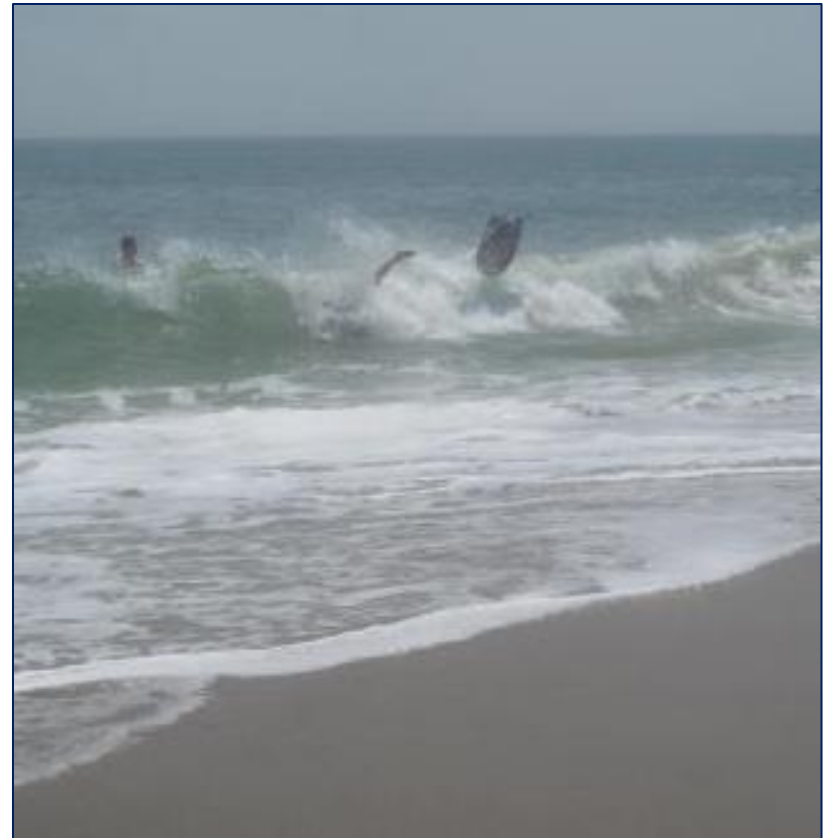


Quantifying Environmental Conditions Associated with the Delaware Surf Zone Injury Study

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OUTLINE

- Introduction to Surf Zone Injuries
- Injury Statistics
- Water Users and Injury Rates
- Environmental Data
- Results



SURF ZONE INJURIES

What are surf zone injuries?

- Injuries occurring due to breaking waves in the surf zone
- Diving into shallow water
- Injuries resulting from surfing, body boarding, etc.
- Hydrodynamic-driven impact into shallow water as a result of beach activities



2014 STUDY

- Location: Data was collected along the Atlantic coast of Delaware at 5 different beach locations
- Time Frame:
 - Environmental Conditions collected between June 2 and August 22, 2014 (82 days)
 - Surf Zone Injury (SZI) data has been collected since 2010



* This study has continued through 2017 but I will only focus on the portion that I took part in, which only includes data through 2014.

2014 INJURY TOTALS

- **280** total injuries during the 2014 summer
- **169** injuries within 5 beach study area and 82-day time frame
- **33** serious injuries (8 cervical fractures, 11 spinal cord injuries, and 1 fatality)
- Up to **13** injuries occurred in a single day

2014 INJURY STATISTICS

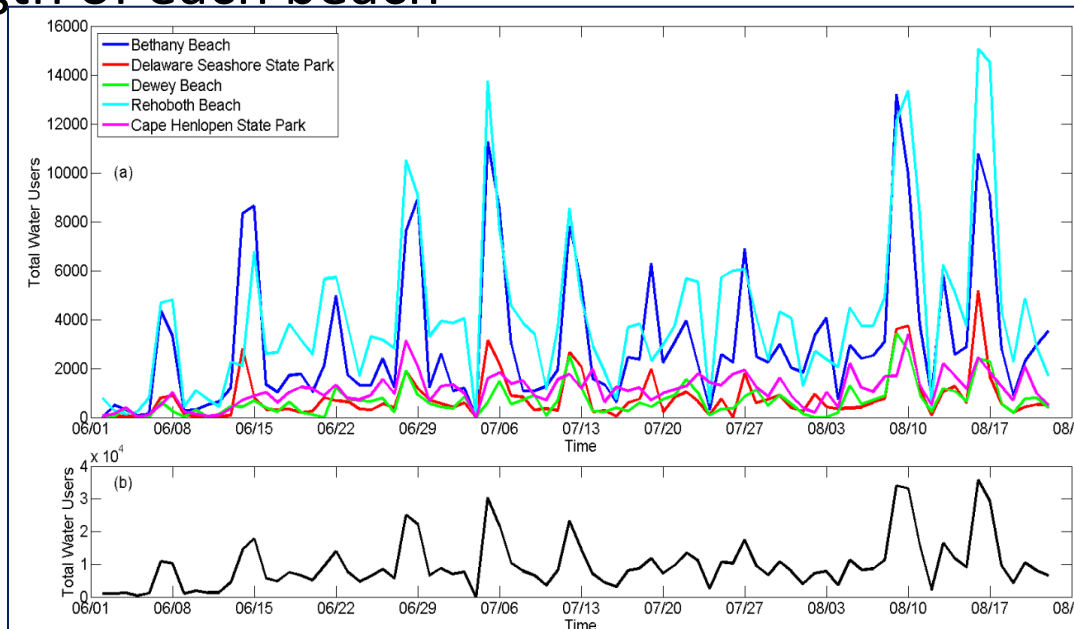
- **2:1** ratio of males injured relative to females
- **6:1** ratio of tourists injured relative to locals
- Average injury age was **32 years old**
- Top 5 Activities at time of injury:

Activity	Number of SZI	Percent of SZI Total
Wading	123	44
Body Surfing	55	20
Body Boarding	48	17
Skim Boarding	17	6
Dive Injuries	10	4

WATER USER COUNTS

Three types of water user counts:

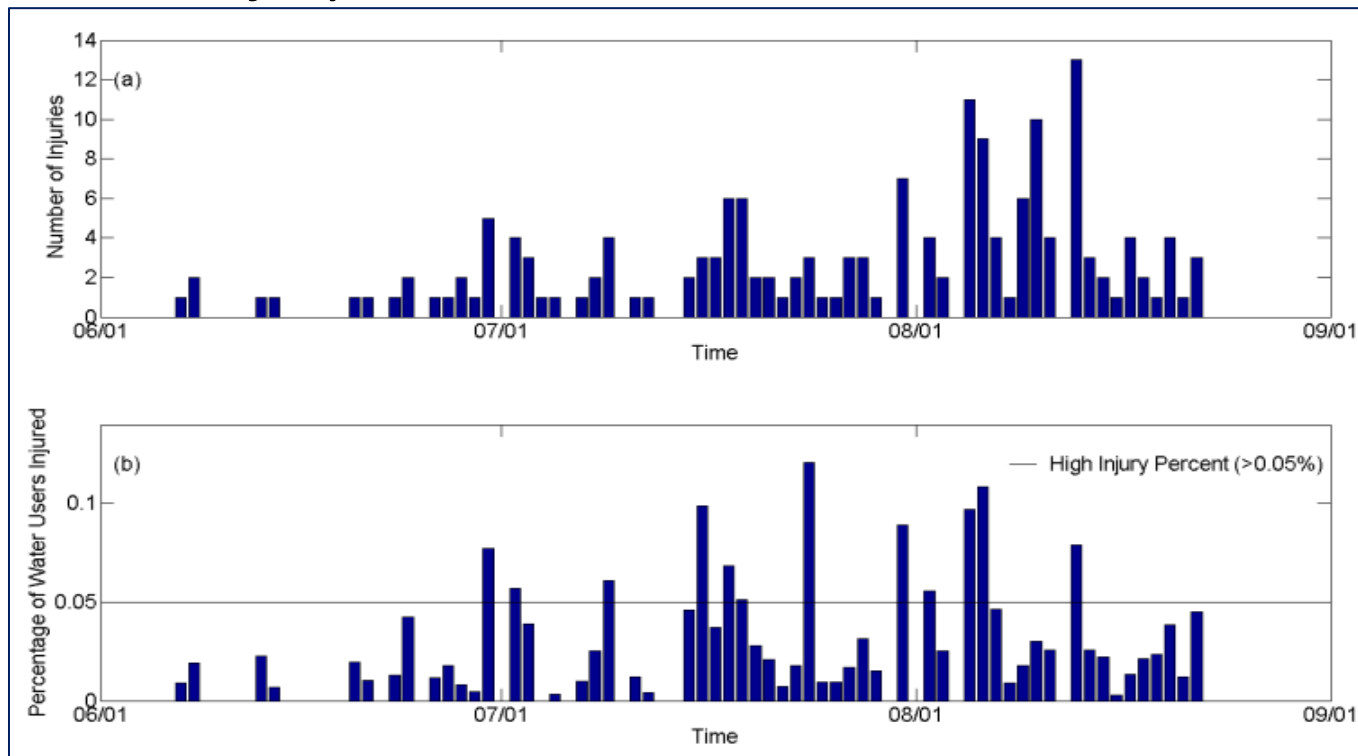
- Daily Water User counts – once per day during peak hours along 100-m segment of each beach
- Intraday Water User counts – 30-minute intervals between 9 am and 5 pm along 100-m segment of each beach
- Beach Water User counts – Counted twice per summer over the entire length of each beach



INJURY RATE

Injury rate calculated by dividing number of injuries by the total number of water users on a given day:

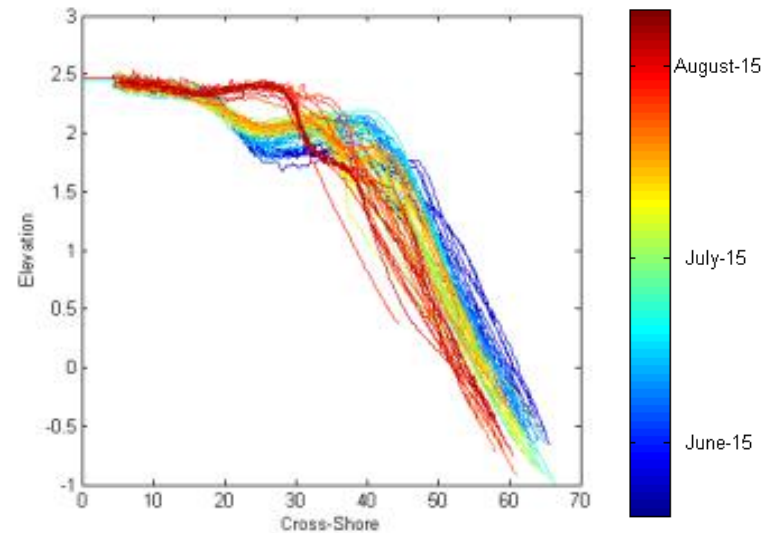
- Mean Injury rate of 0.02%
- Injury rate was greater than 0.05% on 12 days
- Maximum injury rate of 0.12%



ENVIRONMENTAL PARAMETERS

Environmental Parameters:

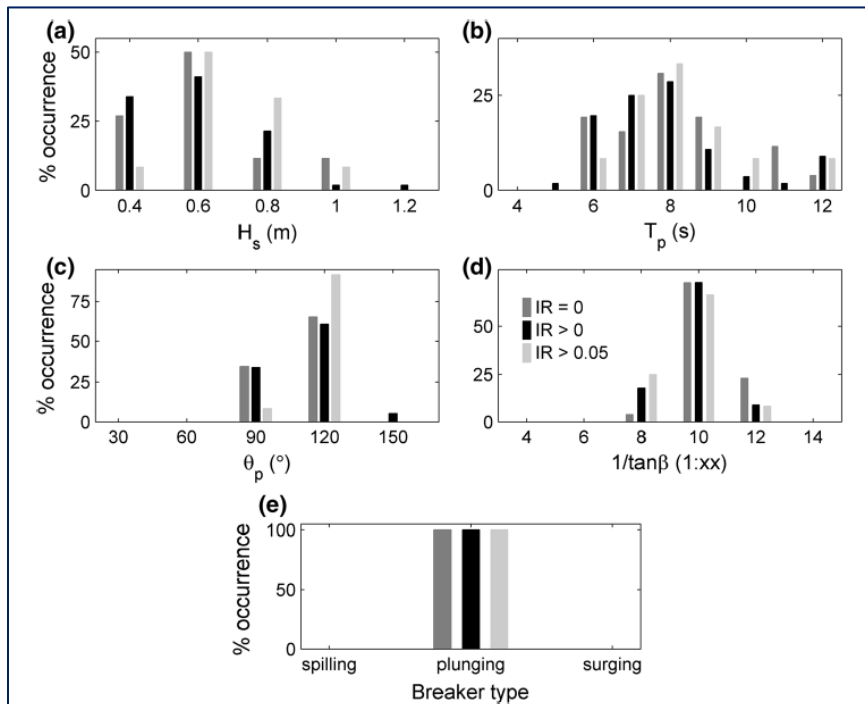
- Beach Morphology
- Wave Height
- Peak Wave Period
- Wave Direction
- Wind Conditions



Variations in Beach slope at Bethany beach for entire length of study

INJURY RELATION TO ENVIRONMENTAL CONDITIONS

- Correlations between injury rate and environmental parameters were generally weak with the max correlation coefficient of 0.08 for significant wave height
- Data was divided into injury rate=0, low injury rate (<0.05%), and high injury rate (>0.05%):

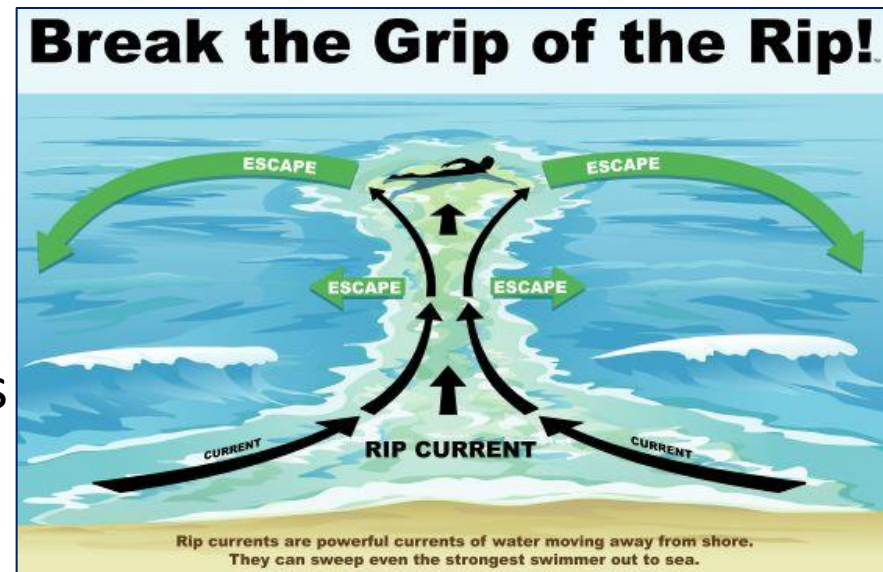


- High Injury rate occurrence was greatest for moderate wave height days ($H_s = 0.6$ m)
- Wave Height alone does not indicate when surf zone injuries are likely to occur

“Delaware surf zone injuries and associated environmental conditions”, Puleo et Al., 2015

BEACH SAFETY AWARENESS

- Surf zone injuries were not purely random suggesting a complicated relationship between human factors and underlying environmental conditions
- Increased education on the possibility of surf zone injuries especially on shore break beaches similar to rip current awareness campaigns
- Higher number of tourists injured relative to locals may suggest that these campaigns need to target visitors to be most effective



THANK YOU!

