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LETTERS TO THE EDITOR

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Undertow, Rip Current, and Riptide

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ABSTRACT

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Undertow, rip current, and riptide are terms used to describe a variety of currents, all of which have different characteristics. However, much of the general public, news media, and even dictionary definitions confuse and misidentify these potential hazards at surf beaches. Many beachgoers use the terms interchangeably, when in fact they are distinctly different hazards. Furthermore, undertow, rip currents, and riptides occur for different reasons at different locations along the beach. Avoiding each of them and escaping their grip requires different strategies. Three-quarters of a century has passed since this issue was last addressed in the scientific literature, and rip currents are recently receiving much more attention by scientists and the general public because of a steady rate of fatalities, making this a timely issue.

ADDITIONAL INDEX WORDS: *Undertow, rip current, riptide.*

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INTRODUCTION

Rip currents are the greatest hazard at surf beaches; more than 100 people drown each year, and these dangerous currents account for 80% of surf rescues in the U.S. (United States Lifesaving Association, 2011). In fact, 25 Great Lakes rip drownings occurred in 2010, which was an unusually warm summer (Meadows *et al.*, 2011). In spite of the beach safety information provided by signs and flags, many beachgoers still have a vague understanding about this phenomenon, partially stemming from confusion regarding terminology. Beach safety surveys, conducted at Miami Beach and Pompano Beach in Florida and Coopers Beach in Southampton, New York, showed that nearly 50% of beachgoers referred to rip currents as undertow, albeit they thought it pulled one under the water.

Shepard (1936) wrote the most often quoted article regarding undertow, rip current, and riptide based on his own observations and in response to a lively discussion in four earlier *Science* articles by other prominent coastal scientists and engineers. He correctly pointed out that riptide was not an appropriate term for rip current because the latter was generated by wave breaking and not the tide. Shepard (1936) also dismissed the term undertow as mythical because there was no current pulling one under the water. Although this is correct, the public relies on their real-life experiences at surf beaches, wherein they perceive that a current on the beach face is pulling them under when being slammed down by a large breaking wave. Perhaps it is time to recognize undertow, but provide a proper definition to distinguish it from rip currents and riptides. Table 1 provides a comparison of these three different phenomenon on the basis of their characteristics.

UNDERTOW

Thousands of waves break on surf beaches every day, each one generating swash uprush and backwash on the beach face. Normally the return flow of the backwash is fairly uniform along the beach face as it flows downslope. Large waves, especially plunging breakers, result in a large swash,

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Table 1. *Three types of seaward-flowing currents at sandy beaches. Undertow occurs along the entire beach face during times of large breaking waves, whereas rip currents are periodical at distinct locations. Riptides occur at inlets every day.*

	Undertow	Rip Currents	Riptides
Description of current	Strong backwash off beach	Strong offshore flow at certain locations	Strong offshore current at inlets
Origin	Big waves breaking on beach face	Longshore variation in wave energy and differential water setup on beach face	Constriction of tidal flow through barrier beaches
Seaward extent of current	Tens of meters or less from shore	100 m offshore in many cases	300+ m offshore at major inlets
Water depth of occurrence	Centimeters to a meter in most cases	0.6 to 3 m (but sometimes deeper)	Tens of meters at major inlets
Danger when caught in current	Knocked around by waves on beach face; generally not life threatening except for small children	Pulled offshore into water over your head	Pulled far offshore by ebbing (falling) tide
Escape from current	Time your escape between breaking waves; walk or crawl up beach	Do not fight the current; swim parallel to the beach or let current take you beyond the breakers while floating and then swim diagonally back to shore	Wave for help to attract attention of fishermen or boaters

with the seaward-flowing water and sand mixture being pulled strongly into the next breaking wave. Waders feel like they are being sucked under the water when the wave breaks over their head—this is undertow in public parlance. Although bathers can be tumbled around roughly, this return flow only goes a short distance—just to the next breaking wave; it does not pull one offshore into deep water (Table 1). The real danger occurs when large waves break directly on steep beaches as shorebreaks. The key is to dive underneath these waves, rather than letting them pick you up and drive you head first into the beach face, which is the leading cause of broken necks. Small children and senior citizens, in particular, have difficulty ducking the waves and escaping the strong backwash (e.g., undertow), which requires good timing.

Coastal professionals have long tried to eliminate the term undertow from the public lexicon with little to no success (Leatherman, 2011). Anecdotally, such attempts have led some beachgoers to discount the important information on surf zone dynamics provided by coastal scientists. Instead of stating that undertow is mythical, it would be better to explain this current as strong beach backwash on big wave days and sanction its usage.

RIP CURRENTS

Breaking waves push water up the beach face, and this piled-up water must escape back out to sea as water seeks its own level. Normally the return flow (backwash) is fairly uniform along the beach so that rip currents are not present. If a differential amount of water piles up on the beach face, often caused by alongshore variations in the nearshore area, then the flow is concentrated as it flows through the breaks or depressions in the sand bars as rip currents.

Rip currents are often detected in about knee- to waist-high water (Table 1); they can be difficult to escape by walking back toward shore against the current once you are in chest-deep water. These strong, offshore-directed currents pull the water (and any unlucky person) at all water depths through the surf zone. The current dissipates offshore of the breaking waves where the water can be quite deep—certainly over your head. Moderate swell-type waves (e.g., only a meter or less high) on sunny days are very appealing to bathers, but can sometimes generate strong rip currents, accounting for many drownings and rescues.

RIPTIDES

Riptide (or rip tide) is the terminology often used by reporters to actually describe rip currents, perhaps because it sounds powerful, even though it is a misnomer. Tides are astronomically generated, and tidal currents become strong where the flow is constricted. These powerful currents are caused by the tide pulling water though an inlet at barrier beaches; they can carry one far offshore during a falling or ebbing tide (Table 1). Fishermen are well aware of these tidal flows and make their plans accordingly.

These strong, reversing currents are termed tidal jets by coastal engineers because they carry large quantities of sand that form sand bars far out in the ocean and in the bay opposite the inlet channel. Typically, riptides or tidal jets are more powerful than rip currents; for example, the ebbing tide at Shinnecock Inlet in Southampton, New York, extends more than 300 m offshore so even good swimmers caught in this current will likely find it difficult to swim back to shore. Obviously, inlets are not a place for bathers and swimmers, and even sailboats can have difficulty negotiating these waters during certain tidal and wind conditions.

DISCUSSION AND CONCLUSIONS

Coastal scientists (e.g., Leatherman, 2003; Shepard, 1936; Short, 1985) have consistently used rip currents to describe these powerful rivers in the sea that flow offshore. The public has little understanding of rips, partially because so many names have been applied to these phenomena. Also, the divide between coastal scientists and beach safety professionals needs to be bridged, and a common language would be most helpful. For instance, some lifeguards in South Florida still use the term runouts to describe rip currents. Print and on-line dictionaries and other sources of information, such as Wikipedia, which have varying definitions for rip currents and often lump undertow, rip currents, and riptides together, also need to be changed (Leatherman, 2011).

The term undertow is also used by oceanographers to describe a laterally homogeneous current that flows offshore near the seabed (Garcia-Faria *et al.*, 2000). These flows typically have much lower speeds than rip currents and are characteristically found on beaches with minimal alongshore variation in sand bars; therefore, they would not be a problem for swimmers. These currents should be renamed underflow as defined by Finkl *et al.* (2006) as wind-wave downwelling to distinguish them from undertow, which is restricted to the beach face. The overall purpose is to clarify the terminology in order to promote better understanding by the general public of dangerous currents at beaches and hence reduce the number of drownings and rescues at surf beaches.

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