay has proven to be a challenge due to the fact that it is the largest and most heavily trafficked maritime port in Puerto Rico. As a result of this maritime activity, FAD E was the first FAD to ever suffer damage from a purported ship strike around 2/18/2016, 262 days after it was deployed. While divers from Puerto Rico’s Department of Natural Resources Marine Ecology Division, working with the Cuerpo de Vigilantes and Fundación Legado Azul, were able to briefly repair it, the FAD was ultimately lost 46 days later around 4/5/2016. This was a major disappointment for the many fishermen that had used the FAD as well as for our research team because the FAD was equipped with a fish tracking hydrophone that was apparently torn from its mount during the ship strike. Although we will never be able to recover the data from FAD E after losing the hydrophone, to our surprise, we later learned that FAD E was not finished providing fishermen with great fishing opportunities.

Captain Chris Briggs of Harbourhouse Marina must have scratched his head and jumped for joy as birds drove him closer to a big yellow steel buoy floating 25 miles north of Rum Point Channel, Grand Cayman, on February 19th, 2017. This was 319 days after FAD E said farewell to Puerto Rico. Upon reaching the buoy, Chris examined it and noted shackle failure at the end of the buoy chain, damage consistent with a ship pulling the FAD and ultimately breaking it off the chain and rope that hold the FAD in place (click here to see locations of shackles). Much like other captains in Puerto Rico that have retrieved FADs (Captain Luis Burgos of Caribbean Fishing Academy has retrieved the most), Chris used a bridle to tow it back to shore where he worked on the FAD for a year before he redeployed it on January 11th, 2018.

Table 1 FAD deployments and durations moored off the north coast of Puerto Rico as of July 28, 2018.
After redeploying the FAD, Chris observed that there was an abundance of marine life around FAD E. He noted, “From my experience there are always blackfin, yellowfin, skipjack, silky sharks, jacks, dolphin, ocean trigger fish and marlin. The tunas are mostly down 250’ to 300’ and if there are no tunas then they are within 3 miles of the FAD and seem to come and go throughout the day.”

Chris went on to say that in terms of use, “There are no commercial boats that fish the FAD. Most of the boats that visit the FAD are recreational, the reason being is that it is too far offshore for most charter and commercial boats.”

Its position 20 miles north of Grand Cayman in 3600’ of water is very different than the PR FADs which are in an average of 1500’ of water and 5 miles from shore. Commercial boats are routinely the first boats to visit the PR FADs (see published results here) and we have heard of commercial boats going very far offshore in the Dominican Republic to fish private FADs. The use patterns that Captain Briggs describe are very useful for fisheries scientists and managers because they provide an idea of how FADs are being used in the Caribbean Sea, which are data that are lacking.

We have received reports from Dr. Guy Harvey and his team as well as Captain John McDow and Captain Chris Briggs that the Cayman FADs may hold greater amounts and larger sizes of fish than do the PR FADs. Exemplifying this are accounts from fishermen in the Cayman Islands that suggest the size, presence, and number of silky sharks observed around the Cayman FAD are higher than those off Puerto Rico. To date, we have conducted 16 standardized scuba dives around the PR FADs and have observed silky sharks in 25% of our dives and all of them were juveniles. Data as described in the first section of this newsletter showed that a juvenile silky shark tagged with a PSAT stayed near the PR FADs for up to 16 days, while Filmalter et al. 2011 observed silky sharks to associate with drifting FADs for up to 10.7 days. Identifying the amount of time silky sharks associate with FADs can help us understand how FADs may impact their behavior in that they may hold or retain sharks in areas that could be unsuitable for aspects of their biology (e.g., growth, reproduction) and make them more vulnerable to fishing activity.

Improving our knowledge of their ecology and behavior at FADs can prompt mitigation measures to reduce fishing mortality. In terms of conservation, according to the International Union for Conservation of Nature (IUCN), the population status of silky sharks is considered to be vulnerable. Therefore, it is important for
anglers to treat these animals humanely when caught as bycatch and to tag and release any individuals they may encounter (request tags here). In the image above, Captain Pete Foster-Smith tags an adult silky shark with one of our dolphin tags (Don Hammond - if you are reading this I’m sorry but it was all they had on board!). We hope this shark is either identified in dives around the Cayman FAD or recaptured so that we may gather more data on silky shark FAD association and behavior. Our team will be deploying more acoustic and satellite tags on juvenile silky sharks around the PR FADs this October.

Help Support our FAD Research

Help support our FAD research by purchasing a program tee. The logo featured on the shirts was done by Casta Design in San Diego, CA, owned and operated by Dom Castagnola. You can also buy a Dolphinfish Research Program (DRP) tee with a logo done by Guy Harvey, the renowned marine artist and fisheries scientist. The DRP tees come in white, grey, and black. Please click here to order a t-shirt.

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Caption 5 Click to enlarge