Letter to the Editor (published by Cape Cod Today)
Jan 20, 2020

Dear Editor,

I wanted to bring to your attention a new study from the same group that published the Robbins et al. paper. Robbins et al. was the paper out of Australia which the Woods Hole Group failed to understand but nevertheless still chose to base the entire visual observation section of their report on.

As the authors of the Robbins et al. had mentioned in their original paper they believed that testing of drones in coastal waters warranted further investigation. They have since completed a new study examining the performance of drones in more shallow coastal waters using very similar test methods to those seen in Robbins et al. The new study, "Beach safety: can drones provide a platform for sighting sharks?", was published in Wildlife Research on December 4th, 2019. This new publication validates a number of points that I made in my analysis of the Woods Hole Report.

As you will recall, beyond the numerous factual errors I pointed out in the Woods Hole Report, I also detailed a number critical misunderstandings concerning the limitations of the Robbins et al. study in regards to its application to both drones and Cape Cod waters. One of these was the Woods Hole Group's failure to recognize that the shallower nearshore waters found at many Cape Cod beaches would be expected to greatly enhance the ability to detect sharks from the air as compared to the relatively deep waters in which the Robbins et al. study was completed. Indeed, one of the primary findings of this recent study is that there is a negative correlation between water depth and detection rates. The authors report that *"an increase in water depth by 1 m results in a 58% reduction in the odds of detection."*

They explain this by noting that:

"In deeper water, wavelengths of light are either scattered or absorbed before reflecting off the substrate, creating a darker ocean colour and masking the grey shark-like colour of the analogues (Bloom et al. 2019). Conversely, in shallower water, where the depth of sightability is greater than the water depth, light is reflected from the sand or reef substrate, giving the water a lighter appearance and allowing better contrast with the silhouette."

The authors conclude that *"shark detection will be optimised: when the water turbidity state allows vision to a depth of at least 1.5 m in shallow water depths less than 3.5m"*

While this study had not yet been published when the Woods Hole Group drafted their report the results in regards to the influence of water depth on shark detection should not be the least bit surprising to anyone. The effects are just as we had predicted and we would reiterate again

that the Woods Hole Group's *"failure to recognize this is a gross oversight as its importance cannot be overstated for particular Cape Cod beaches and conditions."*

The Woods Hole Report stated that the performance limitations seen in Robbins et al. were *"likely to carry across all methods of visual detection."* As we stated previously they made this erroneous claim while *"providing no evidence, references or theory and in fact ignoring strong evidence to the contrary."* This recent study utilizing drones demonstrates superior performance to that seen with manned aircraft in the Robbins et al. study. However, it must be noted that the superior performance seen with drones in this sturdy can not be entirely decoupled from performance gains due to the study being conducted in shallower water.

Test methods followed those seen in the distance portion of the Robbins et al. study with 2.5m shark analogs placed 2m below the surface and detection rates recorded across a variety of conditions. When eliminating results from test conditions in which shark analog depth was greater than actual water visibility depth and utilizing larger screens and dedicated observers in post video analysis 50% of shark analogs were detected. While detection rates were lower for pilots in real time using smaller tablets this is likely due in large part to the fact that they did not utilize full sun shades to block glare as well as the pilots having a larger workload. Dedicated observers using larger screens with full sun shading are completely feasible for operations utilizing drones for shark detection. In more clear and shallower waters the difference in detection rates between pilots in real time and post video analysis faded away. It is also worth noting that these results were achieved without any optimization of drone positioning or gimbal angle to minimize sun glint.

The study was not able to identify significant effects of wind and sea state on sighting rates. While the authors state that they cannot make definitive conclusions regarding the effect these environmental variables on detection rates they do note that:

"the comparatively lower altitudes, smaller search area and slower speeds of drone- based surveys would allow longer scanning time over an area for the observer and pilot, and buffer some of the adverse effects on detection rates in comparison to manned aircraft"

The authors also recognized that the use of stationary shark analogs in their study may result in lower detection rates than would be seen with actual moving sharks stating:

"The use of shark analogues to determine sighting rates in the present study provides an indication of performance, but, for a given shark size and water depth, a moving shark would undoubtedly be detected more easily than a still replica."

We pointed this out in our analysis of the Woods Hole Report:

“Robbins et al. dismissed the effect that the lack of movement of analogs may have on their study due to the fact that relative motion of actual sharks would be severely limited for observers in moving aircraft. This would not be the case for stationary or slow moving drones.” The Woods Hole Report failed to recognize this. They ignored the way in which motion would affect observations differently depending on the speed of the aircraft. They did this despite their extrapolation of the results of Robbins et al. across all aerial imaging platforms. During the presentation at Nauset High School on October 17, 2019, it was directly suggested by an audience member that shark movement would make detection easier. The Woods Hole Group’s response was “Possibly, but it’s complicated.”

One thing that is not complicated is the complete and utter failure of the Woods Hole Group’s Outer Cape Shark Mitigation Alternatives Analysis. It should be clear to anyone interested in actually moving forward that it is best to disregard this report.

Thank you,

Kristian Sexton, PhD
Wellfleet , MA

Author Background:

Kristian Sexton grew up sailing and surfing the waters of Cape Cod. He has a background in both optical systems and aviation. He completed his PhD in biomedical engineering in the Optics in Medicine Lab at Dartmouth College with his research focused on the development of systems and methodologies for fluorescence guided surgery. He has spent most of the last ten years developing and testing optical systems through various positions in both academia and industry. In his most recent role, he led the development of optical tracking methods for the testing of a surgical robotics platform at Verb Surgical, a Google and Johnson & Johnson funded joint venture based in Silicon Valley. Dr. Sexton is also a commercial pilot and flight instructor with over 1400 flight hours in light single and twin engine fixed-wing aircraft including experience working as a spotter pilot for commercial fishing operations. He recently received the commercial remote pilot certificate and has in the vicinity of 200 flight hours testing drones over Cape Cod for the purpose of examining their potential use in shark detection. Preliminary results from these tests led Dr. Sexton to found Moosh Systems, LLC in August of 2019.