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How Are People Lost at Sea Found?

How does the U.S. Coast Guard conduct searches for people stranded in bodies of water, including two National Football League players and their friend missing off the Florida coast?

By Adam Hadhazy

The U.S. Coast Guard today announced that it had suspended its search at 6:30 P.M. EST for three boaters, including two pro football players, missing in the Gulf of Mexico off the coast of Clearwater, Fla. The trio was part of a group of four men who left from Clearwater on a fishing trip Saturday and were reported missing early Sunday after failing to return. In calling off the hunt, Coast Guard Capt. Timothy Close said that "We're extremely confident that if there are any survivors on the surface of the water that we would have found them," the Associated Press reports.

The missing men are Oakland Raiders linebacker Marquis Cooper, 26, Detroit Lions defensive end Corey Smith, 29, and Will Bleakley, 25, a former tight end at the University of South Florida.

The Coast Guard located their capsized, 21-foot (6.4-meter) Everglades boat along with one survivor about 35 miles (55 kilometers) from the shoreline yesterday afternoon. Former University of South Florida football player Nick Schuyler, 24, found wearing a life vest and clinging to the outboard motor on the overturned vessel, said that he and his friends were pulling up anchor when a large wave rolled over their craft on Saturday, according to the *Chicago Tribune*. The Coast Guard had initially searched an area of about 16,000 square miles (41,440 square kilometers), but narrowed it to 4,700 square miles (12,170 square kilometers) based on information from Schuyler.

To find out how authorities go about finding those lost at sea or in other vast waters, *ScientificAmerican.com* spoke with Art Allen, a physical oceanographer with the U.S. Coast Guard Office of Search and Rescue in Washington, D.C.

[*An edited transcript of the interview follows*]

What's the first thing the Coast Guard does when alerted that someone or something is lost at sea?
The initial step is to talk with the reporting source and essentially gather as much information as possible about the particular case. We want to know possibly where and when the boaters got in trouble, when they left port, where they intended to go fishing and where else they may have gone fishing – what their plan B was. We'd also want to know what boat they were in and what survival gear they had. We basically determine all the possible scenarios about the incident and establish what it is that that we're looking for.

How does the Coast Guard use this information to determine where and how to search?
Two years ago, the Coast Guard put a new search planning software into some of its computers called the Search and Rescue Optimal Planning System (SAROPS). It's the tool they're using down in Florida to coordinate and determine the optimal plan for this search. SAROPS simulates the drift trajectory for search objects. Over the past 20 years, I've done experiments on how stuff drifts in the water, from people to life rafts to 55-gallon oil drums, which all have different drift and detection characteristics. We take the information we get from the reporting sources and build a case using the SAROPS software – I'll make one here on my computer as we talk. I was actually just looking at wind and weather off Clearwater where the boaters have gone missing.

How does the software program work?
To begin devising the search in SAROPS, we first pick from a list of search objects for which we have previously calculated drift equations. Looking at types of vessels, we have things like life rafts, sea kayaks, sailboats, skiffs, Cuban refugee rafts, debris-like objects and more. We have a sport boat with a center console as an option, which is what went missing in Florida, so we'll choose that.

SAROPS is a Monte Carlo-based system that uses thousands of simulations or replications, or "particles," if you will. Some particles will be assigned as people in the water and others as the boat, and they all can start drifting at different

times and locales. What this allows us to do statistically is actually make something like 10,000 guesses about where the boaters got in trouble and when and where they might end up. We can make 10,000 guesses for a given scenario A, and 10,000 guesses for a different scenario B. All these particles get their own weighting as to which scenario is most probable. There's always uncertainty, of course, which is why we're having a search in the first place.

Are winds factored into the search parameters?
Yes. Once we have the basics set up, the next step is to get the environmental data that's required to track these objects. We need wind data over the area of interest through the time of the incident, and not just until now, but also forecasting into the future. If I'm sitting at my desk at 10:30 A.M., say, I'm probably planning the 12 P.M. – 3 P.M. helicopter flight. I need to know winds from last Saturday when the accident happened to this afternoon to know where survivors may have drifted in the intervening four days.

We have developed a powerful tool called the Environmental Data Server. This goes to a great variety of National Oceanic & Atmospheric Administration (NOAA), U.S. Navy and academic sources of wind and current data that are updated several times a day. The Server translates all this data into a common format. While we've been talking, it's already gotten all that data.

How much of a factor do ocean currents play in this type of search operation?
The idea is to look at the wind forcing on the surface current, major ocean currents like the Gulf Stream, and currents made by river discharge. The ocean is a very dynamic area and we have less data out there than we do for the atmosphere. To help, during cases we deploy a self-locating data marker buoy, an oceanographic surface drifter that has a Global Positioning System (GPS) unit on board to report its position to the ARGOS system, which allows us to compare ocean drift to numerical models we have available to see which is doing better and is more accurate right now in the given case.

What kind of air and sea craft does the Coast Guard use in search and rescues?
We generally use helicopters, C-130 planes, boats called cutters, and motor life boats. SAROPS allows us to optimally place those craft available to us so we have the greatest likelihood of detecting missing people in an area.

What are the deployment tactics for the different kinds of search and rescue craft?
What we have for this variety of aircraft and vessels is the probability of detection from 100 percent down to zero percent as a function of lateral range, which is the distance off your flight path or track line. So we know if we're flying a helicopter at 300 feet (90 meters) at 90 knots (105 miles or 165 kilometers per hour) that we can see a person in the water at a certain probability of detection away from the track line of the helicopter. We account for effects such as white caps on waves in model range curves, because they decrease the visual effectiveness of a search. The ocean surface is a very tough place to find someone. Even though we're searching many, many square miles, the bare fact is that the ocean is very, very large, and you're very small. It's like looking for a soccer ball – the person's head above water – in an area the size of the state of Connecticut.

How do the parameters of searches change as time passes?
Now if search and rescuers do locate someone, like they did yesterday, then we go all the way back to the beginning of the scenarios and readjust them accordingly. What we're really doing is flying these lateral range curves against all these particles and each particle then gets adjusted in its probability of not yet being detected. In a three-hour search, a particle will move relative to that search, so it may be more advantageous to search from north to south, rather than south to north, for example. All these particles start with a 100 percent probability that they have not yet been detected, and after each pass, or each time we fly over, we're going to reduce that amount by where the lateral range curve fell over the particle. That allows us to optimize the next series of search patterns accounting for all the previous patterns, which is called a Bayesian update. We're using all the modern applied statistics in our search and rescue efforts.

How much of the search is up to commanders at the scene?
The computer suggests a set of optimal searches but is not the final authority; the search and rescue controller is. The computer may have said that the poor small motor life boat has to search up and down with seas coming across its beam. The controller can take each individual pattern and manipulate it interactively onscreen to be operationally more acceptable and also see how this affects the probability of detection.

What do you think the chances are of finding the remaining three missing boaters?
Well, I shouldn't speak to that as I don't own the case. But the question does get at another whole aspect of our search and rescue procedures – survival models. We have models that work very well in cold water scenarios, though these guys are not in cold water. It's a heat-loss versus heat-producing from shivering model. When you're out in the water, you

have an insulating layer of fat and an insulating layer of clothing. This is a situation where being big and fat or muscular is helpful.

The survivor that we have located suffered hypothermia – the physical and cognitive decline that happens when your body loses more heat than it produces – because he was out there for 36 hours or so. The body's core is 98.6 degrees Fahrenheit (37 degrees Celsius), so he was losing heat to 65 degree Fahrenheit (18.3 degree Celsius) water. He was also dehydrated, which exacerbates hypothermia. Besides losing heat, you also lose water through metabolism, respiration and sweating, and that does come into play in warmer waters. There are still more steps like predation [from sharks] and running out of food, though we don't have models for those yet. Basically, these guys out there are now at the edge of the survival model.

Is that why the Coast Guard has called off the search?
Yes, that and because of where they have already searched. If more information comes to light, they could reopen the active search, but that is unlikely. Unfortunately, despite our technology and best efforts, not everyone who is lost at sea is found.

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