Reviewer #1

I understand that the aim of the Authors is to analyse the results of the survey and that the article is not focused on the phenomenon "per se", nevertheless I think that they presume that all the readers know about it, while this is not true. For example, describing figure 2 they assume that all the readers know what are the most dangerous sectors, but it is not true instead (or it is not for me that only know Mediterranean Sea and swimming pools). Maybe some notes in the caption of figure 2 could avoid that a reader having no experience with this type of phenomenon does not understand its importance and only can appreciate the correct scientific analysis of data.

- We agree with the reviewer that this level of detail is a needed in the revised manuscript. Specifically, we added notations to Figure 2 to identify the safe and unsafe areas in each picture, including the location of the rip current in each photograph. An additional annotation will be added to the Figure heading to let readers know that the annotation was not included in the original survey. As described further below, we have also added a section to the Introduction that describes rip currents in more detail. We have also added simple statements throughout the revised manuscript that help provide a basic understanding of rip currents.

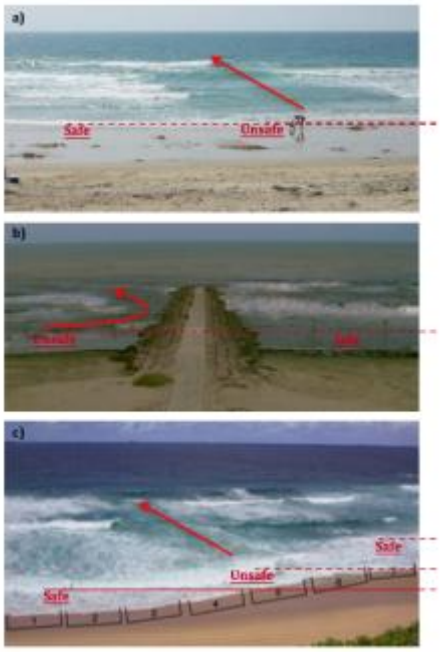


Fig. 2. *Photographs used in Questions 42 through 44 of the survey to ask respondents "Where on this photograph would you swim?". The location of the rip current in each photograph is shown by the red arrow, which was not visible to the respondents. In these examples, rip current location can also be identified by areas of reduced wave breaking.*

The same impression reading the section Forecast. The Authors should first give clear information on the "right message", the right definition of high/low risk and then present the different people answers. In my opinion, this lack of information can generate confusion and obstruct a complete comprehension of the importance of the different answers.

- The question raised by the reviewer represents one of the problems with the current warning systems for rips - there is no 'right message' for the definition of high or low risk. The forecast used by different agencies and in different areas are not consistent (as discussed on page 6, line 141 in the original manuscript), which means that it is not possible to identify the 'right message' for readers. However, we have added several statements (see below) to the results section on forecasts to remind the reader that there is no 'right message' and that we are only concerned about whether the respondent believed the message to be consistent with their observations.

…..The lack of consistency in forecasting is complicated by rip development being dependent on how the incident wave field interacts with the pre-existing nearshore morphology, which is difficult to predict without local knowledge on how it evolves over a range of spatial and temporal scales.

Since perception of the rip hazard depends in part on trust in experts and authorities, and trust in the protective measures they employ (Njome et al., 2010; Heitz et al., 2009; Terpstra, 2009, 2011; Barnes, 2002), inaccuracies in the forecast or a discrepancy between the forecast and what is observed at a specific beach at a specific time can erode confidence in the forecast (Siegrist and Cvetkovich, 2000; Espluga et al., 2009). A lack of confidence in the forecast could potentially condition beach users to downplay the hazard warning on future visits (Hall and Slothower, 2009; Scolobig et al., 2012; Green et al., 1991; Mileti and O'Brien, 1993)……

Respondents were also asked about whether they were aware of forecasts and whether those forecasts altered their behavior, and if the forecasts conformed with their observations at the beach. Since forecasts are not consistent and few are based on an understanding of the pre-existing morphology, we were not worried about whether the forecast was accurate, and focused on whether the respondent believed the message to be consistent with their observations.

The problem lies in the fact that rip forecasts tend to be overly general to a larger region and time and not necessarily dependent on an understanding of the pre-existing morphology…

Moreover, it is difficult to predict the potential for rip development without an understanding of the pre-existing nearshore morphology that is difficult to predict without local knowledge on how it evolves over a range of spatial and temporal scales.

The Authors, in my opinion, are too much focused on the results of their analysis and neglect to consider that not all the readers know the analysed phenomenon.

- We have added a section in the introduction that describes rips in more detail and explain their formation. This will be combined with the suggestion by Reviewer #2 to describe how rip forcing and behavior may vary in different regions.

Rip currents (often called "rips" or "rip tides") are strong, narrow seaward flows driven by alongshore variations in wave breaking and resulting wave set-up landward of the breaker zone. Due to their dependence on wave breaking, rips can develop in any beach environment in oceanic, sea and lacustrine environments. Castelle et al. (2016) classify rips as: 1) boundary rips that develop along both natural and engineered structures including headlands, groins and piers, 2) bathymetric rips that develop in response to variability of the nearshore morphology; and 3) hydrodynamic rips that are

spatially and temporally variable and develop in the absence of morphological variations or a lateral boundary. The type of rip that develops on a beach depends on the local wave climate and geology. For example, rips in the Great Lakes tend to be associated with natural headlands or the presence of large groins or harbor jetties, while rips in Florida and Texas tend to be bathymetrically controlled and associated with a transverse bar and rip nearshore morphology (Houser et al. 2013). Rips also vary regionally based on the driving forces, with rips on the Great Lakes typically associated with moderate to strong winds, while on the West Coast of the United States, rips are often associated with large swell events independent of the wind.

Rips are capable of carrying unsuspecting bathers significant distances away from the shoreline with speeds reaching over 2 m s^{-1}. As a consequence rips are considered a major public health problem in the USA….

The paper is very fluent, but also very long and not schematic. I think that a further effort should be done to summarise the main results of each paragraph in a table for each paragraph, and also in a general table summarising all the findings in the discussion. Otherwise, as the paper is structured, the reader can not perceive each of the results obtained. Considering that this paper should be the starting point of an improvement of the Campaign, I think that the results should appear more clearly from the paper, in form of a list of bullets.

- This is a very good suggestion that will help to summarize the main findings from each section. We have added a table to the beginning of the discussion section.

Table 2. Summary of major findings from the "Break the Grip of the Rip!" National Rip Current Survey.

Focus of Questions	Example topics
Beach Preference	• Frequency and purpose of visits to a beach affect perception of surf conditions, importance of swimming near a lifeguard and self-reported ability to spot a rip current
Swimming Ability	• Range of self-reported swimming ability (distance in open water) related to self-reported competency
Ability to Identify a Rip Current	• Ability to identify safest location in a photograph related to frequency of beach visits, self-reported swimming competency and training • Ability to identify safest location related to perceived importance of and concern about surf hazards, self-reported understanding of "high" and "low" risk conditions, and perceived accuracy of rip forecasts

Response to Warning Sign	• Perceived ability to use sign to identify a rip current varied with ability to identify safest location on a photograph • Sign has been effective in communicating swimming parallel as an escape strategy, and taking caution when entering the water • Identified need to provide a more accurate depiction of a rip current, detailed instructions on how to escape a rip current, and local emergency information
Prevention	• "Break the Grip of the Rip" Campaign has been successful in informing beach users to: 1) not fight the current; 2) swim out of the current, then to shore; 3) if you can't escape, float or tread water; and 4) if you need help, call or wave for assistance
Forecasts	• Self-reported change in behavior based on forecasted beach and surf conditions, but tendency for forecasts to be inconsistent with observations • Perceived inaccuracy of forecast related to spatial and temporal broadness of forecast, inability to identify a rip, and behavior of other beach users
Trusted Sources of Information	• No significant correlations were observed between trust in a source of information and respondent demographics

Figure 2: The authors have the answer in mind but also the readers would like to know it.

- As noted above, we added notations to Figure 2 to show the location of safe and unsafe swimming areas, as well as the location of the rip current in each photograph.

Fig. 2. *Photographs used in Questions 42 through 44 of the survey to ask respondents "Where on this photograph would you swim?". The location of the rip current in each photograph is shown by the red arrow, which was not visible to the respondents.*

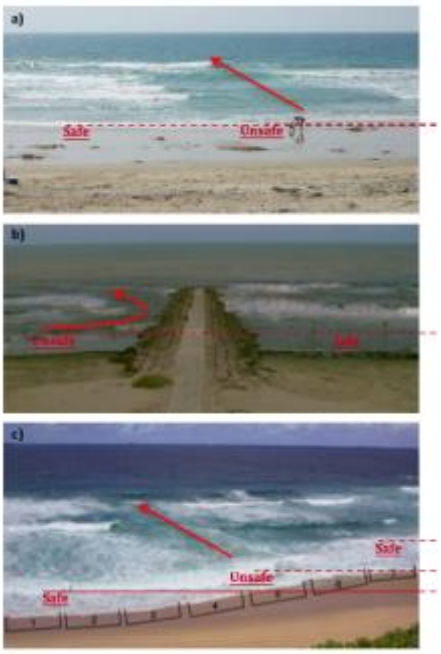


Figure 3: some of the characters are impossible to read. I suggest reducing the description, reducing the size of the diagram, increasing the size of the characters and putting the labels vertically (print to understand if it is readable).

- We have increased the size of the text in the revised manuscript to ensure that all characters are readable.

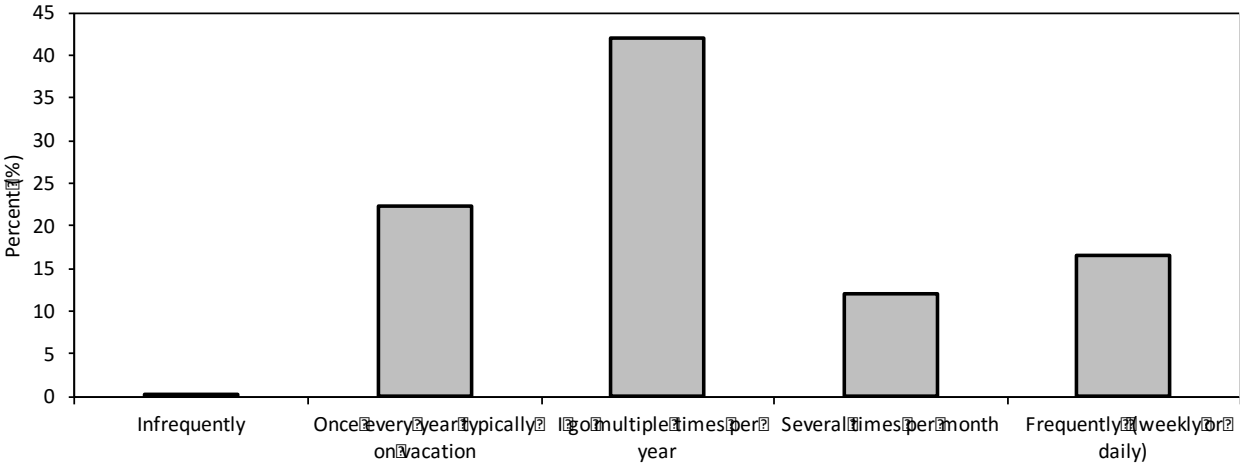


Figure 4: reduce the size of the diagram and increase the size of captions that currently are impossible to read

- We have increased the size of the text in the revised manuscript to ensure that all characters are readable.

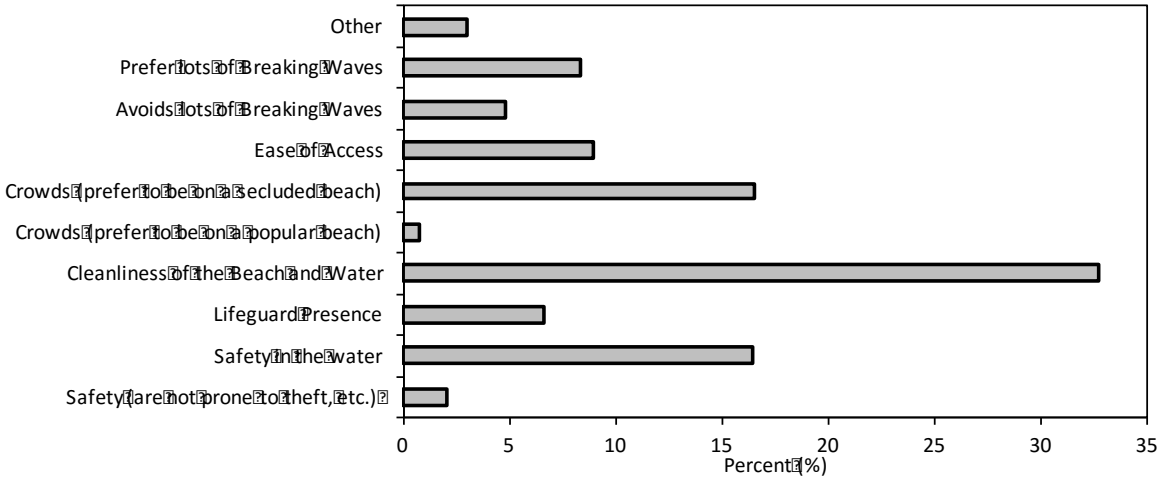
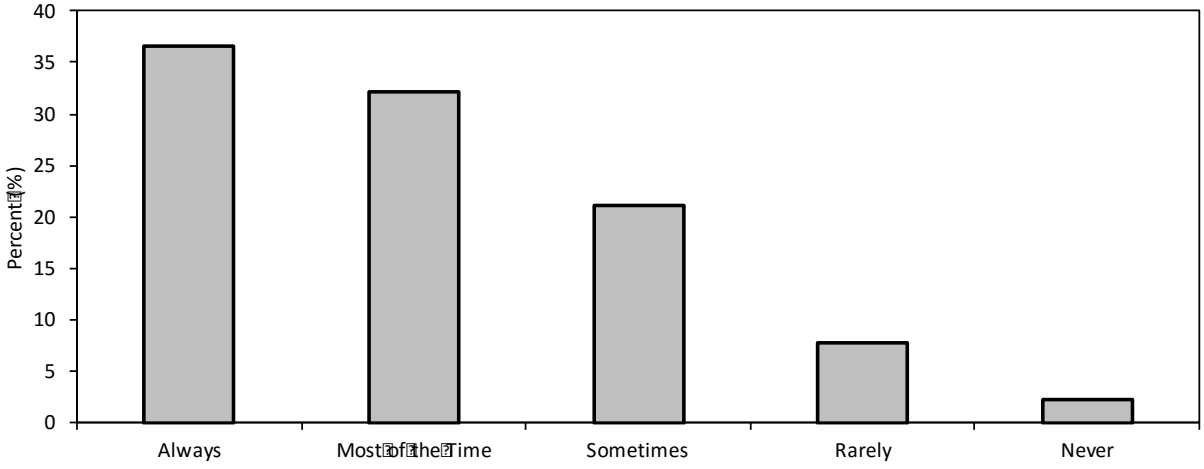
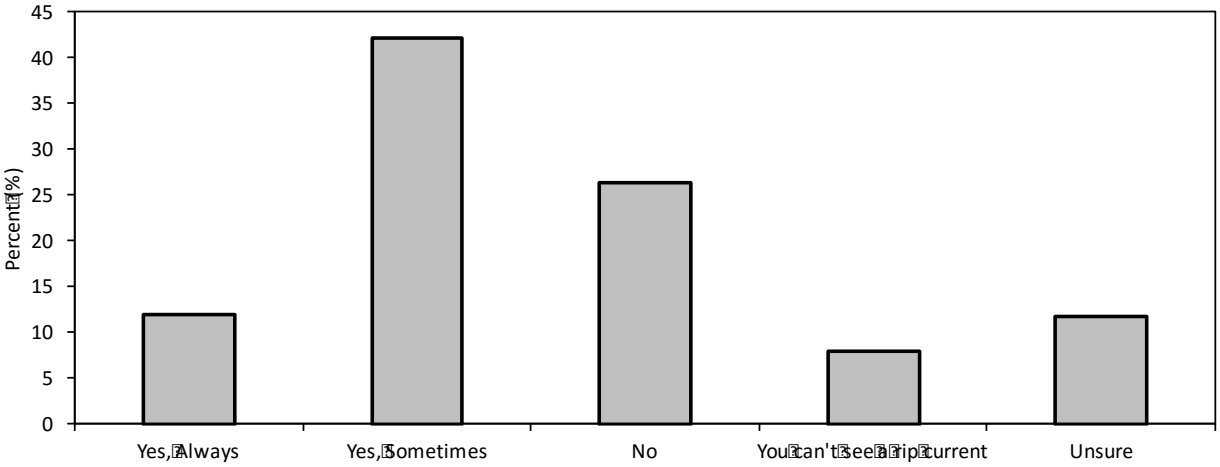
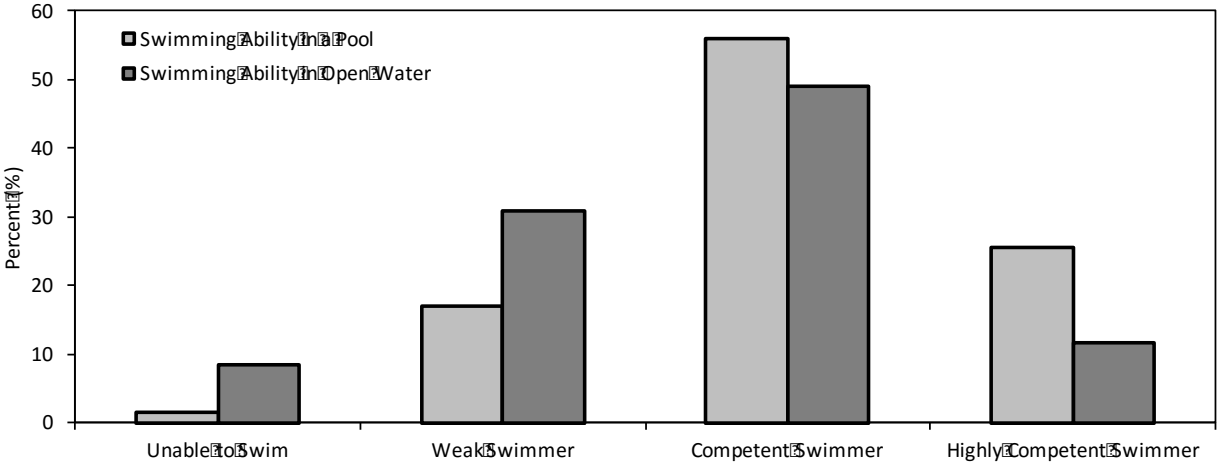


Figure 5, 6 and 7: as for fig. 3

- We have increased the size of the text in the revised manuscript to ensure that all characters are readable.







Reviewer #2

There is no section that focusses on familiarity with the "break the grip' program itself and it might be useful to tackle this first and then go on to the detailed analysis.

- This is a valid criticism and we have added a section about the "break the grip' program at the start of the results section and use that as an introduction to the other results.

3.1 Familiarity with the Break the Grip of the Rip ® Campaign

Only 18% (n=304) of respondents reported hearing about the Break the Grip of the Rip ® Campaign with a nearly identical split by gender and age. Of those who did, approximately 40% reported hearing about the campaign either through a brochure/pamphlet (n=120) or at the entrance to a beach (n=119). The majority of respondents (54%; n=163) reported hearing about the campaign through various sources on the internet including 90 respondents who reported having heard about the campaign from the Break the Grip of the Rip ® website itself. When asked what Break the Grip of the Rip means, most respondents (familiar with the campaign) reported (to varying degrees of accuracy) that it was designed to provide information about what to do if caught in a rip current:

Do not try to fight the current, instead work with the current
until you can break free of its pull

Advises affected swimmers not to struggle while heading shoreward
but to swim parallel to the beach till out of the off-beach current

Swim parallel to get out of the rip

There were, however, several respondents (familiar with the campaign) who believed that the messaging was not appropriate and needed to be rethought:

The slogan is useless to anyone caught in a rip current!
What can you do by knowing this slogan? …."Wave, Yell & Swim Parallel"
is a far better slogan...it provides 3 lifesaving pieces of information. The existing slogan provides nothing.

it's an advertising slogan; it doesn't mean much at all.
It's a bad slogan; it does not tell folks what to do,
what to watch for, or anything useful.

Responses from those who were not familiar with the campaign were much shorter and did not contain the level about survival strategies provided by those familiar with the campaign. Representative responses include "how to escape", "tips to survive", and "how to get out of a rip".

In support of this new section we added to the introduction and the discussion:

Results from Brannstrom et al. (2015) suggest that while most beach users in Texas were not familiar with the campaign itself, many were familiar with a key message of the campaign on "what to do" when caught in a rip current. This suggests that the campaign may have been successful in educating beach users and reducing the number of drownings, but this hypothesis has never been formally tested.

Results of this rip current survey suggest that while many potential US beachgoers are not aware of the "Break the Grip of the Rip" ® campaign, those that are tend to be informed about rip current safety. While this is an encouraging result, it needs to be placed in context.

It is also interesting to note that while many survey respondents were not familiar with the "Break the Grip of the Rip" ® campaign itself, a clear majority of respondents (~91%) understood the primary message of the campaign and were able to provide an explanation of the message (i.e. "break the grip"), with those previously familiar with the campaign providing detailed explanations of how to escape by 'swimming parallel' and/or 'floating until the current weakened'. This also indicates that respondents may also have gained this knowledge from other sources.

The results section is a little lengthy and could be shortened a bit by confining the quotes to one or two per section since they are provided purely for illustration.

- We included as many quotes as possible to ensure that we provided as much context and detail as possible for the readers. However, we recognize that there are large number of quotes and that they are only used for illustration. In this respect, we have reduced the number of quotes in the results section by a third.

The discussion is quite lengthy, but serves a useful purpose in drawing out the relevant messages from the survey itself and especially the contrast between frequent visitors, who were knowledgeable of the hazard, and infrequent visitors who were not knowledgeable and therefore likely to be most at risk. However, the key take-home messages in the discussion are not always apparent and it might be better to make them clearer in the conclusions by presenting them (the conclusions) as a set of concise bullet points that bring out the key results and recommendations rather than as a lengthy paragraph.

- This is consistent with the comments of Reviewer #1, and we have therefore added a table at the start of the discussion section to highlight the most important findings presented in the results section. Because we have added this table, we maintained the structure of the conclusion section with a broad summary and a focus on what can be done to improve the campaign and forecasting.

Table 2. Summary of major findings from the "Break the Grip of the Rip!" National Rip Current Survey.

Focus of Questions	Example topics
Beach Preference	• Frequency and purpose of visits to a beach affect perception of surf conditions, importance of swimming near a lifeguard and self-reported ability to spot a rip current
Swimming Ability	• Range of self-reported swimming ability (distance in open water) related to self-reported competency
Ability to Identify a Rip Current	• Ability to identify safest location in a photograph related to frequency of beach visits, self-reported swimming competency and training • Ability to identify safest location related to perceived importance of and concern about surf hazards, self-reported understanding of "high" and "low" risk conditions, and perceived accuracy of rip forecasts
Response to Warning Sign	• Perceived ability to use sign to identify a rip current varied with ability to identify safest location on a photograph • Sign has been effective in communicating swimming parallel as an escape strategy, and taking caution when entering the water • Identified need to provide a more accurate depiction of a rip current, detailed instructions on how to escape a rip current, and local emergency information
Prevention	• "Break the Grip of the Rip" Campaign has been successful in informing beach users to: 1) not fight the current, 2) swim out of the current, then to shore, 3) if you can't escape, float or tread water, and 4) if you need help, call or wave for assistance
Forecasts	• Self-reported change in behavior based on forecasted beach and surf conditions, but tendency for forecasts to be inconsistent with observations • Perceived inaccuracy of forecast related to spatial and temporal broadness of forecast, inability to identify a rip, and behavior of other beach users
Trusted Sources of Information	• No significant correlations were observed between trust in a source of information and respondent demographics

The authors note in the introduction that the US has 4 coastlines (presumably the Arctic coast is omitted because of limited swimming opportunities) and that they differed considerably in terms of wave climate and beach systems. They also differ in the role of winds in generating or exacerbating the hazard. Thus, on the Great Lakes rip currents always occur in the presence of moderate to strong winds while on the west coast rip currents are often associated with large swell events and wind may be light. In the Great Lakes most rip current deaths appear to be associated with natural headlands, or with the presence of large groynes or harbour jetties but in Florida or Texas this is probably not the case. It might be useful therefore to comment on whether there were differences in responses based on which coast people used and to assess whether the education program should be tailored to individual coasts.

- In response to Reviewer #1 we will add to the introduction to describe rip currents and will use this section to describe the differences in the rip problem amongst the different coasts. While there is not enough information to determine whether location had an influence on the responses, we will add this as a qualifier and possible complicating factor in the discussion section.

Rip currents (often called "rips" or "rip tides") are strong, narrow seaward flows driven by alongshore variations in wave set-up landward of the breaker zone. Due to their dependence on wave breaking, rips can develop in any beach environment in oceanic, sea and lacustrine environments. Castelle et al. (2016) classify rips as: 1) boundary rips that develop along both natural and engineered structures including headlands, groins and piers, 2) bathymetric rips that develop in response to the variability of the nearshore morphology and 3) hydrodynamic rips that are spatial and temporally variable and develop in the absence of morphological variations or a lateral boundary. The type of rip that develops on a beach depends on the local wave climate and geology. For example, rips in the Great Lakes tend to be associated with natural headlands or the presence of large groins or harbor jetties, while rips in Florida and Texas tend to be bathymetrically controlled and associated with a transverse bar and rip nearshore morphology (Houser et al. 2013). Rips also vary regionally based on the driving forces, with rips on the Great Lakes typically associated with moderate to strong winds, while on the West Coast of the United States the rips are often associated with large swell events independent of the wind.

Rips are capable of carrying unsuspecting bathers significant distances away from the shoreline with speeds reaching over 2 m s^{-1}. As a consequence rips are considered a major public health problem in the USA….

Finally, we have made small edits throughout the manuscript in an attempt to reduce the overall length of the paper without compromising the content and findings.

Public Perceptions of a Rip Current Hazard Education Program: 'Break the Grip of the Rip!'

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Abstract

Rip currents pose a major global beach hazard; estimates of annual rip current related deaths in the United States alone range from 35 to 100 per year. Despite increased social research into beach-goer experience, little is known about levels of rip current knowledge within the general population. This study describes results of an online survey to determine the extent of rip current knowledge across the United States, with the aim of improving and enhancing existing beach safety education material. Results suggest that the US-based "Break the Grip of the Rip"® campaign has been successful in educating the public about rip current safety directly or indirectly, with the majority of respondents able to provide an accurate description of how to escape a rip current. However, the success of the campaign is limited by discrepancies between personal observations at the beach and rip forecasts that are broadcasted for a large area and time. It was the infrequent beach user that identified the largest discrepancies between the forecast and their observations. Since infrequent beach users also do not seek out lifeguards or take the same precautions as frequent beach users, it is argued that they are also at greatest risk of being caught in a dangerous situation. Results of this study suggest a need for the national campaign to provide greater focus on locally specific and verified rip forecasts and signage in coordination with lifeguards, but not at the expense of the successful national awareness program.

KEYWORDS: Rip Current, Beach Safety, Survey, Perceived Risk

1 Introduction

Rip currents (often called “rips” or “rip tides”) are strong, narrow seaward flows driven by alongshore variations in wave set-up landward of the breaker zone. Due to their dependence on wave breaking, rips can develop in any beach environment in oceanic, sea and lacustrine environments. Castelle et al. (2016) classify rips as: 1) boundary rips that develop along both natural and engineered structures including headlands, groins and piers, 2) bathymetric rips that develop in response to the variability of the nearshore morphology and 3) hydrodynamic rips that are spatial and temporally variable and develop in the absence of morphological variations or a lateral boundary. The type of rip that develops on a beach depends on the local wave climate and geology. For example, rips in the Great Lakes tend to be associated with natural headlands or the presence of large groins or harbor jetties, while rips in Florida and Texas tend to be bathymetrically controlled and associated with a transverse bar and rip nearshore morphology (Houser et al. 2013). Rips also vary regionally based on the driving forces, with rips on the Great Lakes typically associated with moderate to strong winds, while on the West Coast of the United States the rips are often associated with large swell events independent of the wind.

Rips are capable of carrying unsuspecting bathers significant distances away from the shoreline with speeds reaching over 2 m s^{-1}. As a consequence rips are considered a major public health problem in the USA, Australia, Costa Rica, and many other countries (Klein et al., 2003; Hartmann, 2006; Sabet and Barani, 2011; Woodward et al., 2013; Arun Kumar and Prasad, 2014). Rip currents in these countries are considered a major public health problem (Short and Hogan 1994; Sherker et al., 2008; Morgan et al. 2009; Arozarena et al., 2015). In Australia, rip currents are believed to be responsible for approximately 13,000 beach rescues per year (SLSA, 2016) and an average of 21 confirmed deaths per year (Brighton et al., 2013), which exceeds fatalities caused

by most other natural hazards (Brander et al., 2013). While it has been estimated that 30–40 individuals drown each year in rip current related incidents in the United States (Gensini and Ashley 2010), Lushine (1991) suggested that rips may account for up to 150 fatal drownings per year and the United States Lifesaving Association (USLA) estimate this number to be over 100 per year. USLA's National Lifesaving Statistics Report (2012) indicates that over 82% of surf beach rescues in the US are rip current related and they therefore surmise that 82% of all fatal drownings at beaches are associated with rip currents.

Beach users' vulnerability to drowning in a rip current depends on a combination of nearshore hydrodynamic and bathymetric conditions, personal and group behaviors, and the beach safety and rip current knowledge of the individual (e.g. Houser et al., 2011; Brander et al., 2011; Caldwell et al., 2013; Houser et al., 2016). Morgan et al. (2009) identified that lacking rip current knowledge was associated with rip current drownings, as was gender, age, alcohol consumption, and overconfidence in swimming ability. Recent evidence suggests that while most beach users are aware of rip currents and the hazard they pose, they are not able to identify a rip current (Sherker et al., 2010; Caldwell et al., 2012; Brannstrom et al., 2014). More than 80% of beach users surveyed in Florida and Texas failed to identify rip currents in photographs, usually by incorrectly identifying areas of breaking waves as the most hazardous swimming conditions (Brannstrom et al., 2014). This is consistent with results of Sherker et al. (2010) who argued that most beach users are unable to identify a rip current and that "beachgoers clearly need to know what a rip looks like to actively avoid swimming in it" (pg. 1787). Given sufficient information, it is possible for beach users to identify a rip current with confidence (Hatfield et al., 2012). However, the ability to identify a rip current or to recognize posted warnings about the rip current danger is not a guarantee that a beach user will be safe, particularly because many will still choose to swim

425 in unsafe and unpatrolled sections of the beach, away from the presence of lifeguards, for social
426 or behavioral reasons or because of lack of awareness and/or complacency (Drozdzewski et al.
427 2012; 2014; Williamson et al. 2012; Houser et al., 2016). Recent evidence suggests that beach
428 access management can inadvertently steer unsuspecting beach users towards rip-prone areas,
429 increasing the chances of a drowning occurring on that beach (see Barrett and Houser, 2012;
430 Houser et al., 2015; Trimble and Houser, 2017).

431 Informing the public about the rip current hazard has become a national priority in several
432 countries including the United States (e.g. Ashley and Black, 2008; Brannstrom et al., 2013),
433 Australia (e.g. Sherker et al., 2008; Brighton et al., 2013), United Kingdom (e.g. Woodward et al.,
434 2013), and Costa Rica (Aronzarena et al., 2015). The United States has arguably the longest
435 running cooperative and coordinated public rip current education program operating across various
436 organizational and political levels (Carey and Rogers, 2005). A Rip Current Task Force was
437 convened in 2003 by the National Oceanic Atmospheric Administration (NOAA) and United
438 States Lifesaving Association (USLA) to establish consistent rip current education efforts and
439 improve data sharing about rip current rescue data across the United States. Subsequently, with
440 the assistance of the National Weather Service (NWS) and Sea Grant, a national "Break the Grip
441 of the Rip!" ® education campaign was initiated in 2004. The "Break the Grip of the Rip!" ®
442 campaign aimed to educate the public about the rip current hazard by providing information about
443 what rip currents are, why they are dangerous, how to identify them, what to do if caught in one,
444 and how to help someone else if they are caught in a rip current. Aspects of this information have
445 been disseminated through various means such as the NWS Rip Current Safety webpage
446 (http://www.ripcurrents.noaa.gov/), brochures, beach signs, videos, newspaper articles, and public
447 service announcements on television.

While this campaign was the first of its kind globally, it was also particularly challenging given that the United States has four very different coastlines (West Coast, East Coast, Gulf Coast, Great Lakes) that differ in terms of wave climate and beach systems, and a large inland non-coastal population who may only visit any of these coastlines infrequently. Results from Brannstrom et al. (2015) suggest that while most beach users in Texas were not familiar with the campaign itself, many were familiar with a key message of the campaign on "what to do" when caught in a rip current. This suggests that the campaign may have been successful in educating beach users and reducing the number of drownings, but this hypothesis has never been formally tested.

The core visual image used in many of these interventions was a simple diagrammatic illustration of an idealized rip current from an oblique aerial perspective (Fig. 1). In this image, the rip current is characterized by relatively calm white water surrounded by more intensive wave breaking adjacent to the rip and close to the shoreline. An image template was created that could be accessed online and in hardcopy and duplicated freely to be posted along boardwalks, beachfronts and public beach access points throughout the United States. The image has also been more recently adopted in other countries such as Thailand, Costa Rica, Mexico, South Korea, and Japan. While the NOAA-USLA sign was not intended to teach the general population to identify a rip, the prominent image of a rip current on the sign and attempts to post the sign on beaches indicate that its function and visual argument constitute an invitation to beach users to use the information to identify rip currents (Brannstrom et al., 2015).

Due to this conflict between its' theoretical and practical use, the NOAA-USLA rip current sign has proven to be mostly successful in regards to educating beachgoers on "what to do" (e.g. swim parallel to the beach) when caught in a rip current, but has not been particularly successful

in improving beach users' ability to identify rip currents from the perspective of standing or sitting on the beach (Brannstrom et al., 2015). Consistent with results of Matthews et al. (2014), only a small percentage of beach users (<50%) recalled observing rip current warning signs on beaches in Florida and Texas (Caldwell et al., 2012; Brannstrom et al., 2014) despite their wide spread occurrence at beach access points. However, it is important to note that despite observing and understanding a warning sign, it is well established that some people will not take the appropriate actions to prepare for or avoid the hazard (Sietgrest and Gutscher, 2006; Karanci et al., 2005; Hall and Slothower, 2009; Johannesdottir and Gisladottir, 2010).

In a separate initiative, the NWS has endeavored to develop a public rip current forecasting system, although the methodology varies among Weather Forecast Offices (WFO). Some WFOs issue surf zone forecasts that include a 3-tiered (low, moderate, high) rip current outlook communicated to the public during television and radio news broadcasts (Carey and Rogers, 2005) and social media platforms. Some WFOs work with local lifeguards to update their outlooks based on real-time observations. However, as discussed in NOAA (2015), these forecasts are not necessarily communicated or disseminated in a consistent manner throughout all regions and therefore, are not communicated seamlessly. The lack of consistency in forecasting is complicated by rip development being dependent on how the incident wave field interacts with the pre-existing nearshore morphology, which is difficult to predict without local knowledge on how it evolves over a range of spatial and temporal scales.

Since perception of the rip hazard depends in part on trust in experts and authorities, and trust in the protective measures they employ (Njome et al., 2010; Heitz et al., 2009; Terpstra, 2009, 2011; Barnes, 2002), inaccuracies in the forecast or a discrepancy between the forecast and what is observed at a specific beach at a specific time can erode confidence in the forecast (Siegrist and

494 Cvetkovich, 2000; Espluga et al., 2009). Lack of confidence in forecasts could potentially
495 condition beach users to downplay the hazard warning on future visits (Hall and Slothower, 2009;
496 Scolobig et al., 2012; Green et al., 1991; Mileti and O'Brien, 1993). Furthermore, the generic
497 nature of the rip current forecasts can result in situations where the actual intensity of rips varies
498 substantially from the forecast. Beachgoers could easily observe a discrepancy between their beach
499 location and the rip forecast, caused by either the generalized nature of the forecast or their inability
500 to identify a rip current (Caldwell et al., 2012; Brannstrom et al., 2014, 2015).

501 The national US rip current education program is clearly an impressive effort yet many rip
502 current related fatalities and rescues still occur on US beaches and overseas (Gensini and Ashley
503 2010) and there is little quantitative evidence available to assess the overall effectiveness of the
504 program. This is largely because no 'pre-program' study was conducted on public understanding,
505 perception, or behavior in relation to the rip current hazard. There is also a lack of hard data on rip
506 current related fatalities, beach visitation numbers and how incident frequency and exposure rate
507 may have changed over time. In this regard, NOAA sponsored a workshop in 2015 to review the
508 "Break the Grip of the Rip" ® program and NWS rip current forecasts to discuss whether existing
509 messaging is scientifically sound, as well as effective and clear in reaching all age groups and
510 demographics (NOAA, 2015).

511 It was acknowledged at the NOAA workshop that while there have been several recent
512 studies to describe the extent of rip current knowledge amongst beach users (or lack thereof) on
513 specific beaches in the United States (Caldwell et al., 2013; Brannstrom et al., 2014, 2015) there
514 is insufficient understanding about beach user knowledge of rip currents and their behavior at the
515 beach at a national level. This study describes results of a national online survey focused on United
516 States based beachgoers and their understanding of, and experience with, the "Break the Grip of

517 the Rip" ® program and the rip current hazard to provide quantitative evidence to guide future
518 improvements to beach safety education material and forecasting efforts.
519
520 **2 Methodology**
521
522 The study research design relied on an internet-based survey instrument using Qualtrics
523 approved by the relevant human subject protection program from Texas A&M University. The
524 survey consisted of questions re-phrased from Sherker et al. (2010) and photograph-based rip
525 current identification protocols (Fig. 2) modified from Brannstrom et al. (2014, 2015), with
526 questions grouped into six categories (Table 1). The survey had 75 questions and took
527 approximately 20-30 minutes to complete. It remained open from May-August 2015 and all
528 answers were recorded anonymously through Qualtrics Survey Software. A copy of the survey
529 instrument is provided as an appendix to this manuscript.
530 The survey was distributed by email to cooperating organizations and individuals for
531 distribution though listservs, websites, social media and in advertisements. In particular, it was
532 disseminated via secure Internet and social media links for Texas A&M University, Sea Grant,
533 Science of the Surf, NWS, and the National Oceanic and Atmospheric Association (NOAA).
534 While this internet-based recruitment process attempted to target a much wider demographic of
535 the US population, it is also reasonable to assume that as the host websites were all beach and surf-
536 related, survey respondents likely had greater interest in, and understanding of, coastal
537 environments and hazards leading to a potential bias that was also experienced in a beach safety
538 related study by Drozdzweski et al. (2012).
539
540 **3 Results**
541

Between May and August 2015, a total of 2084 respondents started the online survey, but only 1622 completed all questions (completion rate: 78%). Geographically, the largest number of respondents were from the state of Texas (n=368) where Texas Sea Grant and the local NWS office conducted significant advertisement for the survey. Large numbers of respondents also came from North Carolina (n=214), California (n=184), and Florida (n=130), with most remaining states having <50 respondents. Of the 50 US states, only Nebraska did not have a respondent. Overall this cohort managed to capture respondents who use each of the coastlines in the continental US. Respondents were evenly distributed by age (>18 years); each 10-year range between 21 and 60 garnered about between 320 and 420 respondents. A slight majority of the respondents were female (55%).

3.1 Familiarity with the Break the Grip of the Rip ® Campaign

Only 18% (n=304) of respondents reported hearing about the Break the Grip of the Rip ® Campaign with nearly identical split by gender and age. Approximately 40% of respondents reported hearing about the campaign either through a brochure/pamphlet (n=120) or at the entrance to a beach (n=119), whereas 163 respondents (54%) reported hearing about the campaign through various sources on the internet. 90 respondents reported having heard about the campaign from the Break the Grip of the Rip ® website. When asked what Break the Grip of the Rip means, most respondents (familiar with the campaign) reported (to varying degrees of accuracy) that it was designed to provide information about what to do if caught in a rip current:

Do not try to fight the current, instead work with the current
until you can break free of its pull

Advises affected swimmers not to struggle while heading shoreward
but to swim parallel to the beach till out of the off-beach current

There were, however, several respondents (familiar with the campaign) who believed that the messaging was not appropriate and needed to be rethought:

The slogan is useless to anyone caught in a rip current!
What can you do by knowing this slogan? …."Wave, Yell & Swim Parallel"
is a far better slogan...it provides 3 lifesaving pieces of information. The existing slogan provides nothing.

it's an advertising slogan; it doesn't mean much at all.
It's a bad slogan; it does not tell folks what to do,
what to watch for, or anything useful.

Responses from those who were not familiar with the campaign were much shorter and did not contain the level about survival strategies provided by those familiar with the campaign. Representative responses include "how to escape", "tips to survive", and "how to get out of a rip".

3.2 Beach Preference

As presented in Fig. 3, most respondents visited the beach either once per year on vacation (22%) or multiple times per year (42%). Visitation exhibits a statistically significant relationship with age, with older respondents (>40) visiting the beach more often than younger respondents (χ^2=46.5, ρ<0.01). Perceived wave size on beaches visited by respondents depends on age and frequency of beach visitation with older respondents who visit the beach frequently tending to report beaches they visited having strong waves, while younger respondents, who tended to visit the beach infrequently, identified the beach as having small waves (χ^2=84, ρ<0.01). In general, respondents who visit the beach infrequently tend to describe the beach as having small waves and that their primary beach activity is swimming and/or wading. All respondents who visit the beach frequently (weekly or daily) identified board riding as their main activity and tended to frequent beaches with strong wave activity (χ^2=111, ρ<0.01), suggesting a greater understanding of wave

conditions. There was no statistically significant variation in wave description based on home state, suggesting that perception of wave activity is largely based on frequency of beach visitation and other personal characteristics. In terms of choice of beach visited, wave activity and the potential hazard posed by rip currents or the absence of lifeguards is less important than cleanliness and at the same level of importance as crowds (Fig. 4).

When determining which beach to visit, frequent beach users, who were mostly board riders, tended to prefer beaches with lots of waves, whereas infrequent users emphasized safety and cleanliness (χ^2=159, ρ<0.01). Frequent beach users also believed it was very important to swim near a lifeguard, while infrequent users did not (χ^2=51, ρ<0.01). Across both groups, however, respondents suggested they would still enter the water even if a lifeguard was not present, suggesting that recognition about the importance of lifeguards is not consistent with behavior in selecting where and when to swim (Fig. 5). Frequent beach visitors were also more confident in their ability to 'always' spot a rip current in contrast to infrequent beach visitors (χ^2=247, ρ<0.01). Those who visit the beach less often (e.g. several times per year or month) believed they could spot a rip 'sometimes' or believed it is not possible to see a rip current, consistent with the response from all respondents (Fig. 6).

3.3 Swimming Ability

Most respondents (~52%) self-identified as competent swimmers (Fig. 7) and reported in a separate question that they were capable of swimming between 25 and 100 yards (or more than 100 yards) without having to stop or pause in open water (χ^2=1391, ρ<0.01). Respondents who self-reported as *highly* competent open water swimmers (n=213, 12%) primarily believed they could swim more than 500 yards in open water without resting, while those who self-reported as weak swimmers (n=566, 31%) believed that they were only capable of swimming 25 yards or less.

621 Those who identified as highly competent or weak swimmers tended to have the narrowest range
622 of self-reported ranges of swimming ability, while those who self-identified as competent
623 swimmers had the widest range of self-reported swimming distances for both pools and open
624 water.
625
626 **3.4 Ability to Identify a Rip Current**
627
628 When asked "Where on this photograph would you swim?", approximately 54% of
629 respondents correctly identified the location furthest away from the rip current in Photograph 1
630 (Figs. 2a and 8a). However, 182 (11%) respondents incorrectly selected the rip current as the safest
631 location to enter the water, with the remaining respondents identifying other areas of the
632 photograph (adjacent to the rip) as being the safest location. Results of a z-test suggest that
633 respondents who selected the rip as the safest location are significantly younger than those who
634 correctly identified the safest location in the photograph ($z=12.1$, $\rho<0.01$). Those who correctly
635 identified the safest location in the photograph also visited beaches more frequently ($z=6.1$,
636 $\rho<0.01$) and self-reported beaches they visited as having strong waves ($z=6.4$, $\rho<0.01$). Most
637 respondents who identified the rip as the safest location self-reported never having swimming
638 lessons ($z=2.8$, $\rho<0.01$) and described themselves as weak swimmers in both pools ($z=3.7$, $\rho<0.01$)
639 and open water ($z=6.2$, $\rho<0.01$). Those same respondents also self-reported that it was important
640 to swim near a lifeguard ($z=5.8$, $\rho<0.01$), but tended to not consider hazards before going to the
641 beach, unlike respondents who were able to correctly identify the safest spot to enter the water
642 ($z=14.1$, $\rho<0.01$).
643 When asked what beach features they believed to be most dangerous, respondents who
644 correctly identified the safest swimming location away from the rip were more likely to report
645 alongshore currents and rip currents as dangerous features, while those who selected the rip as the

safest location tended to identify jellyfish, sharks, and big waves. Respondents who incorrectly selected the rip current as the safest location were also least familiar with the common US beach safety flag system ($z=11.5$, $\rho<0.01$), and tended to have not heard of rip currents ($z=17.3$, $\rho<0.01$). Respondents who selected the rip as the safest location did not understand what was meant by a "high risk" ($z=3.2$, $\rho<0.01$) or a "low risk" ($z=7.5$, $\rho<0.01$) of rip current development as broadcast by some NWS services. The same respondents also noted that rip forecasts are apt to be inconsistent with the conditions they encountered on the beach, in contrast to respondents who correctly identified the safest location in the photograph and noted that forecasts tended to be consistent with their experience ($z=3.3$, $\rho<0.01$).

Approximately 25% of respondents (n=630) incorrectly identified the left side of the groin (with an active rip) as the safest spot to enter the water in Photograph 2 (Figs. 2b and 8b). Like the responses to Photograph 1, those respondents tended to be younger ($z=5.2$, $\rho<0.01$), go to the beach infrequently ($z=7.8$, $\rho<0.01$), and self-report waves being relatively small ($z=7.3$, $\rho<0.01$) and their swimming ability in open water to be relatively poor ($z=2.2$, $\rho<0.01$). These respondents are also unlikely to consider hazards before going to the beach ($z=10.9$, $\rho<0.01$), are unfamiliar with the common beach flag system in the United States ($z=12.5$, $\rho<0.01$), do not understand the definition of a "high-risk" of rip current development ($z=4.2$, $\rho<0.01$), and believe that rip forecasts are not consistent with their personal beach experiences ($z=2.8$, $\rho<0.01$). Unlike responses for Photograph 1, those respondents who incorrectly identified the rip as the safest location were not significantly different (at the 95% confidence level) from those who correctly identified the safest location (right side of the groin) with respect to: pool swimming, swimming near a lifeguard, type of water activity at the beach, knowledge of the "*Break the Grip of the Rip*" ® campaign, or their perceived ability to use the sign to identify a rip current.

A similar pattern was observed in respondent' ability to identify the safest location to enter the water in Photograph 3 (Figs. 2c and 8c), with 26% of respondents incorrectly identifying the rip current as the safest location. Like responses for the other photographs, respondents who identified the rip as the safest location to enter the water did not visit beaches as often ($z=4.5$, $\rho<0.01$), self-reported having relatively limited swimming ability in pools ($z=3.1$, $\rho<0.01$) and open water ($z=2.8$, $\rho<0.01$), and did not believe it was important to swim near a lifeguard ($z=3.0$, $\rho<0.01$), unlike those who correctly identified the safest location to enter the water in the photograph. Respondents who selected the rip current as safe for swimming were not as familiar with the flag system used in the United States ($z=5.6$, $\rho<0.01$), rip currents ($z=3.9$, $\rho<0.01$), or the "*Break the Grip of the Rip*" ® campaign ($z=4.4$, $\rho<0.01$). These respondents also did not understand what was meant by a "low risk" ($z=2.5$, $\rho<0.01$) and a "high risk" ($z=3.4$, $\rho<0.01$) of rips. However, unlike Photographs 1 and 2, no statistically significant difference was observed between those who correctly or incorrectly identified the safest spot to enter the water with respect to: age, self-reported wave activity, swimming lessons, behavior in the absence of lifeguards, importance of checking for hazards, or the ability to use the sign to identify a rip current.

3.5 Response to the Rip Current Warning Sign

Only 31% of all respondents believed the NOAA rip current warning sign could be used to identify a rip current. Interestingly, those respondents who incorrectly identified the rip current as the safest spot on the beach to enter the water tended to believe that the NOAA rip current warning sign could *not* help a beach user identify a rip current. This contrasted with those who correctly identified the safest location in any of the photographs ($z=5.2$, $\rho<0.01$). When asked to describe how the sign could be used to identify a rip current, some of the latter respondents were able to relate the rip in the picture to a real rip:

It shows that in a rip current, there appears to be a break in the water, with water moving in a different direction.

It shows you the "calm" area between the two areas of normal wave activity indicating the channel where the rip is located

Most of these responses focused on the pattern of wave breaking and the orientation of the 'calmer' water to the beach. There is evidence that some respondents believed the picture to be an accurate representation of a rip, but they could not provide specific detail about the real-world features on the beach it depicted, for example "*Graphic depiction of what the tide looks like*." This suggests that some respondents believe the sign is accurate since it was designed and placed there by an authority.

As previously noted, the rip current warning sign was not designed to help beach users identify a rip current, but rather to inform them how to escape a rip. Most respondents could clearly state what the sign was informing them about swimming parallel to the beach to escape a rip:

Let the current take you out and then swim parallel the shore to escape.

Swim parallel to the shore, or wait until the rip gets less strong further offshore.

96% of respondents could provide a response to this question and virtually all responses indicated that the sign informed them to swim parallel to shore to escape the rip current, suggesting that the sign has been effective in communicating this message. When asked how seeing this sign would change their behavior of the beach, a majority (65%) of respondents suggested they would take precaution when entering the water:

Might avoid going in water if I see surface signs of rip activity and drive to another beach

Consider not going in. Look carefully for signs of rips. Look for flags and lifeguards

This suggests that while most respondents understood that the sign provided them with information on how to escape a rip current, it also helped with prevention as most respondents also noted that they would take precaution or use it to spot (and presumably avoid) a rip, rather than focus on escape strategies.

Most respondents (86%) provided ideas on how to improve the rip current warning sign, with more than half suggesting the sign needed to provide a more accurate depiction and/or description of a rip current:

I don't think it clearly identifies it enough that the waves will not break where a rip current is. It is great because it shows how to get out of one but I think with another picture of an actual rip current people would identify them easier.

Pictures showing what actual rip currents look like would be useful. / Most casual beachgoers are not confident that they could identify a rip current from shore or predict where one might be forming.

There needs to be more info on how to detect, recognize and avoid a rip current. Information on conditions during which rip currents are most likely to form would also be useful.

A small number of respondents (<10%) suggested that the sign should either include step-by-step instructions on what to do and/or provide more information about the experience of being caught in a rip current:

Multiple steps: / 1. Know when you're in a rip / 2. Stay calm and tread water / 3. Wait until you've floated out to a slower moving water. / 4. Swim sideways

Specific instructions on what one should do if caught in a rip current - Should I swim left, right, straight? What if I'm not a strong swimmer? What are some other exit options?

Another group of respondents (~15%) either did not provide suggestions on how the sign can be improved or noted that it only needed minor edits, including space for local emergency numbers

and contacts. A small number of respondents (<5%) believed that the sign should include statements that elicit fear amongst beach users including statements such as "Rip currents can drown you."

3.6 Prevention

One in four (25%) respondents reported they had been previously caught in a rip current by accident, while 10% of respondents reported that they had purposely entered a rip for surfing. When asked how to escape a rip, those who had accidently been caught in a rip current provided relatively detailed responses that either described escape by swimming parallel or riding the current without panic:

> *Let it flow. Don't fight it. Perhaps as long as you minimize tiring exertions try to flow towards the side of the current. Basically do the same thing you'd do if you fell in a strong river about to empty into a lake. You certainly wouldn't kill yourself trying to swim out upstream.*

> *Don't panic!!! Either swim - without too much exertion - parallel to the beach for 25+ yards, OR tread water and allow yourself to be carried out until the rip loses power, then swim parallel to the beach. Once out of the rip, swim back towards shore (again in a relaxed manner, taking time to prevent exhaustion). When nearing the beach, take care not to get drawn back into the rip by water flow parallel to the shoreline.*

Of those who had not been previously been in a rip 7% (n=36) did not provide a description of how to escape. The remaining respondents provided relatively short responses that described escape through combinations of swimming parallel and relaxation

Assuming no response is an indication of a lack of knowledge about rips, the number of respondents who did not provide an accurate description of how to escape a rip current is ~9%, suggesting that overall the campaign has been successful in informing beach users to: 1) not fight

792 the current; 2) swim out of the current, then to shore; 3) if you can't escape, float or tread water;
793 and 4) if you need help, call or wave for assistance.

794
795 **3.7 Forecasts**
796
797 Respondents were also asked about whether they were aware of rip forecasts, if forecasts
798 altered their behavior, and if the forecasts conformed with their observations at the beach. Since
799 existing rip forecasts are not consistent and few are based on an understanding of pre-existing
800 morphology, the focus here was not on the actual accuracy of the forecast, but on whether the
801 respondent believed the message to be consistent with their observations. About half of
802 respondents (52%) reported seeking information about beach and surf conditions before going to
803 a beach with the majority (83%) using the internet to find that information. A large majority (88%)
804 of respondents stated that information about beach and surf conditions affected their behavior, with
805 many saying that they would either "not go" (to the beach), "not go in the water", or "look for
806 rips". When asked whether the rip current forecast (either high or low) was consistent with
807 conditions they experienced at the beach, approximately 67% of respondents stated that the
808 forecasts were not necessarily consistent with their observations. For some, this inconsistency
809 reflected the temporal and spatial broadness of the rip forecast compared to what they observed:

810
811
812 *Weather changed quickly and no beach flags were posted, advising of rip*
813 *currents.*
814
815
816
817 *Rip currents cannot be predicted for individual beaches, they are blanket*
818 *warnings.*
819
820 Other respondents noted the forecast was inaccurate because other beach users had not adjusted
821 their behavior:

I never noticed an[y] thing unusual and people in general don't seem to adjust their behavior.

Others noted it was not possible to determine if the forecast was accurate because they were not able to spot a rip on the beach at that specific time or in general:

I couldn't determine if/where rip tide activity might be in the water if the forecasts had warned beach-goers to be aware of a high risk on that day.

In several cases (n=59), respondents noted they had not heard a forecast warning of the rip hazard on a given day or in general through responses such as "*I don't know if I've ever heard a rip current forecast?"*

Additional questions about high-risk rip conditions solicited written responses that suggest many respondents understood the high-risk warning to mean that wind and wave activity are tantamount to the development of rips:

Due to tides, weather, etc., there is a much greater risk for rip currents in the ocean.

There was a mix of responses in which respondents believed that 'high risk' meant that rips would form or that there was a greater chance of rip formation. Others (n=102) believed that the use of the terms high and low risk were misleading:

Whenever or wherever there are waves there can be rip currents, so I am not sure what 'high' or 'low' risk of rip currents means. All rips are potentially dangerous.

In response to the definition of low risk, respondents tended to suggest this implied that rips were unlikely or would not form:

Rip currents may still exist but are weaker or fewer than normal.

Conditions are not conducive to rip currents.

The factors necessary for rip currents to form are absent- not likely to encounter rip.

Of note, whether a respondent described high and low risk of rips as a probability (likely, unlikely) or in absolute terms (is or is not present) is not related to whether the respondent noted that the rip forecast was consistent with their observations at the beach. For both high and low-risk, some respondents believed that the forecast (by radio, internet, etc.) was not based on the predicted weather, but rather on whether a rip had been sited on a beach or not with statements such as: "*Not Sighted"* or "*Strong rips observed."* Others (n=129) believed that high and low risk was associated with the local bathymetry being conducive to the formation of rips: *"the topography/bathymetry is suited to rip currents."*

3.8 Trusted Sources of Information

Respondents were also asked to rank sources of information about rip currents from (1) most trusted to (5) least trusted. Except for social media (including Facebook, Twitter, etc.), all sources of information were nearly equally ranked from most to least trusted with no discernable pattern. Only social media exhibited a discernable pattern, with more than 35% of respondents identifying it as the least trusted source, although 18% of respondents also identified it as the most trusted. More respondents identified internet sources as the most trusted compared to other sources, while television and radio were identified as trusted (rank 2 and 3), but not the most trusted. No significant correlations were observed between trust in a source of information and respondent demographics, suggesting that a broad communication strategy is the most effective to reach the widest audience.

4 Discussion

The primary results of this US-based rip current survey are summarised in Table 2. Results suggest that while many are not aware of the "Break the Grip of the Rip" ® campaign, the US beach-going public is informed about rip current safety. While this is an encouraging result, it needs to be placed in context. The goal of this study was to examine United States based beachgoers understanding of, and experience with, the national "Break the Grip of the Rip" ® program and the rip current hazard to provide quantitative evidence for improving the program. Despite the dissemination of the online survey leading to a potentially biased cohort (Section 2) that was dominated by respondents who were relatively frequent beachgoers, self-rated as competent swimmers, and were able to successfully identify the safest location to enter the water based on photographs, approximately 10% of survey respondents were infrequent beachgoers, poor swimmers and largely ignorant of the rip current hazard and more liable to make poor swim location choices.

When taking the entire US beachgoing population into account, this cohort represents a significant population of potential 'at risk' beachgoers. Given that this population was a key target of the "Break the Grip of the Rip" ® campaign, it is therefore of considerable concern that this cohort: i) tended to select the rip current as the safest location to enter the water on each of the survey photographs; ii) did not consider hazards before going to the beach; iii) were not familiar with the beach flag system in the United States; and iv) did not seek out lifeguards when visiting a beach. These results clearly highlight how at risk infrequent beach users still are despite the decadal existence and ongoing presence of the campaign.

907 In contrast, survey respondents who were frequent beachgoers and had previous
908 experience with rip currents had a better understanding of what rip currents were, the danger they
909 represent and how to escape from a rip. As described by Brannstrom and Houser (2015), those
910 who get caught in a rip current "*understand the dangers of rips first hand and…. realize [they]*
911 *never want to be caught in that situation or accident [again]*." Similar results were found in studies
912 involving surveys of people who had been caught in rip currents in Australia (Drozdzewski et al.,
913 2012; 2015). Those with indirect or no experience tend to underestimate the danger compared to
914 those with direct experience (Ruin et al., 2007).
915 It is also interesting to note that while many survey respondents were not familiar with the
916 "*Break the Grip of the Rip*" ® campaign itself, a clear majority (~91%) understood the primary
917 message of the campaign and were able to provide an accurate explanation of the message (i.e.
918 "break the grip"). Respondents previously familiar with the campaign provided detailed
919 explanations of how to escape a rip by swimming parallel and/or floating until the current
920 weakened, indicating they may also have gained this knowledge from other sources.
921 Survey results also suggest that other factors can influence behavioral response in relation
922 to the rip current hazard. For example, as noted by several survey respondents, if everyone else at
923 the beach is entering the water and not heeding an existing rip current warning (out of ignorance
924 or purposeful neglect) there is a chance that the beach user may become complacent and also enter
925 the water despite understanding the risk. This suggests that decisions can be made based on what
926 other beach users are doing rather than rip forecasts (Lapinski et al., 2014). The tendency to follow
927 the behavior of others may be enhanced when someone goes together as part of a group and enters
928 the water because everyone is willfully ignoring the risk or is ignorant to the severity of the risk

929 (see Mollen et al., 2012; Aronzarena et al., 2015). A regional forecast or global warning will not
930 necessarily deter beach user behavior as much as direct intervention by lifeguards.

931 This study has also revealed some important issues with existing rip forecasting methods
932 and resultant warnings (Table 2). Approximately 67% of all respondents stated that rip current
933 forecasts are not necessarily consistent with what they observe on the beach. Consistent with
934 previous studies on natural hazards, those who have not experienced a predicted hazard or did not
935 experience personal damage during a visit to the beach are more likely to downplay the danger the
936 next time they visit (Hall and Slothower, 2009; Scolobig et al., 2012; Green et al., 1991; Mileti
937 and O'Brien, 1993). Any inconsistency between a rip forecast and direct observations therefore
938 has the potential for some beach users to downplay the rip current risk on future beach visits..
939 While forecast methodology varies by WFO, most rip forecasts do not consider bathymetry, local
940 topography, or hard structures that may force rips over a range of wind wave conditions. It is also
941 not clear how many forecasts are based on the actual presence of rips observed by lifeguards.

942 The key problem is that rip forecasts tend to be generalized for a large region and time,
943 whereas actual rip development and flow behavior is extremely variable over space and time
944 (Castelle et al., 2016). It is also difficult to predict the potential for rip development without an
945 understanding of the pre-existing nearshore morphology, which itself is difficult to measure
946 directly, remotely or through numerical modelling. A static daily regional rip warning may
947 therefore fail to replicate different rip conditions that occur during that day For beachgoers, this
948 can lead to a different interpretation of the forecast accuracy and may potentially lead to
949 downplaying the actual risk (see Brilly and Polic, 2005). Mileti and O'Brien (1993, p 40) describe
950 this reasoning as "*The first impact did not affect me negatively, therefore, subsequent impacts will*
951 *also avoid me."* At the same time, beach users will not be able to conceptualize events that have

never occurred or to see future trips to the beach as anything more than a mirror of past visits or experiences (Kates, 1962; Tversky and Kahneman, 1973). If the rip forecast and warnings are inaccurate or perceived to be inaccurate by the beach user, there may also be a potential loss of trust in that authority (Espluga et al., 2009) and future forecasts.

It can be assumed that beach users who rely heavily on rip forecasts and assume they are accurate might use them to calibrate their own observations and experiences, which will impact their future forecast expectations. If a low rip risk forecast is issued and the rips are actually prevalent and strong, then beach users may lose faith in forecast accuracy. Similarly, if a high rip risk forecast is issued and no rips are observed with relatively calm conditions, then beach users may become complacent about the hazard and discount or ignore future forecasts in the future. However, results of this study suggest that given time and experience at the beach over a range of conditions, beach users can develop a nuanced understanding of the forecast and gain greater confidence that it is appropriate. Rip forecast inaccuracies appear to be most problematic for infrequent beach users who also do not appear to seek out lifeguards and are unable to spot rips correctly.

A majority of respondents were able to clearly state what the standardized rip current sign was informing them to do in terms of swimming parallel to the beach to escape a the rip, but many identified a need to provide information that would allow beach users to identify a rip current in general (e.g. "*Pictures showing what actual rip currents look like would be useful*") or specific to the local beach (e.g. "*Picture of rip at actual beach [the sign] is placed on*"). However, evidence from beach surveys in Florida and Texas suggest that beach users are not able to accurately identify a rip current (Caldwell et al., 2012; Brannstrom et al., 2014), although there may be ways in which the sign can be made more accurate through small revisions to the perspective, colors, and beach

975 morphology (Brannstrom et al., 2015). While local information may improve the accuracy and
976 interpretation of the sign, there is the potential for different signs and messaging being used (of
977 varying quality and detail), leading to confusion and misinterpretation by beach users. A more
978 appropriate strategy may be to take a more local-approach to risk and emergency management
979 including local emergency contact information. This approach places greater authority in local
980 managers and emergency responders, without resulting in different signs.

981 A local approach also includes putting greater emphasis on the expertise of lifeguards to
982 prevent accidents and respond to emergencies promptly and properly. This would also partially
983 consider the fact that there are different types of rip currents and associated behavior in different
984 geographic locations and regions (Castelle et al., 2016). Of note, Surf Life Saving Australia has
985 recently adopted a 'combined approach' to promoting how to escape a rip current (Bradstreet et
986 al., 2014). This decision was largely based on field tests of rip escape strategies (McCarroll et al.,
987 2014; Van Leeuwen et al., 2016), which clearly showed that natural variance in rip flow behavior
988 influences effectiveness of different rip escape strategy strategies. This has also been illustrated by
989 recent numerical modelling studies (McCarroll et al., 2016; Castelle et al., 2016). However,
990 communicating such a complex and mixed message is problematic. In contrast, concepts of rip
991 avoidance instruction are consistent and simpler to explain, making them more suitable for
992 advertising campaigns and signage (Bradstreet et al. 2014).

993 While there is still insufficient evidence to suggest that present warning systems help
994 people avoid and escape rip currents (see also Lapinski et al., 2014), there is evidence that
995 lifeguards are effective at preventing drowning death through preventive actions and rescues. With
996 proper training and experience a lifeguard can provide invaluable local understanding of the rip
997 hazard to provide effective mitigation. Unfortunately, there is no consensus amongst beach users

998 that it is safe (or not) to swim in the surf after lifeguards are off duty (Petrass and Blitvich, 2014),
999 despite evidence that it is safer to swim in the presence of a lifeguard. In this respect, greater focus
1000 should be placed on reminding beach users to swim near lifeguards and only at times that lifeguards
1001 are present because "the chances of drowning at a beach protected by lifeguards trained under
1002 USLA standards is less than one in 18 million" (Branche et al. 2001).
1003
1004 **5 Conclusions**
1005
1006 A survey about the extent of public rip current knowledge in the United States was
1007 conducted with the aim of establishing a dataset that provides guidance for the improvement and
1008 enhancement of existing beach safety interventions. Results suggest that the US-based "Break the
1009 Grip of the Rip" ® campaign has been successful in helping inform the public about rip current
1010 safety. Although few respondents were familiar with the campaign itself, most respondents could
1011 provide an accurate description of how to escape a rip current by swimming parallel and/or floating
1012 until the current weakened. Results suggest that the most at-risk population are infrequent beach
1013 users because they do not seek out lifeguards, do not take the same precautions as frequent beach
1014 users, and believe there are large discrepancies between rip forecasts and their own observations
1015 at the beach. Survey results provide a conservative estimate of 10% of US beachgoers being at
1016 risk of being caught in a rip due to ignorance and/or poor swimming choices. Future education
1017 efforts should attempt to target this beachgoing demographic group. Knowledge of rips, visual
1018 ability to accurately identify a safe swimming location in where rip currents are present, and ability
1019 to interpret rip forecasts are each dependent on prior experience with rips and the frequency of
1020 beach visitation. In addition to concerns about the spatial and temporal accuracy of public rip
1021 forecasts, many respondents identified a lack of local detail in the rip current warning sign as a
1022 concern, with more than half of respondents suggesting the sign needed to provide a more accurate

depiction and/or description of a rip current and local emergency information. This suggests a need for greater focus on locally specific and verified rip forecasts and signage in coordination with lifeguards, but not at the expense of the successful “Break the Grip of the Rip” ® campaign.

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Tables

Table 1. Question groups used to elicit responses from respondents notified about the survey by various agencies in the United States.

Group	Focus of Questions	Example topics
1	Informed Consent	
2	Non-identifying personal information	ZIP code, age, ethnicity, and beach use
3	Swimming behavior	Self-assessed swimming ability
4	Beach behavior and beach safety information	Frequency of visits; perceived risks at the beach
5	Rip identification and knowledge	Description of a rip current; ability to identify rip current in a photograph
6	Memorability, conspicuity, comprehension, priming	Source of rip information; memory of observing rip safety warnings
7	Rip current sign knowledge and understanding	Understanding rip current warning sign and warnings

Table 2. Summary of major findings from the "Break the Grip of the Rip!" ® National Rip Current Survey.

Focus of Questions	Example topics
Beach Preference	• Frequency and purpose of visits to a beach affect perception of surf conditions, importance of swimming near a lifeguard and self-reported ability to spot a rip current
Swimming Ability	• Range of self-reported swimming ability (distance in open water) related to self-reported competency
Ability to Identify a Rip Current	• Ability to identify safest location in a photograph related to frequency of beach visits, self-reported swimming competency and training • Ability to identify safest location related to perceived importance of and concern about surf hazards, self-reported understanding of "high" and "low" risk conditions, and perceived accuracy of rip forecasts
Response to Warning Sign	• Perceived ability to use sign to identify a rip current varied with ability to identify safest location on a photograph • Sign has been effective in communicating swimming parallel as an escape strategy, and taking caution when entering the water • Identified need to provide a more accurate depiction of a rip current, detailed instructions on how to escape a rip current, and local emergency information
Prevention	• "Break the Grip of the Rip" ® Campaign has been successful in informing beach users to: 1) not fight the current, 2) swim out of the current, then to shore, 3) if you can't escape, float or tread water, and 4) if you need help, call or wave for assistance
Forecasts	• Self-reported change in behavior based on forecasted beach and surf conditions, but tendency for forecasts to be inconsistent with observations • Perceived inaccuracy of forecast related to spatial and temporal broadness of forecast, inability to identify a rip, and behavior of other beach users
Trusted Sources of Information	• No significant correlations were observed between trust in a source of information and respondent demographics

Figures

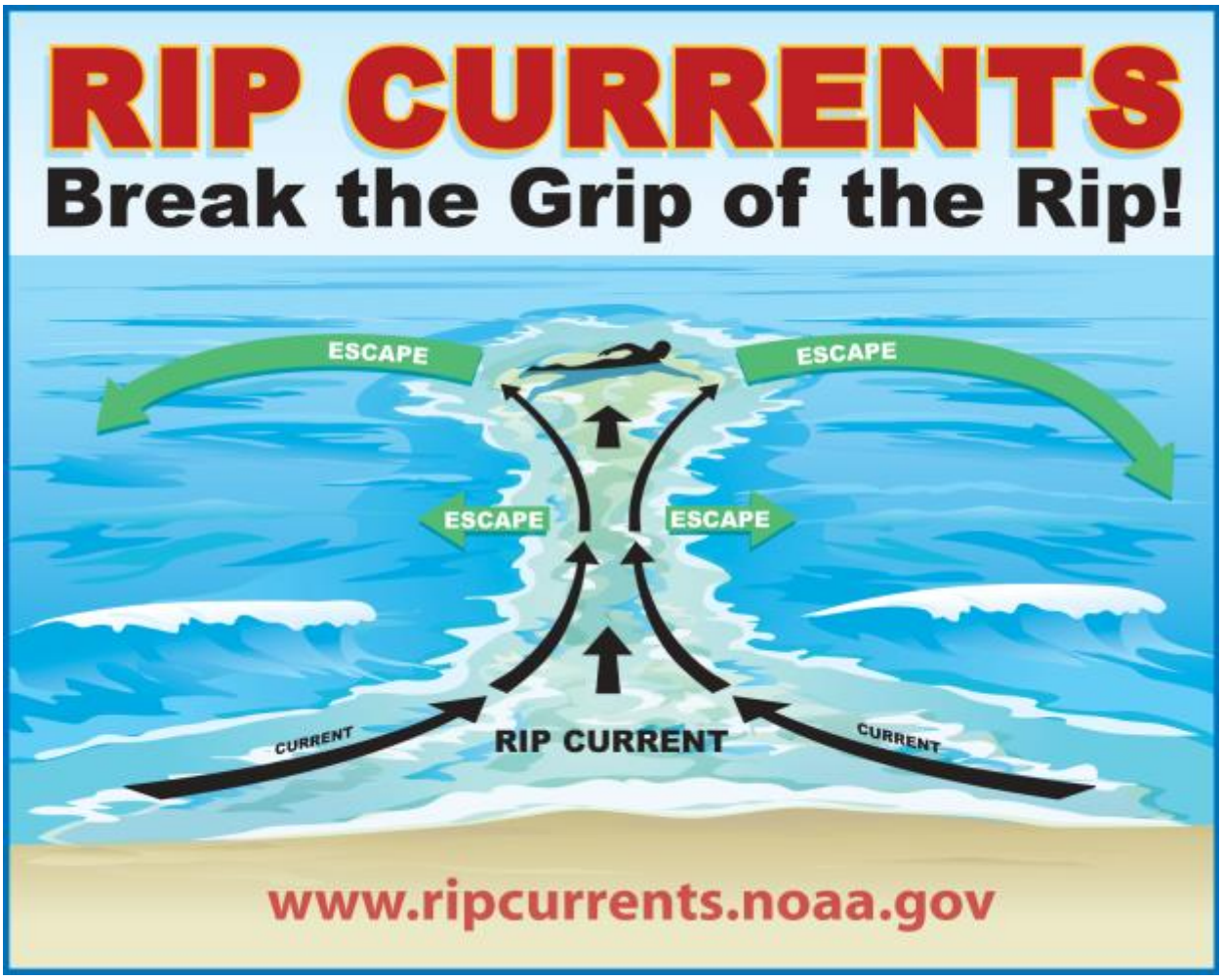


Fig. 1. Rip current warning sign developed by the United States Rip Current Task Force as part of the "Break the Grip of the Rip!" ® education campaign.

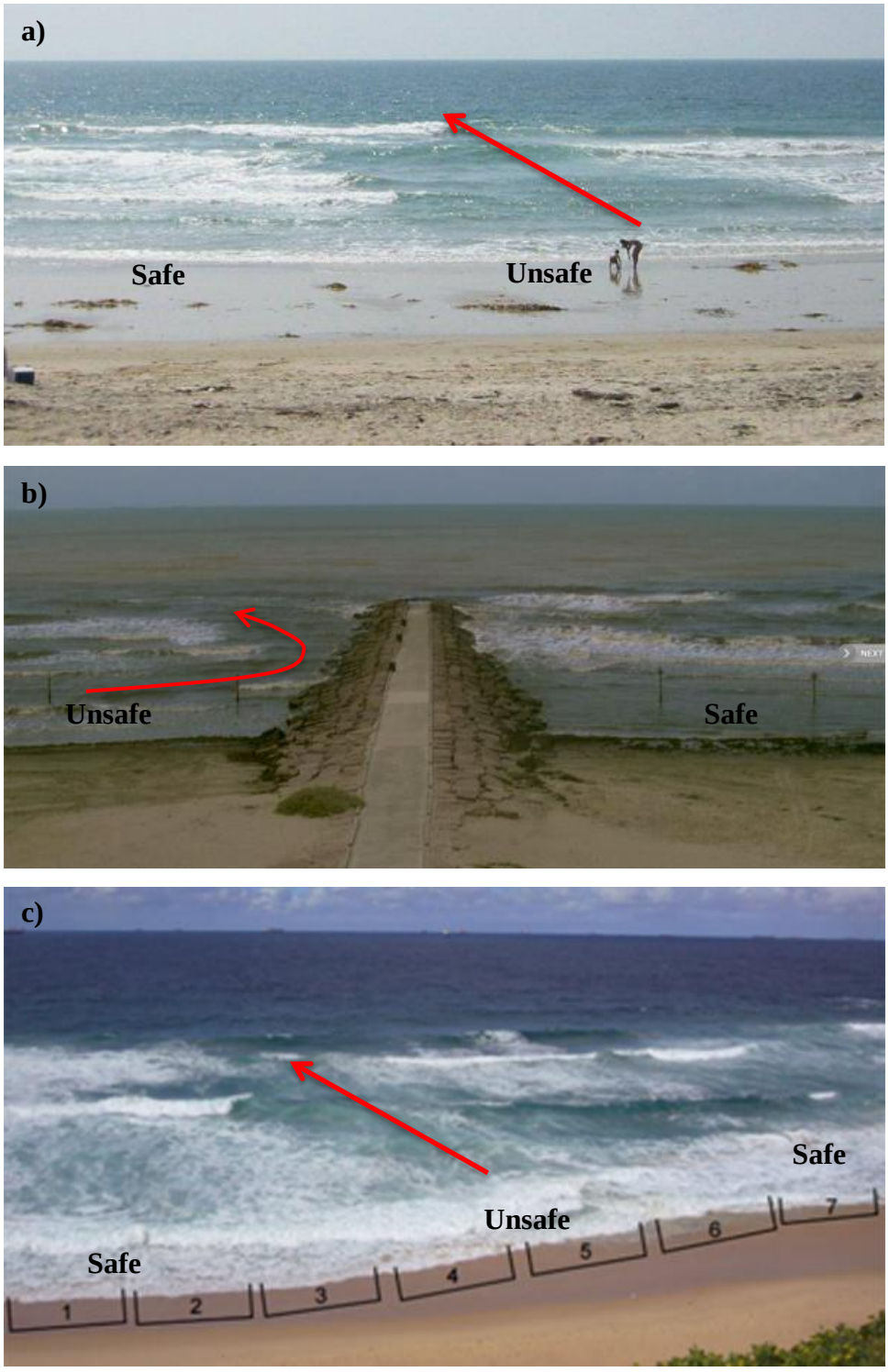


Fig. 2. Photographs used in Questions 42 through 44 of the survey to ask respondents "Where on this photograph would you swim?". The location of the rip current in each photograph is shown by the red arrow, which was not visible to the respondents.

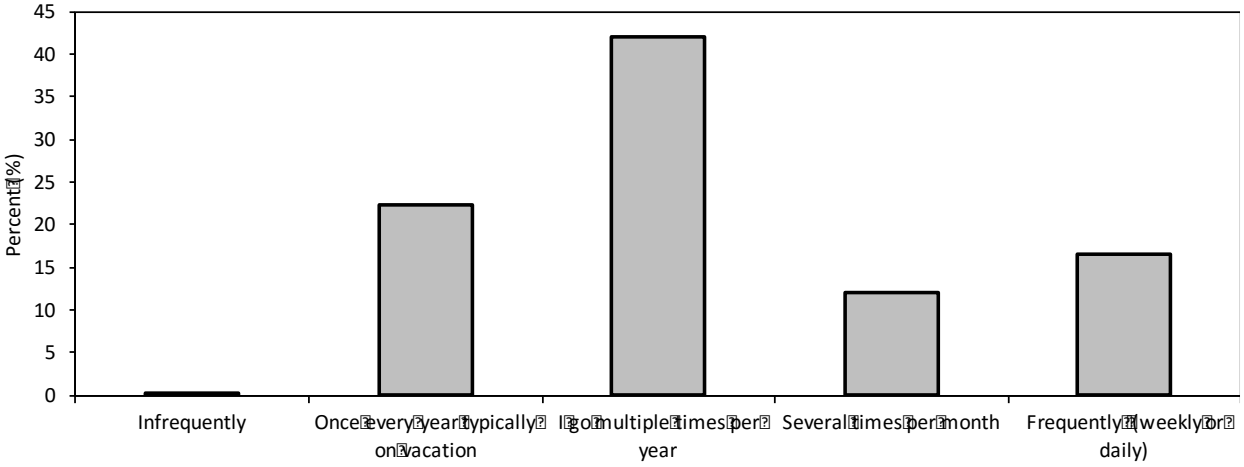


Fig. 3. Percent of self-reported beach visitation by respondents.

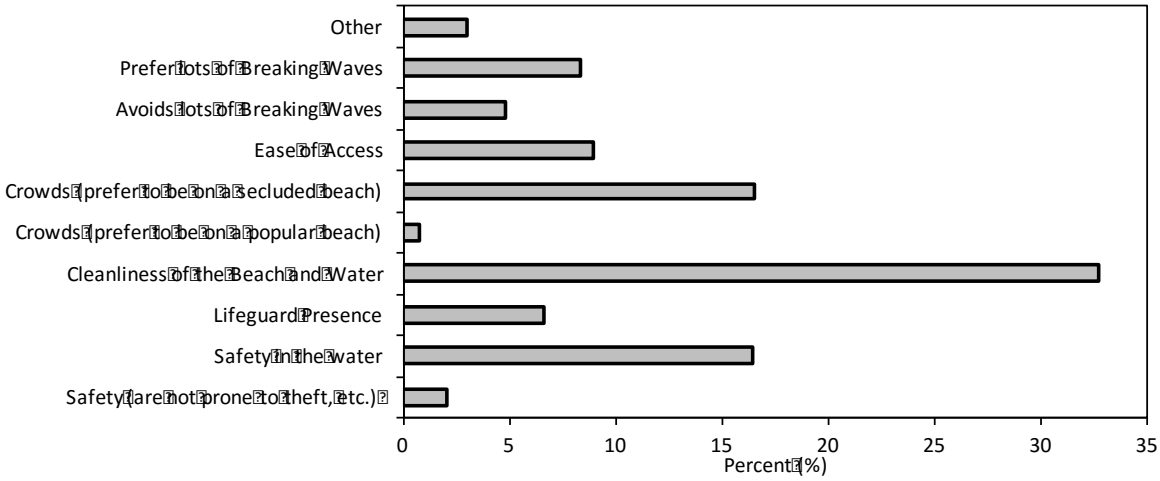


Fig. 4. Relative importance of beach and surf factors to respondents when selecting a beach. Note that respondents were asked to identify all factors that applied.

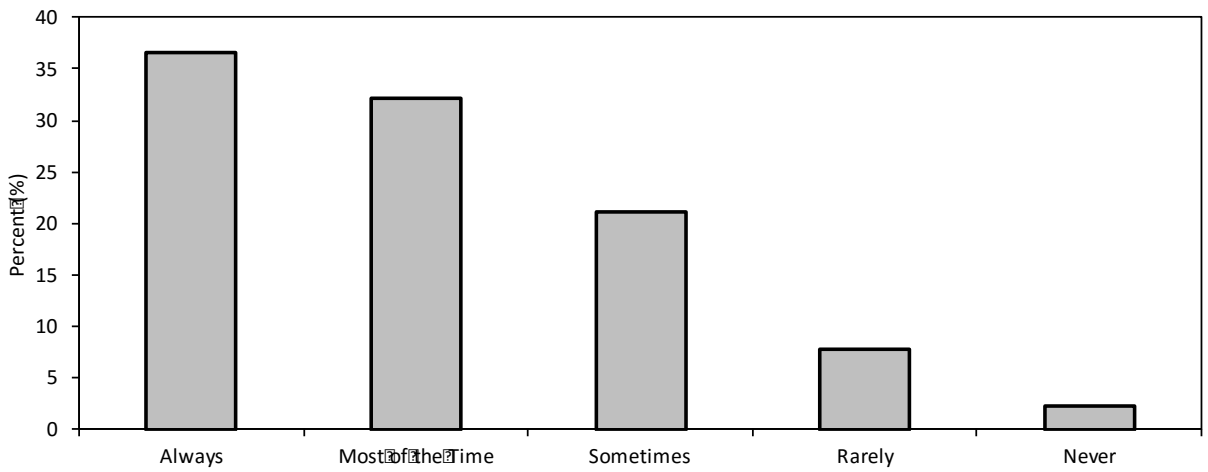


Fig. 5. Self-reported tendency to enter the water in the absence of a lifeguard on a beach.

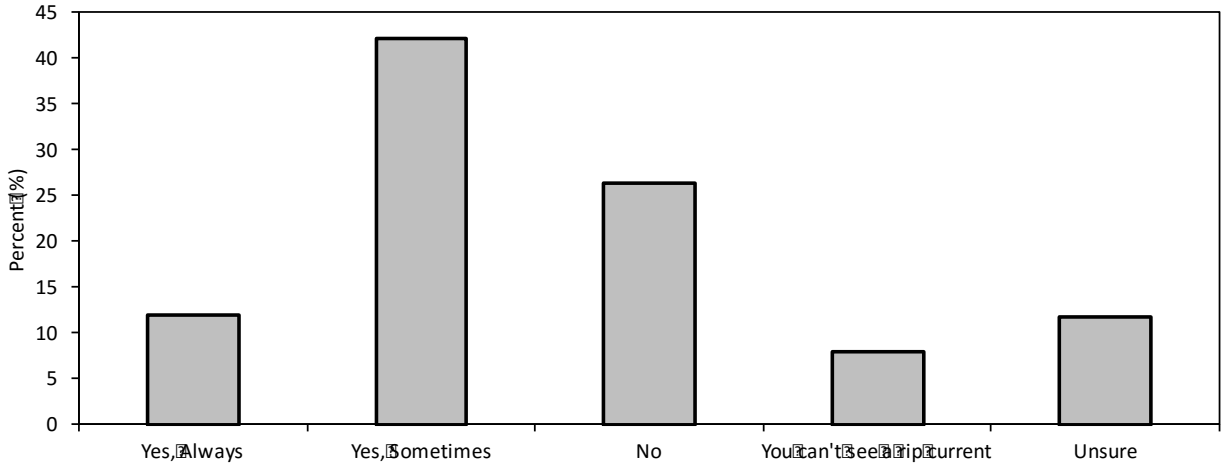


Fig. 6. Percent of respondents' belief that rip currents can be seen by beach users.

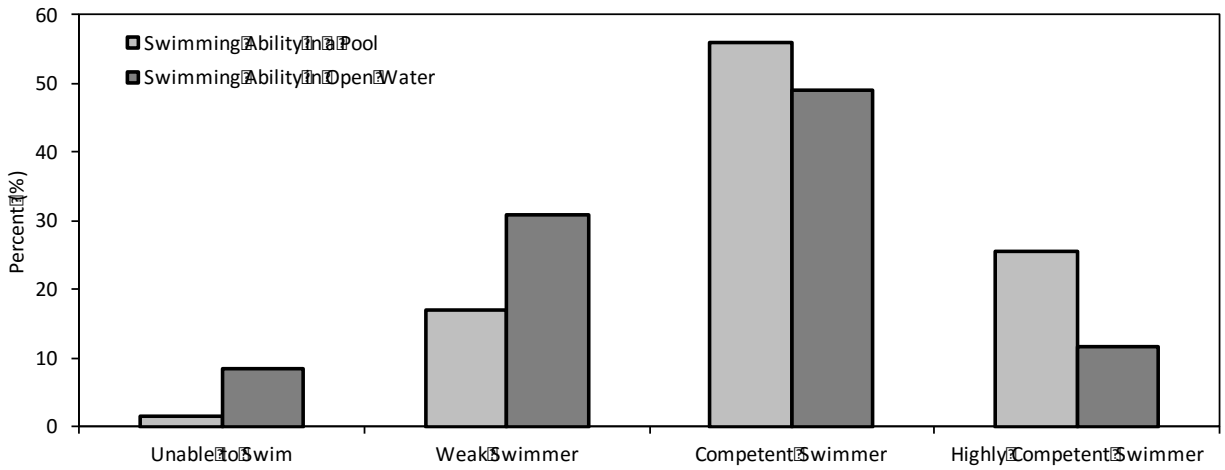


Fig. 7. Percent of self-reported swimming ability in a pool and in open water with waves.

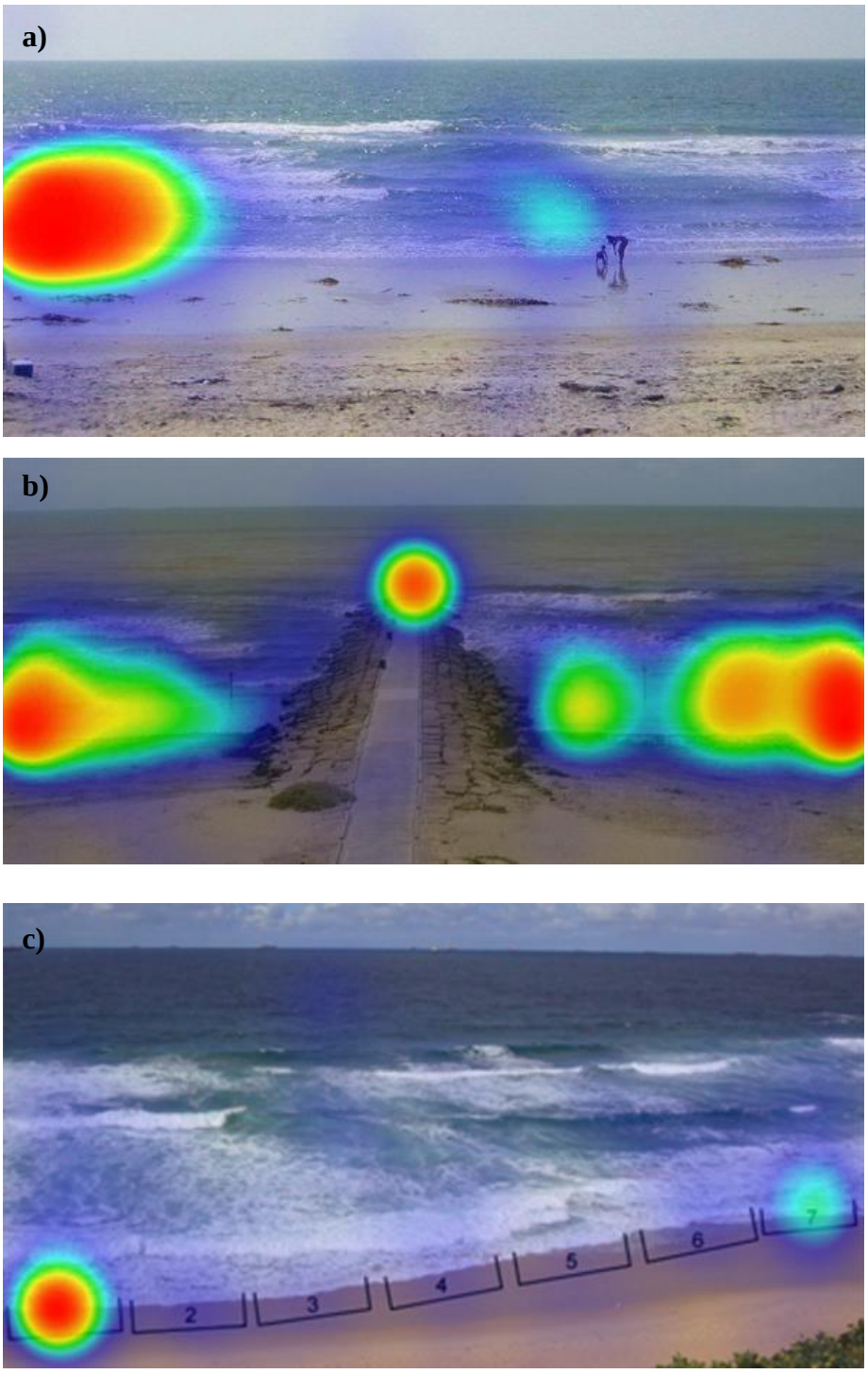


Fig. 8. Identified location of safest location to enter the water in the photographs presented in Question 42 through 44 and also presented in Figure 2. Warm (red) colors indicate large number of responses, while cold (blue) colors indicate few responses. No color (background picture) represents areas that received no responses.

Appendix 1

Q1 Are you a resident of the United States?

- ❍ Yes (1)
- ❍ No (2)

Answer If Are you a resident of the United States? Yes Is Selected

Q2 In which state do you currently reside?

- ❍ Alabama (1)
- ❍ Alaska (2)
- ❍ Arizona (3)
- ❍ Arkansas (4)
- ❍ California (5)
- ❍ Colorado (6)
- ❍ Connecticut (7)
- ❍ Delaware
- ❍ (8)
- ❍ District of Columbia (9)
- ❍ Florida (10)
- ❍ Georgia (11)
- ❍ Hawaii (12)
- ❍ Idaho (13)
- ❍ Illinois (14)
- ❍ Indiana (15)
- ❍ Iowa (16)
- ❍ Kansas (17)
- ❍ Kentucky (18)
- ❍ Louisiana (19)
- ❍ Maine (20)
- ❍ Maryland (21)
- ❍ Massachusetts (22)
- ❍ Michigan (23)
- ❍ Minnesota (24)
- ❍ Mississippi (25)
- ❍ Missouri (26)
- ❍ Montana (27)
- ❍ Nebraska (28)
- ❍ Nevada (29)
- ❍ New Hampshire (30)
- ❍ New Jersey (31)

- ❍ New Mexico (32)
- ❍ New York (33)
- ❍ North Carolina (34)
- ❍ North Dakota (35)
- ❍ Ohio (36)
- ❍ Oklahoma (37)
- ❍ Oregon (38)
- ❍ Pennsylvania (39)
- ❍ Rhode Island (40)
- ❍ South Carolina (41)
- ❍ South Dakota (42)
- ❍ Tennessee (43)
- ❍ Texas (44)
- ❍ Utah (45)
- ❍ Vermont (46)
- ❍ Virginia (47)
- ❍ Washington (48)
- ❍ West Virginia (49)
- ❍ Wisconsin (50)
- ❍ Wyoming (51)
- ❍ I do not live in the continental United States (52)

Answer If Are you a resident of the United States? Yes Is Selected

Q3 What is your zip code?

Answer If Are you a resident of the United States? No Is Selected

Q4 In which country do you reside?

- ❍ Afghanistan (1)
- ❍ Albania (2)
- ❍ Algeria (3)
- ❍ Andorra (4)
- ❍ Angola (5)
- ❍ Antigua and Barbuda (6)
- ❍ Argentina (7)
- ❍ Armenia (8)
- ❍ Australia (9)
- ❍ Austria (10)
- ❍ Azerbaijan (11)
- ❍ Bahamas (12)
- ❍ Bahrain (13)
- ❍ Bangladesh (14)
- ❍ Barbados (15)
- ❍ Belarus (16)
- ❍ Belgium (17)
- ❍ Belize (18)
- ❍ Benin (19)
- ❍ Bhutan (20)
- ❍ Bolivia (21)
- ❍ Bosnia and Herzegovina (22)
- ❍ Botswana (23)
- ❍ Brazil (24)
- ❍ Brunei Darussalam (25)
- ❍ Bulgaria (26)
- ❍ Burkina Faso (27)
- ❍ Burundi (28)
- ❍ Cambodia (29)
- ❍ Cameroon (30)
- ❍ Canada (31)
- ❍ Cape Verde (32)
- ❍ Central African Republic (33)
- ❍ Chad (34)
- ❍ Chile (35)
- ❍ China (36)
- ❍ Colombia (37)
- ❍ Comoros (38)

- Congo, Republic of the... (39)
- Costa Rica (40)
- Côte d'Ivoire (41)
- Croatia (42)
- Cuba (43)
- Cyprus (44)
- Czech Republic (45)
- Democratic People's Republic of Korea (46)
- Democratic Republic of the Congo (47)
- Denmark (48)
- Djibouti (49)
- Dominica (50)
- Dominican Republic (51)
- Ecuador (52)
- Egypt (53)
- El Salvador (54)
- Equatorial Guinea (55)
- Eritrea (56)
- Estonia (57)
- Ethiopia (58)
- Fiji (59)
- Finland (60)
- France (61)
- Gabon (62)
- Gambia (63)
- Georgia (64)
- Germany (65)
- Ghana (66)
- Greece (67)
- Grenada (68)
- Guatemala (69)
- Guinea (70)
- Guinea-Bissau (71)
- Guyana (72)
- Haiti (73)
- Honduras (74)
- Hong Kong (S.A.R.) (75)
- Hungary (76)
- Iceland (77)
- India (78)

- Indonesia (79)
- Iran, Islamic Republic of... (80)
- Iraq (81)
- Ireland (82)
- Israel (83)
- Italy (84)
- Jamaica (85)
- Japan (86)
- Jordan (87)
- Kazakhstan (88)
- Kenya (89)
- Kiribati (90)
- Kuwait (91)
- Kyrgyzstan (92)
- Lao People's Democratic Republic (93)
- Latvia (94)
- Lebanon (95)
- Lesotho (96)
- Liberia (97)
- Libyan Arab Jamahiriya (98)
- Liechtenstein (99)
- Lithuania (100)
- Luxembourg (101)
- Madagascar (102)
- Malawi (103)
- Malaysia (104)
- Maldives (105)
- Mali (106)
- Malta (107)
- Marshall Islands (108)
- Mauritania (109)
- Mauritius (110)
- Mexico (111)
- Micronesia, Federated States of... (112)
- Monaco (113)
- Mongolia (114)
- Montenegro (115)
- Morocco (116)
- Mozambique (117)
- Myanmar (118)

- Namibia (119)
- Nauru (120)
- Nepal (121)
- Netherlands (122)
- New Zealand (123)
- Nicaragua (124)
- Niger (125)
- Nigeria (126)
- North Korea (127)
- Norway (128)
- Oman (129)
- Pakistan (130)
- Palau (131)
- Panama (132)
- Papua New Guinea (133)
- Paraguay (134)
- Peru (135)
- Philippines (136)
- Poland (137)
- Portugal (138)
- Qatar (139)
- Republic of Korea (140)
- Republic of Moldova (141)
- Romania (142)
- Russian Federation (143)
- Rwanda (144)
- Saint Kitts and Nevis (145)
- Saint Lucia (146)
- Saint Vincent and the Grenadines (147)
- Samoa (148)
- San Marino (149)
- Sao Tome and Principe (150)
- Saudi Arabia (151)
- Senegal (152)
- Serbia (153)
- Seychelles (154)
- Sierra Leone (155)
- Singapore (156)
- Slovakia (157)
- Slovenia (158)

- Solomon Islands (159)
- Somalia (160)
- South Africa (161)
- South Korea (162)
- Spain (163)
- Sri Lanka (164)
- Sudan (165)
- Suriname (166)
- Swaziland (167)
- Sweden (168)
- Switzerland (169)
- Syrian Arab Republic (170)
- Tajikistan (171)
- Thailand (172)
- The former Yugoslav Republic of Macedonia (173)
- Timor-Leste (174)
- Togo (175)
- Tonga (176)
- Trinidad and Tobago (177)
- Tunisia (178)
- Turkey (179)
- Turkmenistan (180)
- Tuvalu (181)
- Uganda (182)
- Ukraine (183)
- United Arab Emirates (184)
- United Kingdom of Great Britain and Northern Ireland (185)
- United Republic of Tanzania (186)
- United States of America (187)
- Uruguay (188)
- Uzbekistan (189)
- Vanuatu (190)
- Venezuela, Bolivarian Republic of... (191)
- Viet Nam (192)
- Yemen (193)
- Zambia (580)
- Zimbabwe (1357)

Q5 Which best describes your gender

- ❍ Male (1)
- ❍ Female (2)
- ❍ Prefer not to answer (3)

Q6 What is your age?

- ❍ 18-20 years (1)
- ❍ 21-30 years (2)
- ❍ 31-40 years (3)
- ❍ 41-50 years (4)
- ❍ 51-60 years (5)
- ❍ 61-64 years (6)
- ❍ 65 years and over (7)

Q10 Which statement about beach visitation best describes your experience?

- ❍ Infrequently (fewer than 10 times in my life) (1)
- ❍ Once every year typically on vacation (2)
- ❍ I go multiple times per year (3)
- ❍ Several times per month (4)
- ❍ Frequently (weekly or daily) (5)

Q11 How would you describe the beaches that you commonly visit?

- ❍ Calm with small to no waves (1)
- ❍ Occasional wave activity, primarily during storms (2)
- ❍ Regular wave activity but typically small or medium sized waves (3)
- ❍ Strong waves are common (4)

Q13 What is the main type of activity you do when you go to the beach?

- ❍ Swimming and wading (1)
- ❍ Board riding (including surfboard, boogie board, stand up, etc.) (2)
- ❍ Beach activities only (sunbathing, shell collecting, etc.) (3)
- ❍ Snorkeling or diving (4)
- ❍ Other (5)

Answer If What is the main type of activity you do when you go to the beach? Other Is Selected

Q14 You answer other, please describe what you tend to do at the beach:

Q16 Have you ever had swimming lessons or training, either in a pool or ocean?

- ❍ Yes (1)
- ❍ No (2)

Q17 How would you rate your pool swimming ability?

- ❍ unable to swim (1)
- ❍ weak swimmer (2)
- ❍ competent swimmer (3)
- ❍ highly competent swimmer (4)

Q18 How far do you think you can swim in a pool before you have to stop/pause?

- ❍ I can't swim (5)
- ❍ Less than 25 yards (one length of a typical community swimming pool) (1)
- ❍ More that 25 yards but less than 100 yards (2)
- ❍ More than 100 yards but less than 500 yards (3)
- ❍ More than 500 yards (4)

Q19 How would you rate your swimming ability in open water with waves (like an ocean or lake)?

- ❍ I have never swum in water with lots of waves (1)
- ❍ Weak swimmer (2)
- ❍ Competent swimmer (3)
- ❍ Highly competent swimmer (4)

Q20 How far do you think you can swim in open water with waves before you have to stop/pause?

- ❍ Less than 25 yards (1)
- ❍ More than 25 yards but less than 100 yards (2)
- ❍ More than 100 yards but less than 500 yards (3)
- ❍ More than 500 yards (4)
- ❍ I can't swim (5)

Q21 Have you ever swum in an open ocean or lake with lots of wave breaking?

- ❍ Yes (1)
- ❍ No (2)
- ❍ Unsure (3)

Q22 What is the most important factor for you when choosing an ocean or lake beach to visit, with the intention of going into the water?

- ❍ Safety (are not prone to theft, etc.) (1)
- ❍ Safety in the water (avoid dangerous water hazards) (2)
- ❍ Lifeguard presence (3)
- ❍ Cleanliness of the beach and water (4)
- ❍ Crowds (prefer to be on a popular beach) (5)
- ❍ Crowds (prefer to be on a secluded, private or empty beach) (6)
- ❍ Ease of access (7)
- ❍ Avoid lots of breaking waves (i.e., prefer calm conditions) (8)
- ❍ Prefer lots of breaking waves (9)
- ❍ Other (10)

Answer If What is the most important factor for you when choosing an ocean or lake beach to visit, with the intention of going into the water? Other Is Selected

Q23 You answered "other" to the previous questions. Please describe the most important factor for you when choosing an ocean or lake beach to visit:

Q24 When you go to the beach, how important is it to you to swim near a lifeguard?

- ❍ Not important (1)
- ❍ Important (2)
- ❍ Very important (3)

Q25 If you visit a beach with no lifeguards, do you still go into the water to wade, swim or float?

- ❍ Always (1)
- ❍ Most of the Time (2)
- ❍ Sometimes (3)
- ❍ Rarely (4)
- ❍ Never (5)

Q26 Do you think about or check for hazards when you go to the beach?

- ❍ Always (1)
- ❍ Most of the Time (2)
- ❍ Sometimes (3)
- ❍ Rarely (4)
- ❍ Never (5)

Q27 What do you think is the most dangerous hazard when you swim, wade or float at the beach?

- ❍ Jellyfish (1)
- ❍ Sharks (2)
- ❍ Big waves (3)
- ❍ Shorebreaks (4)
- ❍ Undertow (5)
- ❍ Alongshore currents (6)
- ❍ Rip currents (7)
- ❍ Surfboards/boogie boards/other swimmers (8)
- ❍ Sunburn (9)
- ❍ Other (10)

Answer If What do you think is the most dangerous hazard when you swim, wade or float at the beach? Other Is Selected

Q28 You answered "other" to the previous question. Please identify what you think is the most dangerous hazard at the beach.

Q29 Have you ever seen or heard information about beach hazards. Please select all that apply.

- ❑ Never (1)
- ❑ Yes, in primary school (2)
- ❑ Yes, in high school (3)
- ❑ Yes, at university/college (4)
- ❑ Yes, from my parents (5)
- ❑ Yes, through pamphlets and brochures (6)
- ❑ Yes, through warning signs on the beach (7)
- ❑ Yes, on the internet (8)
- ❑ Yes, on television (9)
- ❑ Yes, on the radio (10)
- ❑ Yes, at my rental property in the guide material (11)
- ❑ Other (12)

Answer If Have you ever seen or heard information about beach hazards. Please select all that apply. Other Is Selected

Q30 You answered "other' to the previous question. Please describe where you have heard about beach hazards.

Q31 Are you familiar with any beach safety flag system in the United States?

- ❍ Yes (1)
- ❍ No (2)

Answer If Are you familiar with any beach safety flag system in the United States? Yes Is Selected

Q32 You answered "yes" to the previous question. Can you describe what you know about the beach safety flag system in the United States?

Q35 Have you heard of rip currents?

- ❍ Yes (1)
- ❍ No (2)

Answer If Have you heard of rip currents? Yes Is Selected

Q37 Can you describe a rip current?

Q38 Where have you learned/heard about rip currents? Select all that apply.

- ❑ I have never heard of a rip current (1)
- ❑ Television (2)
- ❑ Magazine/book (3)
- ❑ Radio (4)
- ❑ Primary school (5)
- ❑ High school (6)
- ❑ College/University (7)
- ❑ Parents (8)
- ❑ Pamphlets and/or brochures (9)
- ❑ Internet (10)
- ❑ Beach signs (11)
- ❑ Lifeguard (12)
- ❑ I have been caught in one (direct experience) (13)
- ❑ Other (14)

Answer If Where on this photograph would you feel most safe to enter the water? Click on the picture at the... Is Selected

Q39 You answered "other" to the previous question. Please tell us where you have heard about rip currents.

Q40 If you were at a beach, would you know how to spot a rip current?

- ❍ Yes, always (1)
- ❍ Yes, sometimes (2)
- ❍ No (3)
- ❍ You can't see a rip current (4)
- ❍ Unsure (5)

Answer If Where on this photograph would you feel most safe to enter the water? Click on the picture at the... Click X Is Selected Or Where on this photograph would you feel most safe to enter the water? Click on the picture at the... Click Y Is Selected

Q41 You answered "yes" to the previous question. Can you describe what a rip current looks like?

Q42 Where on this photograph would you feel most safe to enter the water? Click on the picture at the spot along the beach that you believe is the safest.

Q43 Where on this photograph would you feel most safe to enter the water? Click on the picture at the spot along the beach that you believe is the safest.

Q44 Where on this photograph would you feel most safe to enter the water? Click on the picture at the spot along the beach that you believe is the safest.

Q45 Explain what you should do if caught in a rip current?

Q46 Have you ever been caught in a rip current?

- ❍ Yes, I was caught in a rip by accident (1)
- ❍ Yes, I used the rip on purpose (e.g., for surfing) (2)
- ❍ No (3)
- ❍ Not sure (4)

Answer If Have you ever been caught in a rip current? Yes, I was caught in a rip by accident Is Selected Or Have you ever been caught in a rip current? Yes, I used the rip on purpose (e.g. for surfing) Is Selected

Q47 You answered that you had been caught in a rip current. Where (ie. what beach) were you caught in a rip current?

Answer If Have you ever been caught in a rip current? Yes, I was caught in a rip by accident Is Selected

Q48 You answered that you were caught in a rip current by accident. How did you get out of the rip current the first time this happened to you?

- ❍ Self-escaped by swimming parallel to the beach first, then back to the beach (1)
- ❍ Self-escaped by swimming straight back to the beach (2)
- ❍ Self-escaped by just floating (3)
- ❍ Rescued by lifeguard (4)
- ❍ Rescued by bystander (e.g. family, friend, stranger, surfer) (5)
- ❍ Don't know/can't remember (6)

Q49 Before going to the beach, do you get information on the beach and surf conditions for the day?

- ❍ Yes (1)
- ❍ No (2)

Answer If Before going to the beach, do you get information on the beach and surf conditions for the day? Yes Is Selected

Q50 You answered "yes" to the previous question. What source do you use to get information on the beach and surf conditions for the day? Select all that apply.

- ❑ Radio (1)
- ❑ Television (2)
- ❑ Internet (3)
- ❑ Facebook or other social media (4)
- ❑ Acquaintance (5)
- ❑ Other (6)

Answer If You answered "yes" to the previous question. What source do you use to get information on the beach and surf conditions for the day? Other Is Selected

Q51 You answered "other" to the previous question. Please explain the other source of information about beach and surf conditions that you use.

Answer If Before going to the beach, do you get information on the beach and surf conditions for the day? Yes Is Selected

Q52 Does this information tend to affect your behavior when you go to the beach?

- ❍ It doesn't affect my behavior (1)
- ❍ It affects my behavior (2)

Answer If How does the information from this site affect your behavior at the beach? If affects my behavior Is Selected

Q53 Please explain how it affects your behavior at the beach.

Q54 Rank the following sources of information from "most trusted" (1) to "least trusted" (5).
_____ Radio (1)
_____ Television (2)
_____ Internet (3)
_____ Facebook or other social media (4)
_____ Acquaintance (5)

Q55 Please explain why you trust one source of information more than another.

Q56 Have you ever seen beach safety information at the entrance to, or on beaches, that you have visited?
❍ Yes (1)
❍ No (2)

Answer If Do you remember seeing any beach safety information at the entrance to the beach or on the beach that you visit most often? Yes Is Selected

Q57 What type of beach safety information do you remember seeing?
❍ signs/posters (1)
❍ flags (2)
❍ pamphlets/brochures (3)
❍ other (4)

Answer If What type of beach safety information did you see? other Is Selected

Q58 You answered "other" to the previous question. Please explain the type of beach safety information that you tend to see at the entrance to the beach.

Answer If Do you remember seeing any beach safety information at the entrance to the beach or on the beach that you visit most often? Yes Is Selected

Q59 Where do you tend to see the beach safety information?
❍ At the entrance to the beach (1)
❍ On the beach (2)
❍ Both on the beach and at the entrance to the beach (3)

Answer If Do you remember seeing any beach safety information at the entrance to the beach or on the beach that you visit most often? Yes Is Selected

Q60 What is the primary message of the safety information that you tend to see?

Q61 Have you ever heard of the national United States rip current education campaign called "Break the Grip of the Rip"©?
❍ Yes (1)
❍ No (2)

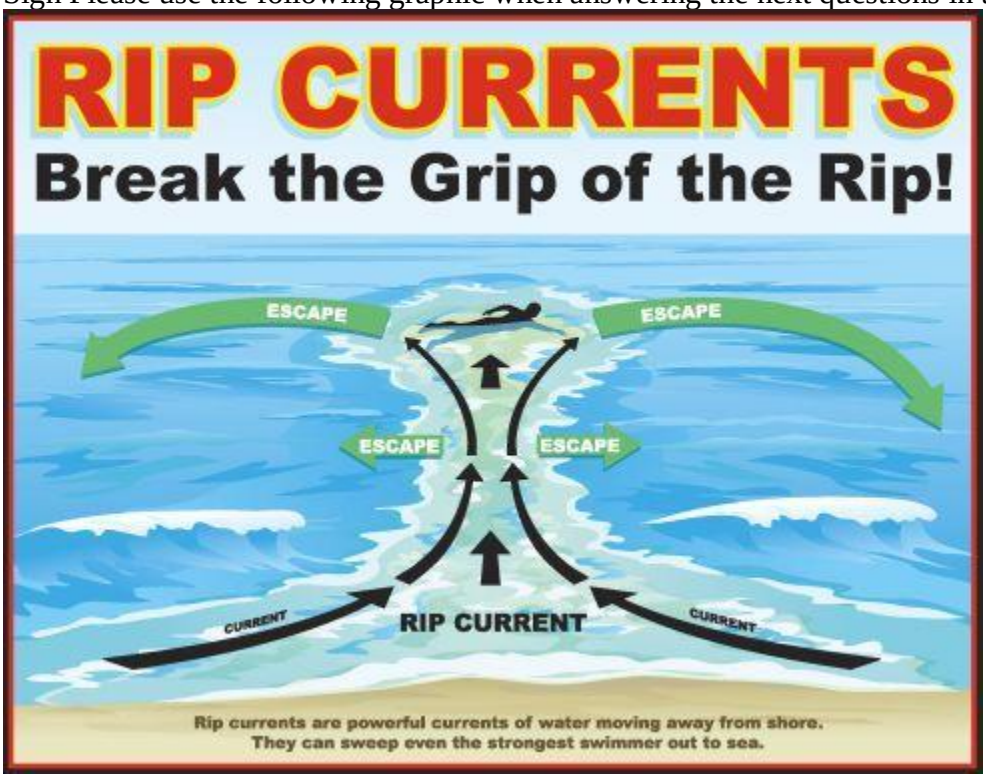
Answer If Have you ever heard of the "Break the Grip on the Rip" campaign? Yes Is Selected

Q62 You answered "yes" to the previous question. Please tell us where you heard or have seen information related to the "Break the Grip of the Rip"© campaign. Select all that apply.

- ❑ Radio (1)
- ❑ Television (2)
- ❑ Newspaper (3)
- ❑ Magazine/book (4)
- ❑ Local magazine or newspaper during my stay (5)
- ❑ Brochure/pamphlet (6)
- ❑ At my rental property here (7)
- ❑ Primary school (8)
- ❑ High school (9)
- ❑ College/University (10)
- ❑ Parents (11)
- ❑ Internet (12)
- ❑ "Break the Grip of the Rip"© website (13)
- ❑ Youtube or other internet video site (14)
- ❑ Facebook (15)
- ❑ Twitter (16)
- ❑ Other social media (17)
- ❑ Signs at the entrance to a beach (18)
- ❑ Signs on the beach (19)
- ❑ Lifeguards (20)
- ❑ Other (21)

Q63 What do you think "Break the Grip of the Rip"© means?

Sign Please use the following graphic when answering the next questions in the survey.



Q64 What does this sign tell you to do if caught in a rip current?

Q65 If you see this sign at a beach, how would it change your behavior at the beach?

Q66 Does this sign help you identify a rip current?

- ❍ Yes (1)
- ❍ No (2)

Answer If Does this sign help you identify a rip current? Yes Is Selected

Q67 You answered "yes" to the previous question. How does it help you identify a rip current?

Q68 What other information would be useful to be included in the "Break the Grip of the Rip"© sign?

Q69 Have you ever seen or heard rip current forecasts from the following sources? Select all that apply.

- ❑ Radio (1)
- ❑ Newspaper (2)
- ❑ Television (6)
- ❑ Internet (3)
- ❑ Social media (4)
- ❑ No (5)

Q70 Do you understand what it means if there is a "high risk" for rip currents?

- ❍ Yes (1)
- ❍ No (2)

Answer If Do you understand what it means if there is a "high risk" for rip currents? Yes Is Selected

Q71 You answered "yes" to the previous question. What does a high risk of rip currents mean?

Q72 Do you understand what it means if there is a "low risk" for rip currents?

- ❍ Yes (1)
- ❍ No (2)

Q73 You answered "yes" to the previous question. What does a low risk of rip currents mean?

Q74 Do you adjust your activities at the beach based on the rip forecast?

Q75 If you heard a rip current forecast (e.g. low risk or high risk) and went to the beach on the same day, did the forecast match the conditions that you encountered at the beach?

- ❍ Yes (1)
- ❍ No (2)

Answer If you heard a rip current forecast (e.g. low risk or high risk) and went to the beach on the same day, did the forecast match the conditions that you encountered at the beach? No Is Selected

Q76 You answered "no" to the previous question. How did the conditions that you encountered differ from the conditions that you experienced at the beach?