

Study of a Possible Link between Drowning and Near-Drowning Events and Surf Conditions in South Texas

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Executive Summary

The main focus of this work is to explore a possible link between incidents in the surf zone and general atmospheric and oceanic conditions affecting the beaches of South Texas. Of particular interest is a possible link between such incidents and the occurrence of rip currents. The study area includes the Gulf of Mexico coastline from Port O'Connor to the Mexican border with an emphasis on the highly attended beaches in the vicinity of Corpus Christi and South Padre Island.

Study data: The study is based on data obtained from local agencies, from entities monitoring atmospheric and oceanic conditions and based on data specifically collected for the study. The data sets include (i) records of drowning, near-drowning and swimmer in distress obtained from the Nueces County Beach Services Division and the Cameron County Park Ranger Division, (ii) past atmospheric and oceanic conditions from monitoring platform and buoys obtained electronically from the National Data Buoy Center (NDBC) and the Texas Coastal Ocean Observation Network (TCOON) (iii) a questionnaire designed and administered as part of the study to gather information on the occurrence, frequency and intensity of rip currents in the study area. Atmospheric conditions were evaluated through past wind and barometric measurements (C-MAN station of Port Aransas, TCOON stations of Bob Hall Pier and South Padre Island Coast Guard Station) while offshore wave climate was evaluated through significant wave height and direction at the NDBC 42020 buoy and the DNR RTNS station. The rip current questionnaires were collected through E-mail and direct interviews from surfers, windsurfers and fisherman. Only questionnaires from respondents visiting the beach at least 20 times per year and having done so for at least 5 years were retained for the study. The Nueces County data includes 166 incidents from 1983 to 2001, the Cameron County 76 incidents from 2000 to 2004 and a total of 14 questionnaires satisfied the study criteria. Press articles and web accounts were also used as complementary materials. The available and gathered data is believed by the author to be appropriate for a general assessment and several specific recommendations. As is often the case the study also recommends gathering additional information and in particular to monitor more specifically surf zone conditions and the onset of rip currents and to collect more systematically information for surf zone incidents.

The following observations, conclusions and recommendations are based on the analysis of the collected data.

On the Occurrence of Rip Currents in South Texas: Assessment of the occurrence of rip currents is based on responses to the study questionnaires complemented by press articles and web accounts. The questionnaire respondents reported that mild rip currents take place daily on

the South Texas coast while strong and dangerous rip currents are observed mostly correlated with the passage of tropical storms and hurricanes, strong frontal passages and high winds and/or high surf. Accounts of strong rip currents were overwhelmingly associated with the presence of structures, piers, jetties, seawalls, natural passes (26 out of 29). The presence of rip currents near structures is not a surprise as wave diffraction and changes in bathymetry around the structures are known to favor rip currents. Several rescues of swimmers in distress were associated with rip currents likely facilitated by the presence of these structures. Structures were also reported to lead to more complex currents than straight outward going rip currents such as a loop current taking place between the jetties and the pier at Port Aransas. The correlation between observations of strong rip currents and the presence of structures in this study should however not lead to the conclusion that strong rip currents do not take place away from structures. In this study both questionnaire respondents and the general beach going population visit locations/parks which usually include structures such as piers and jetties (Port Aransas, Mustang Island State Park, Bob Hall Pier, Isla Blanca Park, etc.). Observations are therefore naturally biased towards surf zone conditions affected by the presence of structures. Nevertheless the presence of structures on most highly attended beaches of South Texas should be taken into account for the outreach message, for rip current monitoring, for the design and improvements of rip current indexes and for preparedness for rescue efforts.

On Rip Current Outreach, Monitoring and Rescues: Based on the rip current observations the author recommends when possible to increase the focus of the rip current outreach message for South Texas on the presence of structures and particularly jetties and piers. The majority of the most frequented beaches (including Port Aransas, Bob Hall Pier, Isla Blanca) include such structures. While NOAA and USLA brochures present excellent information on rip currents and the influence of structures is often mentioned the message could be further focused on structures for South Texas. The author also recommends studying the possibility of monitoring currents near the surf zone from the end of these existing piers. Due to the break in the bathymetry created by the piers in an otherwise featureless coast such locations are likely where rip currents first initiate. Two of the piers are already instrumented and provide real-time information. Although such measurements are still only part of research projects, even imperfect information could lead to real-time rip current warnings and better data to study the onset of rip currents in the South Texas context. When swimmers are caught in a strong rip current they often have difficulties reacting appropriately and saving themselves. Several accounts of rescues by life guards and surfers are highlighted in the study. The interaction between the long shore currents and rip currents and the reported presence of loop currents between structures may also disorient swimmers and make the situations even more dangerous on some of the South Texas beaches. Life guards are not present on at least one of the most frequented beaches of South Texas, Isla Blanca Park. Reasons cited for the absence of life guards are in part the cost of the service but also liability concerns. It is recommended that the relevant local agencies overseeing highly frequented beaches be contacted and be helped to initiate a lifeguard program.

On the Impact of Oceanic and Atmospheric Conditions on Surf Zone Incidents, Drownings and Near Drownings: Atmospheric and general oceanic conditions were obtained for most drowning near drowning and swimmer in distress cases. The average conditions during these incidents were compared with the overall average conditions during the same period. The 166 recorded cases for Nueces County took place between April and September while the 76 recorded cases for Cameron County took place year round. For Nueces County, the comparison

yielded the following results for some of the main variables (average during incidents vs. general average): Average Significant Wave Height at NDBC 42020 Buoy (1.30 +/- 0.68 m vs. 1.13 +/- 0.54 m), 24-hr barometric pressure absolute difference (1.6 +/- 1.5 mb vs. 1.9 +/- 1.9 mb), average wind speed during the day (12 hrs) (15.9 +/- 5.7 mph vs. 14.8 +/- 5.6 mph), average wind speed during the past 24 hrs (14.2 +/- 4.4 mph vs. 14.1 +/- 5.5 mph) and daily water level range (0.53 +/- 0.17 m vs. 0.49 m +/- 0.17 m). The results for the same variable for the Cameron County data set were the following: Average Significant Wave Height at NDBC 42020 Buoy (1.34 +/- 0.61 m vs. 1.32 +/- 0.65 m), 24-hr barometric pressure absolute difference (2.1 +/- 2.2 mb vs. 2.9 +/- 2.9 mb), average wind speed during the day (12 hrs) (11.5 +/- 5.1 mph vs. 11.4 +/- 5.5 mph), average wind speed during the past 24 hrs (10.8 +/- 4.5 mph vs. 10.4 +/- 5.0 mph) and water level range (0.42 +/- 0.16 m vs. 0.41 m +/- 0.16 m). Based on this comparison overall average conditions at the time of the incidents are not significantly different than the general conditions along the South Texas coast. This observation by no means indicates that rip currents or other surf zone events associated with oceanic and atmospheric conditions are not a danger along the South Texas coast. Possible explanations for the lack of a meaningful correlation are that strong rip currents or other dangerous surf zone conditions develop during average South Texas surf conditions or that other factors are statistically more important than surf zone conditions for this region. Direct measurements of surf zone conditions could have possibly alter somewhat the comparison but most of the forcings influencing surf zone conditions are already included and none of the variables available are showing substantial differences. Other possible factors influencing surf zone incidents include other surf zone and behavioral factors. A potential surf zone hazard developing regularly along the South Texas coast is the presence of strong along shore currents. The South Texas coast is one of the windiest locations in the lower 48 states with dominant south easterly winds blowing in the general direction of a low lying coastline made of barrier islands leading to frequent strong along shore currents. These currents coupled with a fast changing bathymetry in the bar system could be an important factor for surf zone incidents not identified by unusual atmospheric or oceanic conditions. Among behavioral factors independent of surf zone conditions consumptions of alcoholic beverages is a leading candidate. Other studies and local life guards have mentioned alcohol as a likely important factor. This information is presently not collected. A more systematic collection of information on victims of surf zone incidents would be very helpful in identifying the major threats and focusing outreach efforts. If alcohol is indeed a significant factor, outreach efforts should target this factor specifically.

On the Impact of Tropical Storms and Hurricanes on Surf Zone Incidents, Drownings and Near Drownings: A correlation between recorded incidents and the presence of tropical storms and hurricanes in the Gulf of Mexico was explored as well. For Nueces County 7 out of 166 incidents were correlated with the presence of a hurricane (4) or a tropical storm (3). For the 76 recorded Cameron County incidents 8 took place while a tropical storm (6) or a hurricane (2) was in the Gulf waters. The numbers are small for Nueces County and a little higher, about 10%, for Cameron County. Although incidents do take place during storms the author does not recommend additional warnings as the public is already warned by the local National Weather Service Offices, Television and radio stations. Also the aforementioned incidents were correlated only with the presence of the storms in the Gulf of Mexico but the South Texas coast was not necessarily significantly affected. For example for only one of the 8 Cameron County such incidents were the wave heights above 1.5 m.

On additional studies of the occurrence and intensity of rip currents and their impact on surf zone incidents in South Texas: Some of the main results of the study are the confirmation of the existence of strong and dangerous rip currents along South Texas beaches and the absence of a strong correlation between atmospheric and oceanic conditions and surf zone incidents. While such findings are not mutually exclusive further research could help determine the respective influence of surf zone conditions, including rip currents and along shore currents, and other possible factors such as alcoholic consumption. However to perform further research more information on the victims, surf conditions and factors such as possible alcoholic consumptions need to be available. A good portion of this information is already being collected by the Nueces County Beach Services Division but to the author's knowledge most of this data is not collected for other beaches. Encouraging and coordinating the collection of systematic and complete data sets for surf zone incidents would be essential for more in-depth studies. Measuring directly surf zone conditions would also provide essential information to determine the cause of drownings, near drownings and swimmer in distress incidents. Such measurements could also help initiate real-time rip current monitoring strategies and help with the continuing development of rip current index.