Journal of Coastal Zone Management

Leatherman, J Coast Zone Manag 2016, 19:3
DOI: 10.4172/2473-3350.1000431

Short Communication Open Access

Rip Currents in South Florida: A Major Coastal Hazard and Management Challenge

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Received date: August 08, 2016; **Accepted date**: August 17, 2016; **Published date**: August 24, 2016

Abstract

The first field measurements of rip currents in South Florida showed that these offshore-flowing currents are fairly weak as generated by moderate-sized waves during fair-weather conditions, but are still a major water hazard. Miami Beach is world famous, but unfortunately this area has a large number of drownings, partly because the rips here at nearly invisible. These ongoing tragedies were recently highlighted by the loss of two prominent rabbis that point to the misconceptions and lack of understanding of nearshore currents even by highly-educated people.

Keywords: Coastal zone management; Beach safety; Nearshore currents

Introduction

Two high-profile rabbis from New York City drowned in a rip current at Haulover Park, just north of Miami Beach on May 17, 2016. These men were Orthodox Jews from Brooklyn that came to Haulover Park while on vacation. Upon arriving, they consulted with the lifeguards who informed them that rip currents were present and advised them to swim near a lifeguard tower. Due to their religion, the men were not able to show skin near women, and therefore chose an unpopulated area of the beach, which was unguarded. These two beachgoers unfortunately entered the water at the exact location of a rip current.

The rip current that drowned the two men was a "clear-water" rip-it contained little to no sediment and therefore was nearly invisible and hence very difficult to observe (Figure 1).

Figure 1: A "clear-water" rip current at Miami Beach, Florida as delineated by red fluorescent tracer dye.

The conditions on this day were idyllic-it was sunny and warm, and the waves were only of moderate size. What seemed like a perfect beach day ended in tragedy.

This incident was a worldwide newsmaker--articles appeared in newspapers as far away as Australia (Dr. Robert Brander, personal communication, 2016). The front-page headline in the Miami Herald was titled "Two Rabbis Drown in Strong Rip Current." However, this is a misconception because the rip currents on this day were not strong albeit dangerous. The waves were not high-only 0.6-0.9 meters, which is certainly not enough to produce a powerful rip current [1]. Strong rips are generally produced during stormy conditions, and most beachgoers do not enter the water during big wave days (e.g., exceeding 1.5 meters in height). Therefore, life-threatening rips can occur on sunny, fair-weather days with seemingly safe waves.

Florida is the rip drowning capital of the United States (Figure 2) [2].

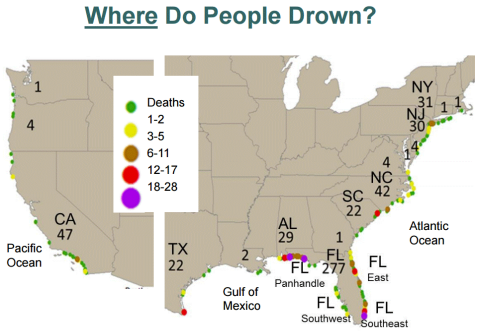

Figure 2: Rip current drowning in continental United States from 1994 to 2012 [2], not including the Great Lakes that average about 10 rip fatalities per year (June 16, 2016).

Ironically, Florida has a low to medium-low wave energy environment. So why does Florida have so many drownings? Florida

boasts of 1,320 kilometers of high-quality, sandy beaches and good beach weather (e.g., Florida is called the "Sunshine State").

In addition, Florida is the third most populous state in the nation with nearly 20 million people and has the most visitors in the nation (more than 100 million per year). People visit Florida beaches from all over the world-Canada, Europe, and especially Latin America for South Florida.

Beach conditions for rip current drowning

The rabbis entered the water exactly where a bar-gap rip current existed and during low tide on May 17, 2016. This was unfortunate on both counts; rip currents have been shown to be strongest at low tide [3,4]. Bar-gap rips, which are the most common on surf beaches, form where the wave backwash is concentrated seaward through pre-existing channels or holes in the sand bar.

This particular day in May was "Chamber of Commerce weather," being sunny with a fresh onshore breeze. The air and water temperatures were both in the 80° Fahrenheit range-a seemingly perfect day for bathing in the ocean although red flags were flying.

Haulover Park was chosen by the rabbis because it is a surf beach that is much less crowded than nearby Miami Beach. The waves on this day were less than one-meter high with spilling breakers, which are not threatening to beachgoers as compared to the dramatic plunging breakers that surfers seek. Most beachgoers avoid entering the water when waves approach 1.5-2 meters. It must be recognized that wave energy is proportional to the wave height squared so that a 2-meter wave is about ten times more powerful than a 0.6-meter wave. However, even weak rip currents can be deadly, and even waves in the 0.6 to 0.9-meter range are large enough to generate dangerous offshore currents that can take the lives of beachgoers who panic and drown.

The onshore wind on May 17, 2016 was only 10-15 kts according to observations by Lt. Matthew Sparling who is in charge of a well-regarded academy of lifeguards. Field measurements in South Florida by Leatherman [5] showed that relatively weak rip currents (e.g., approximately 0.3 meters per second) are often generated during the same conditions as experienced on the fateful day the two rabbis drowned (Table 1). By contrast, strong rip currents can exhibit speeds exceeding 2 meters per second as observed in California and Australia, which is faster than most Olympic swimmers.

Date 2016	Location	Tide Level	Wind Speed	Wind Direction	Wave Height	Flag Color	Rip Speed
Apr-06	Haulover Park	Low	15 kts	NE	0.6-0.9 m	Red	0.2 m/s
Jun-20	Haulover Park	Low	15-20 kts	NE	0.6-1.2 m	Red	0.2 m/s
Mar-23	Miami Beach	Low	15-20 kts	ESE	0.6 m	Red	0.3 m/s
Apr-10	Miami Beach	Low	15 kts	NE	0.6 m	Red	0.4 m/s

Table 1: Field measurements of beach conditions during rip current events in South Florida acquired by GPS drifters.

Public safety and management challenge

Rip current drownings do not generally garner national attention, but they are responsible for more deaths than other marine-related hazards, killing approximately 100 people annually in the United States (Figure 3).

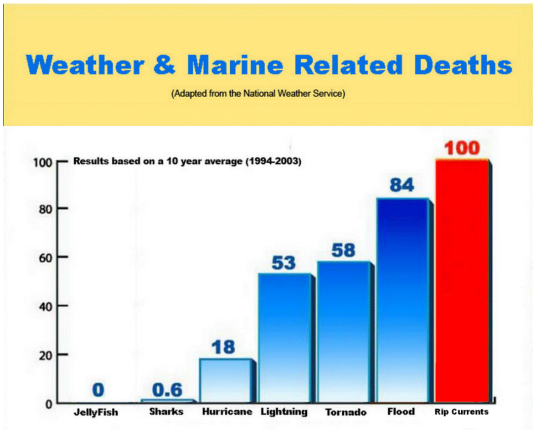

Figure 3: Weather and marine-related deaths annually averaged (retrieved from ripcurrents.com/watertracer.html, 2013).

According to an unpublished survey of beachgoers conducted at Pompano Beach, Florida by the author, the greatest fear of beachgoers is sharks, which account for less than one death per year. So why is it that rip currents are so deadly, yet the public is not that afraid of them? The public knows very little about rip currents, and they are difficult to spot, especially the "clear water" rips of South Florida (Figure 1). While a shark kills in a terrifying display with blood in the water, rip currents result in relatively "quiet deaths" contrary to the Hollywood portrayal of victims frantically thrashing around in the water.

There are methods to lower your risk of being caught in a rip current. The following is a surf safety check list:

- Check for warning signs and flags (double red flags mean the beach is closed and a red flag indicates no swimming allowed)
- Swim near a lifeguard
- Scan the water from a high point to look for signs of a rip current:
- Areas of less breaking wave activity where the rip is forcing its way seaward through the surf zone; beachgoers often seek more quiescent water thinking it is safer, which is counterintuitive
- Change in water color from the surrounding water or choppy water; bar-gap rips, which are the most common type of rip currents, flow through holes or channels in the nearshore bar wherein the deeper water will appear slightly darker colored when viewed through polarized sunglasses that greatly reduce reflection off the water surface.
- Floating objects moving seaward (e.g., seaweed caught in a rip is a good indicator)

- Study the waves, especially the wave approach angle:
- Straight on-shore waves (e.g., arriving perpendicular to the shore) result in a higher risk of rips
- Waves approaching at an angle can create a sweep or longshore current. When present, swim with the longshore current to escape the rip, not against it

Conclusions

Rip currents are the friend of surfers who use them to take a free ride offshore, but the foe of bathers who are caught in these offshore-flowing currents, panic and drown. Rip current drowning is preventable, but beachgoers need to heed all warnings (e.g., signage and red flags), learn to read the surf and know how to swim.

All surf beaches, including the Great Lakes, are subject to rip current drowning, and, in fact, most of the beach-related rescues and fatalities in Lake Michigan are the result of rips. The public is generally aware of water flow in rivers and streams, but have little understanding of oceanic currents, especially nearshore rip currents which are wave-generated.

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