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First *in situ* observations of the sharpnose sevengill shark (*Heptranchias perlo*), from the Tongue of the Ocean, Bahamas

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Abstract

Using a baited remote underwater video system (BRUV), we provide the first recorded *in situ* observation of the sharpnose sevengill shark, *Heptranchias perlo* (Bonnaterre, 1788), from the Tongue of the Ocean, Bahamas. The individual was recorded at a depth of 718 meters, allowing for visual analysis of behavior in its natural environment. Temperature recordings of about 9° C at this depth indicate that *H. perlo* is physiologically capable of thriving within the lower mesophotic zone. This observation underscores the need to conduct further explorations of elasmobranch diversity and distribution in the Bahamas, which can be readily facilitated by BRUV-based methods.

Key words: fishes, elasmobranchs, Elasmobranchii, ichthyology, Atlantic Ocean, deep-sea, BRUV, trench.

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Introduction & Background

Sharks are a group of ancient fishes that are found in virtually every marine habitat, exhibit slow rates of biological productivity, and remain highly threatened due to overfishing on a global scale (Ferretti *et al*. 2010, Gallagher *et al*. 2012). The waters of the Bahamian Archipelago support high shark-population densities and elevated biodiversity in shallow, pelagic, and deepwater ecosystems (Brooks *et al*. 2011, 2015). Many Bahamian islands drop off sharply into extremely deep water (>1000m), often within only a few kilometers of the shoreline (Buchan 2000). These deeper regions remain largely unexplored, and there is limited understanding of the biomass and diversity of fish communities, including sharks and other elasmobranchs, in these regions. Recent work has suggested that shark species richness is elevated in certain deepwater regions of the Bahamas (Brooks *et al*. 2015), however, our understanding of sharks at these depths is greatly limited by sampling effort. Baited remote underwater video systems (BRUVs) are regularly employed in shallow-water teleost and elasmobranch studies (Brooks *et al*. 2011, Goetz & Fullwood 2013, Bond *et al*. 2012) and are being increasingly adopted for deepwater research (Friedlander *et al*. 2014, Phillips *et al*. 2016, Devine *et al*. 2018). BRUV-based approaches may thus provide a relatively simple and low-cost technique for studying deep-water community structure and function.

The Tongue of the Ocean (TOO) is a large (40 km wide, 200 km long), semi-enclosed deep ocean trench oriented roughly north to south in the mid-western region of the Bahamas. Like neighboring systems, such as the Exuma Sound, the TOO is characterized by rapidly sloping margins at the shelf edge, largely composed of eroded cliffs until ~400 m (Buchan 2000). Beyond 400 m, the bottom is comprised of gullied slopes, which extend to about 1800 m in the deepest parts of the basin (Buchan 2000). Although the seafloor is largely considered a flat-bottomed trough, turbidity current events along regions of the seafloor have resulted in the formation of some V-shaped canyons; these events occur roughly every 500–10,000 years (Sealey 1994, Buchan 2000). Despite this unique topography, little is known of the biota found within the TOO, with abundance and diversity estimates only available for a limited number of taxa, such as deepwater corals and sponges (Porter 1973). Considering the notable chondrichthyan abundance and diversity recently observed in the nearby Exuma Sound (Brooks *et al*. 2015), it is likely that the TOO may show similar ecological characteristics, calling for further investigation in this region.

The sharpnose sevengill shark, *Heptranchias perlo* (Bonnaterre, 1788), is a medium-bodied (<1.5 m total length) deepwater shark found circumglobally throughout tropical and temperate seas at depths from 0–1000 m (Weigmann 2016), with individuals typically found between 100–450 m (Castro 2011). Despite the broad geographic range of *H. perlo*, there are relatively few records of individuals throughout the northwestern Atlantic region and all are restricted to specimens caught using longline fishing (e.g. Henderson & Williams 2001, Palm & Schröder 2001, Başusta 2016, Shipley *et al*. 2017b, 2017c). Alternative direct methods for documenting this species may provide additional resolution on its behavior, habitat preferences, and distribution patterns. Notably, recent scientific longline fishing surveys collected two sharpnose sevengill sharks, from 603 m and 656 m, in the Exuma Sound (Shipley *et al*. 2017b, 2017c), providing the only locality record and depth estimate for this species in the Bahamas. Here, we present high-resolution *in situ* imagery of *H. perlo* from the Tongue of the Ocean, Bahamas using a baited remove underwater video (BRUV) system. This observation provides new insights into the behavior of this elusive shark, as well as new locality and depth records of *H. perlo* in the Bahamas, and particularly documenting the low ambient water temperatures (<10° C) at the site.

Methods

On 4 May 2018 at about 08:40 EST, a BRUV-camera system was deployed in the Tongue of the Ocean, approximately 2.6 km southwest of the island of New Providence, Bahamas at 24.9827°, -77.5564° (Fig. 1). The BRUV system consisted of a vertically oriented, carbon-fiber frame with pressure-tolerant flotation and an acoustic weight-release system (Fig. 2). Two GoPro Hero4+ Black cameras within deepwater housings (GoBenthic, GroupB Incorporated, USA) were attached to the frame, mounted about 1.5 m above the bottom. One camera recorded 4K video, while the other recorded still images every 5 seconds. Two potted LED lights were used to illuminate

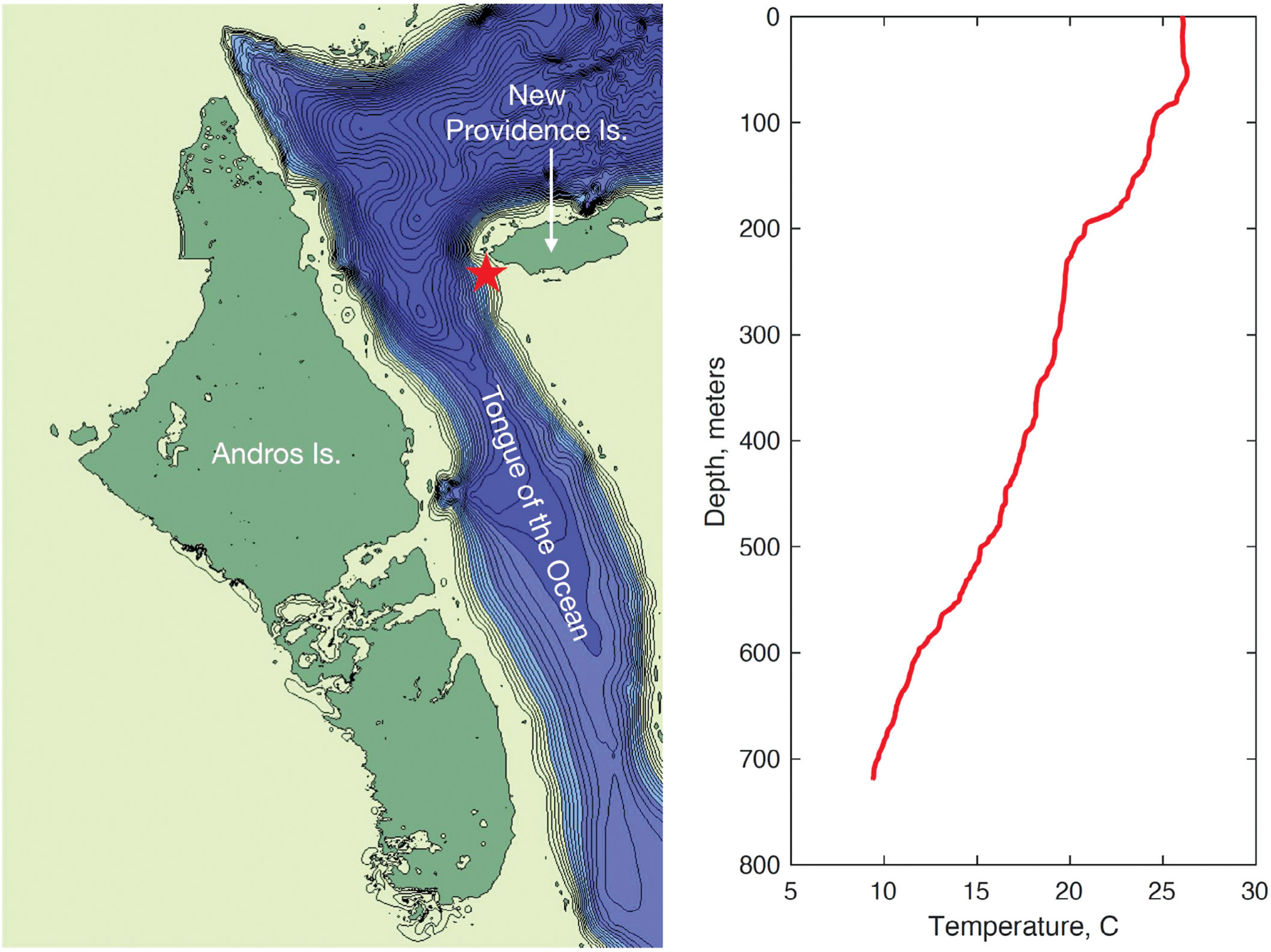

Figure 1. Map of Tongue of the Ocean, Bahamas, (star indicates deployment site) with the temperature/depth profile.

the seafloor (SiteLite, Juice Robotics, USA), and both cameras and lights were powered with a custom lithium-ion battery pack. Temperature and depth were monitored using a calibrated Starmon TD stand-alone logger (Star Oddi, Iceland). A small bait bag was attached to a pole containing about 500 g of minced chum (a mixture of snapper *Lutjanus* spp. and dolphinfish *Coryphaena hippurus*). The BRUV was positioned at a depth of 718 m for a total of 6.5 hours. An acoustic-release system (PORT LF, EdgeTech, USA) was used to release an expendable drop weight of 20 kg, allowing for the entire system to return to the surface upon command, where it was located with a handheld GPS unit and retrieved.

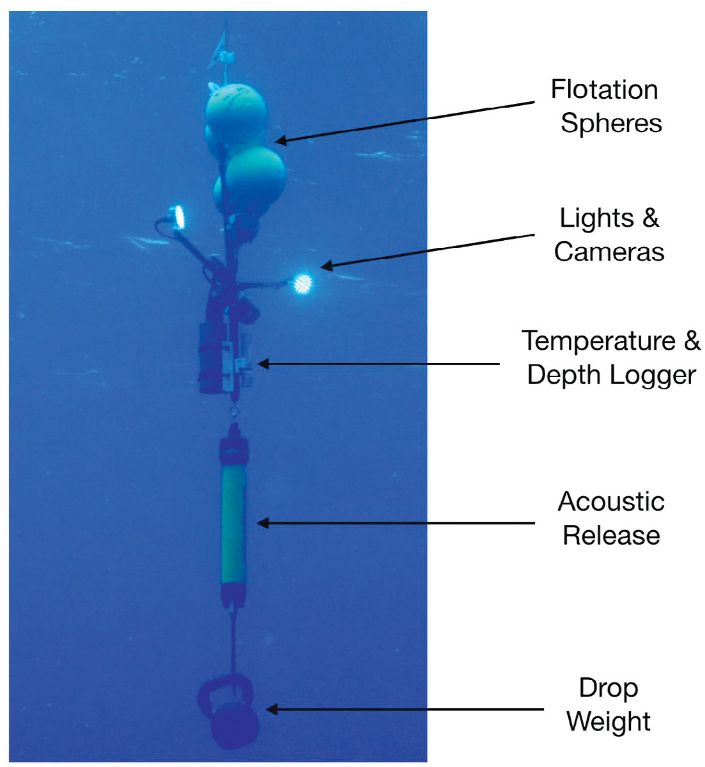

Figure 2. 1200-m-rated BRUV system used in the study, filmed at the surface during a descent.

Results & Discussion

A single adult male *H. perlo* was observed on the video system at approximately 09:30 EST (Fig. 3). The videos are permanently archived at Zenodo at:

https://doi.org/10.5281/zenodo.1491895

The shark appears at 3:45 in the first video (GP070025) and is last seen at 3:58 in the second video (GP080025).

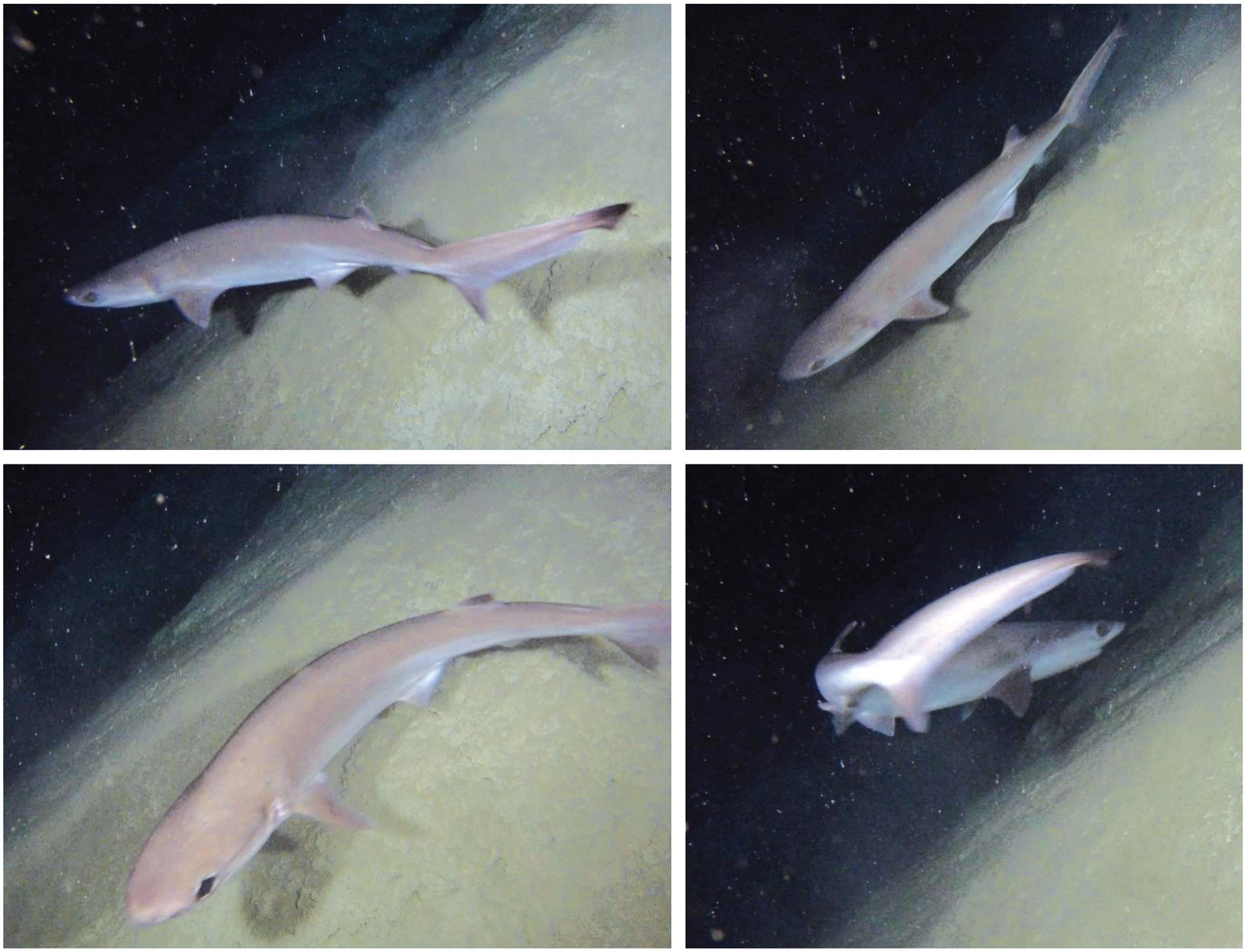

Figure 3. *Heptranchias perlo*, male, approx. 1 m total length, MBRUV video stills at 718 m depth.

The individual was identified as *H. perlo* based on the slender body, dark dorsal-fin tips, and white dorsal-fin apex (D.A. Ebert, pers. comm.), and is a male. The BRUV system used in this study was not equipped to measure lengths, but based on the known field of view of the system and the height of the camera from the seafloor, we estimate a total length of approximately 1 m, a mature male specimen according to available length at maturity estimates for the species: L_{mat} of 75–105 cm (Paul & Fowler 2003), and max L_{mat} of 107 cm (Barnett *et al*. 2012). Throughout the recording, the shark repeatedly circled the BRUV for approximately 10 minutes (Fig. 2) but does not contact the bait bag located just above the camera; the individual was either fixated on foraging on the seafloor or may have been disturbed enough by the BRUV lights to maintain a perimeter. No other sharks were observed on this deployment.

To our knowledge, this is the first *in situ* documentation of *H. perlo*. Furthermore, the record represents a depth extension of this species in the Bahamas (Shipley *et al*. 2017b, 2017c). This also may be the coldest record for the species: the temperature profile at this location (Fig. 1b) shows that the water was 9.02° C at the depth where *H. perlo* was observed. While temperature is not usually recorded when collecting specimens using longline fishing, the typical depths of 450 m as reported by Castro (2011) would correspond to about 16.5° C at this location.

Methodologies such as satellite telemetry would be required for more thorough documentation of the vertical movements of *H. perlo*, especially as depth preferences for deepwater sharks can vary with time of day (Comfort & Weng 2015, Shipley *et al*. 2017a), in addition to topography, season, and region. Data on these questions are particularly lacking for uncommon and deepwater species such as *H. perlo* (Barnett *et al*. 2012).

The results presented here underscore the need for further research into many facets of deepwater elasmobranch biology, especially in the Bahamas, where comparisons between the Tongue of the Ocean and the nearby Exuma Sound may yield insights into the drivers of abundance, diversity, and the evolution of life histories. Our findings illustrate how deepwater BRUV methods are an efficient and cost-effective tool for this purpose, and future work may align well with ongoing shallow water BRUV studies. Such efforts will hopefully contribute to the ongoing management and conservation efforts in the Bahamas and provide much-needed biological information on a number of data-poor species.

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