

Perceptions of the Rip Current Hazard and Observations of Beachgoer Behavior on Bondi Beach, Sydney

Sarah Trimble*¹, Chris Houser¹, and Rob Brander²

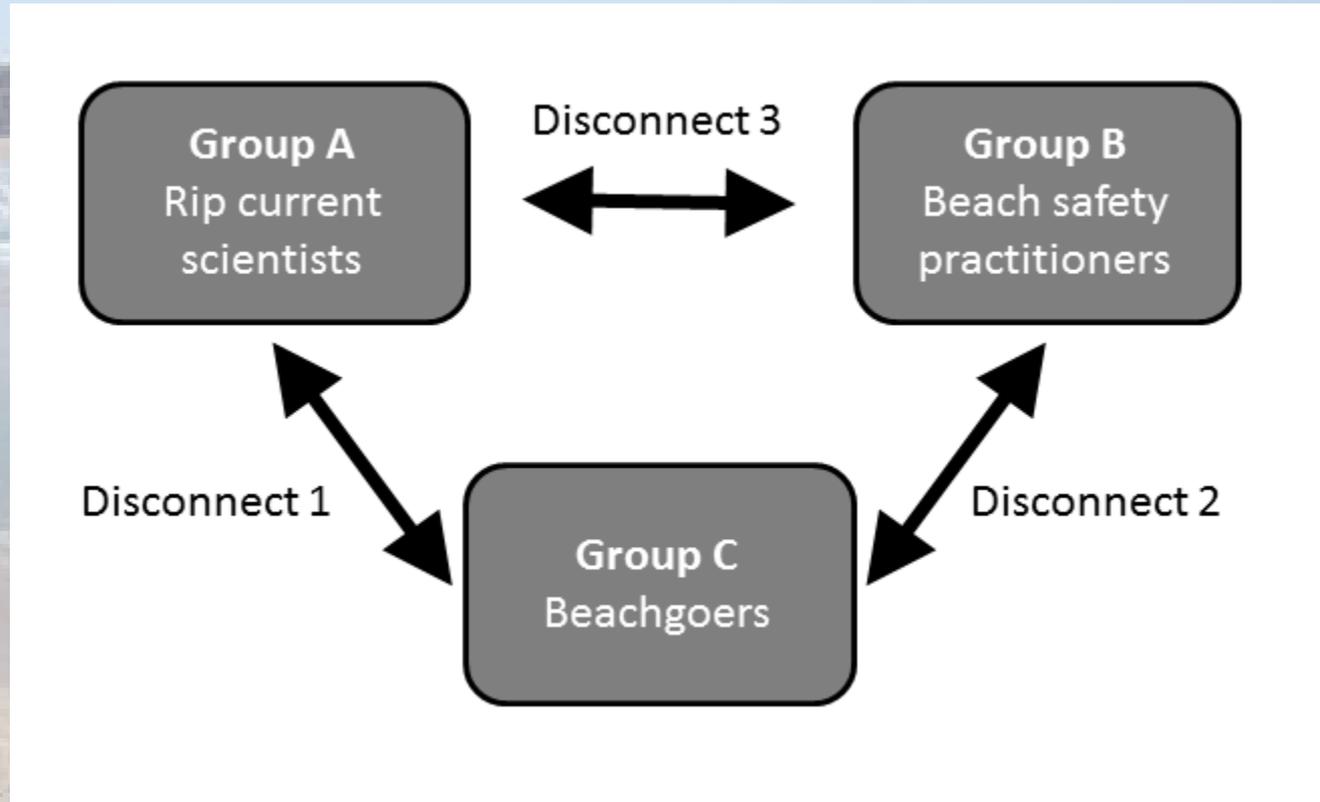
*Presenting Author

¹Texas A&M University, ²University of New South Wales

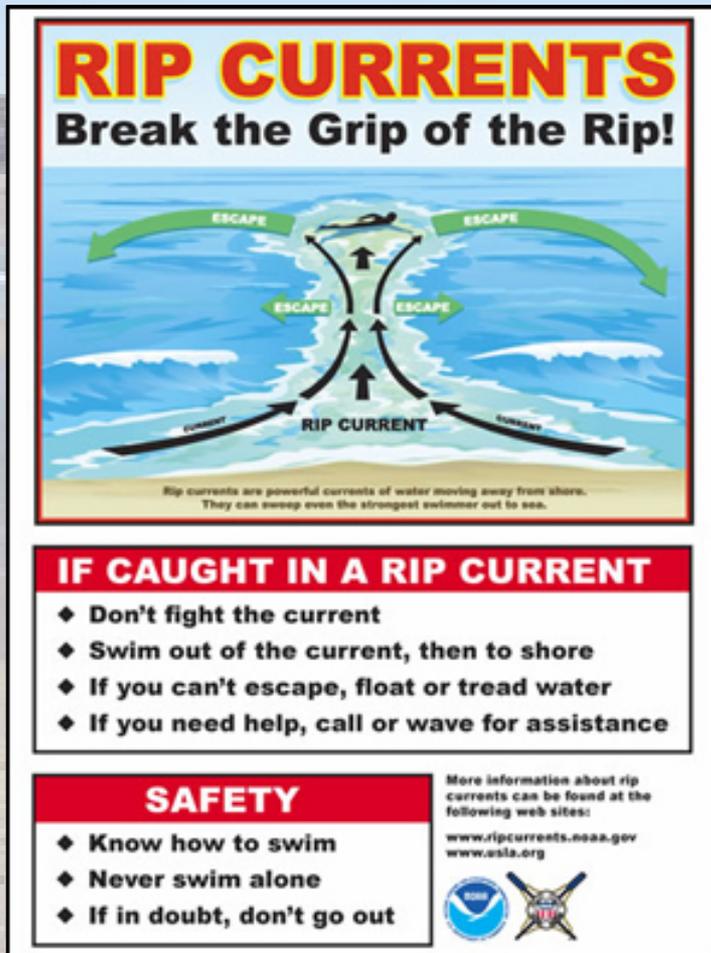
What is a rip current?



Communication Gaps



Signage/warnings in the US



RIP CURRENTS
Break the Grip of the Rip!

ESCAPE ESCAPE ESCAPE ESCAPE

CURRENT RIP CURRENT CURRENT

Rip currents are powerful currents of water moving away from shore. They can sweep even the strongest swimmer out to sea.

IF CAUGHT IN A RIP CURRENT

- ◆ Don't fight the current
- ◆ Swim out of the current, then to shore
- ◆ If you can't escape, float or tread water
- ◆ If you need help, call or wave for assistance

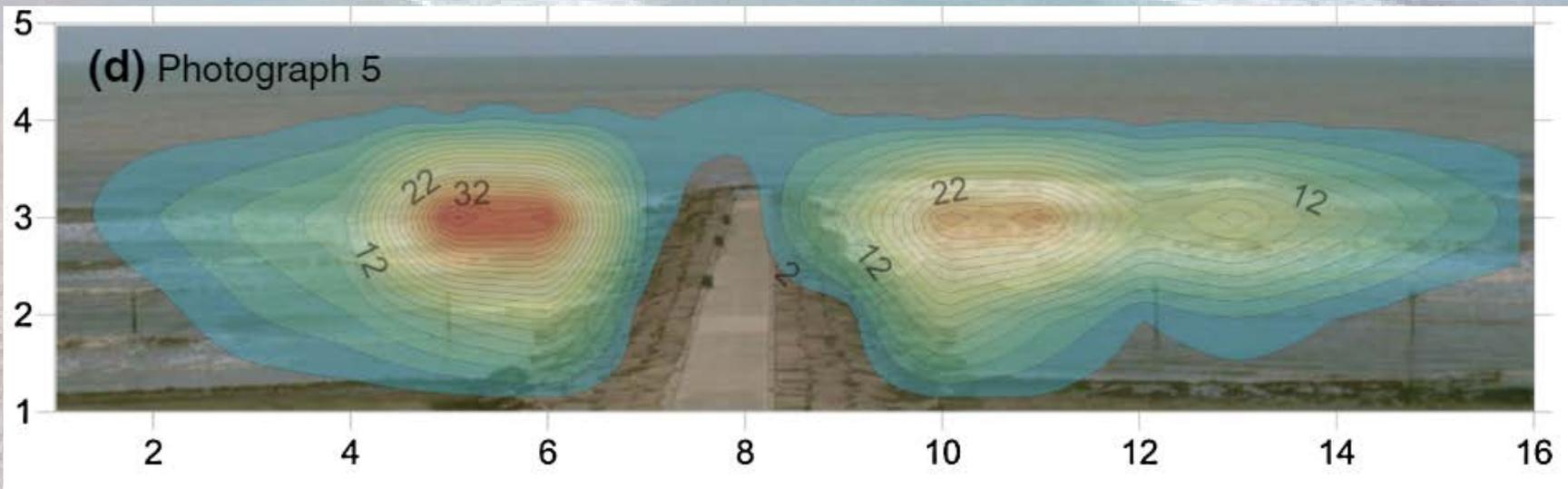
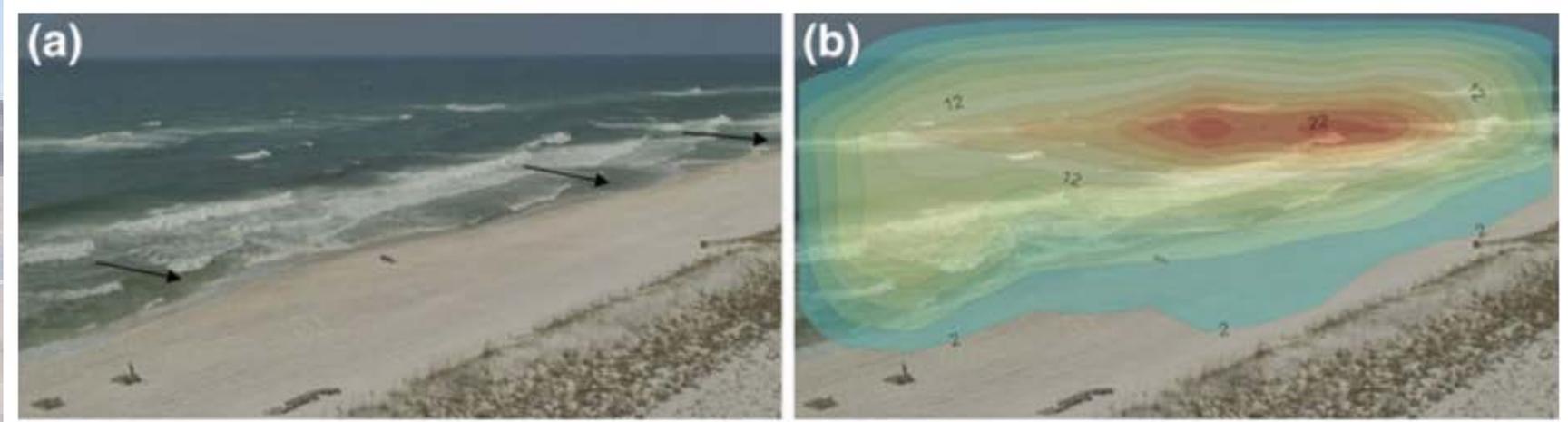
SAFETY

- ◆ Know how to swim
- ◆ Never swim alone
- ◆ If in doubt, don't go out

More information about rip currents can be found at the following web sites:
www.ripcurrents.noaa.gov
www.usla.org



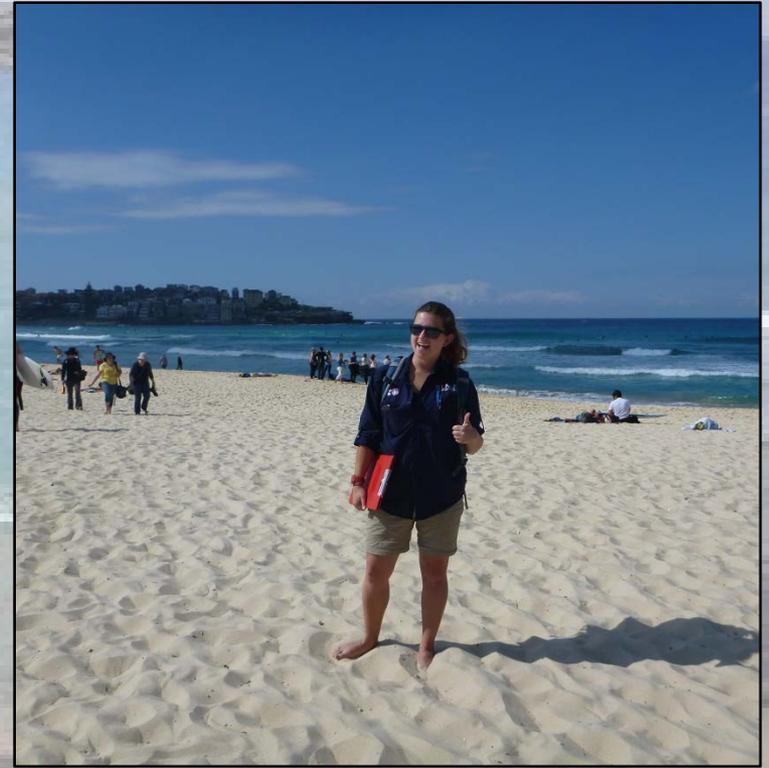
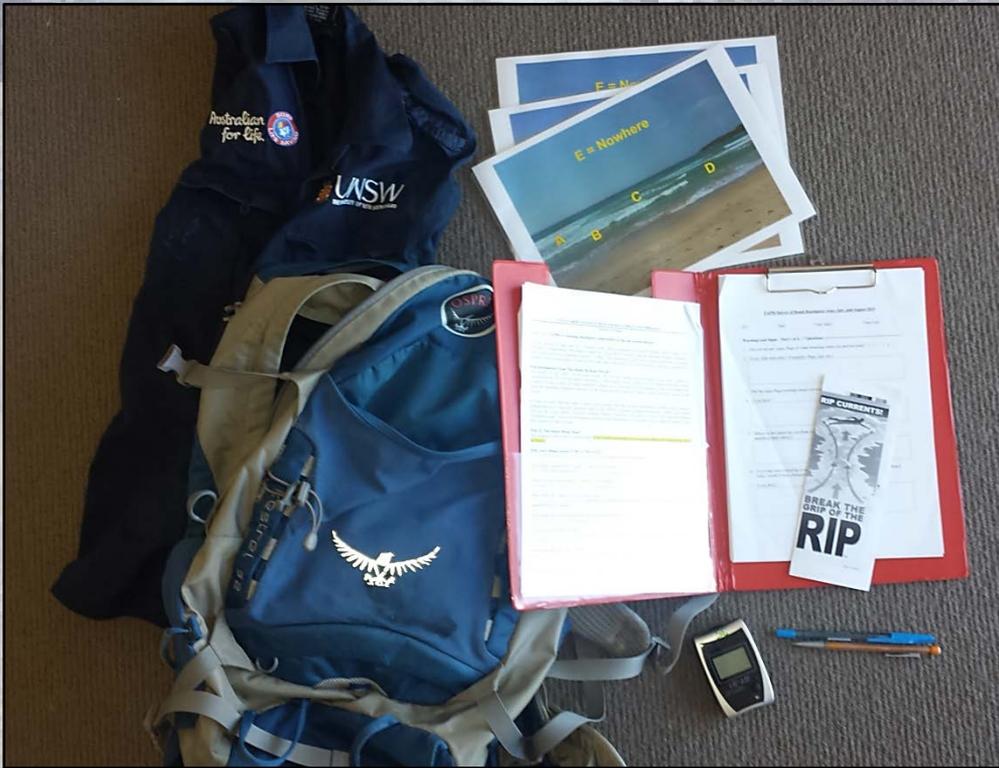
Where is most dangerous to swim?

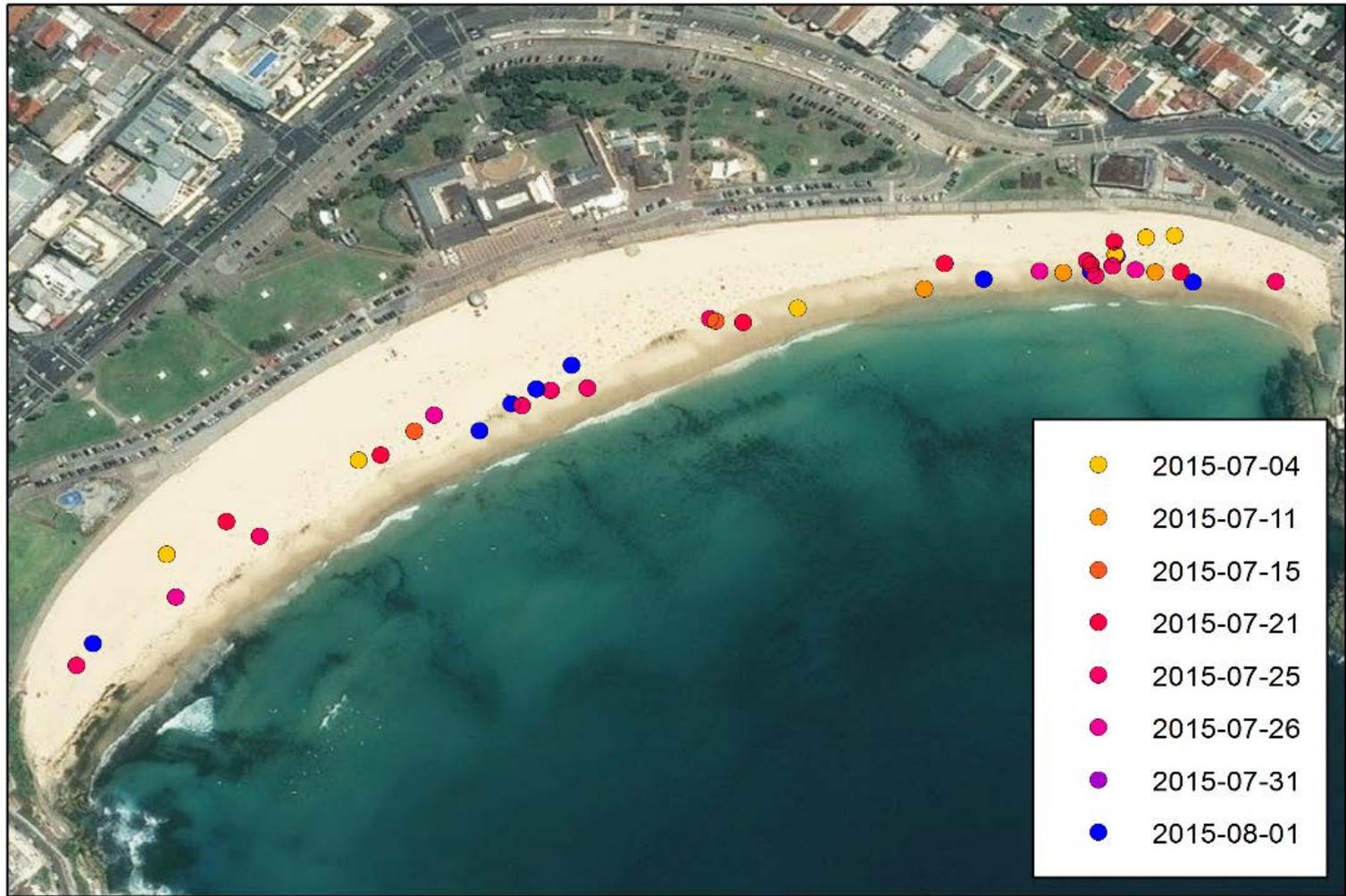


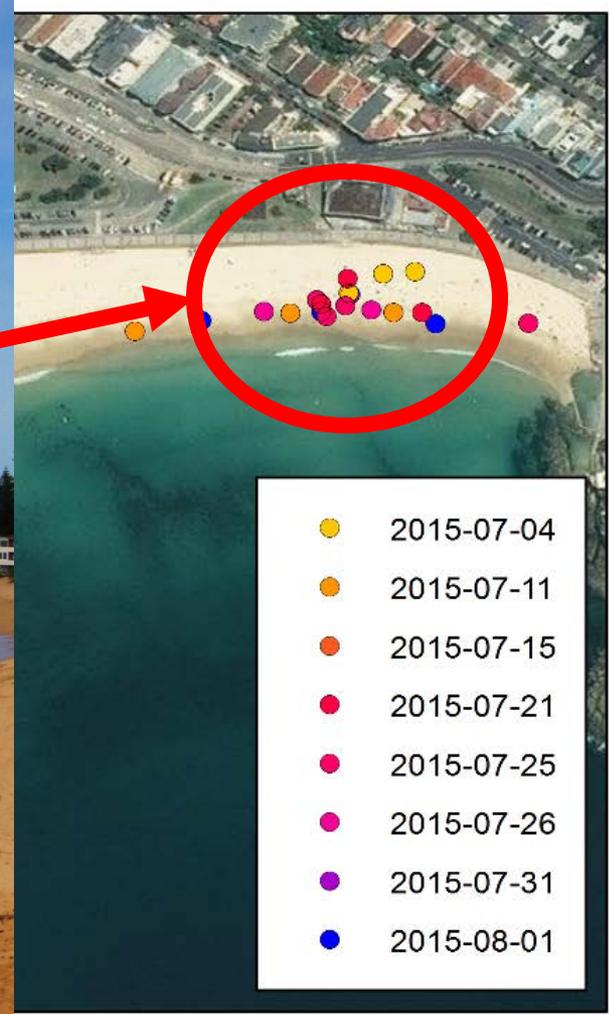


Are vulnerable swimmers *actually*
attracted to rip currents?

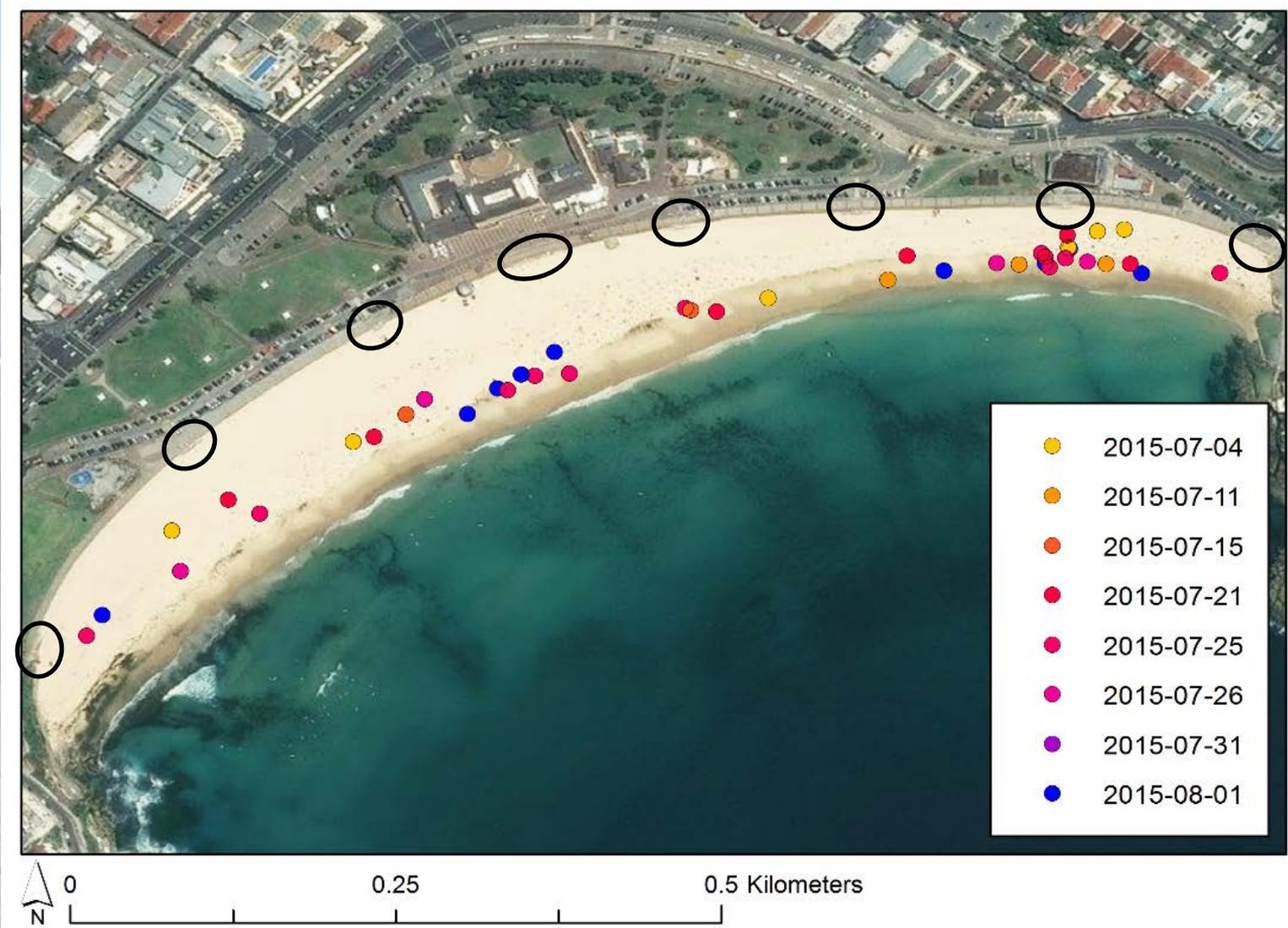
GPS tagged interviews

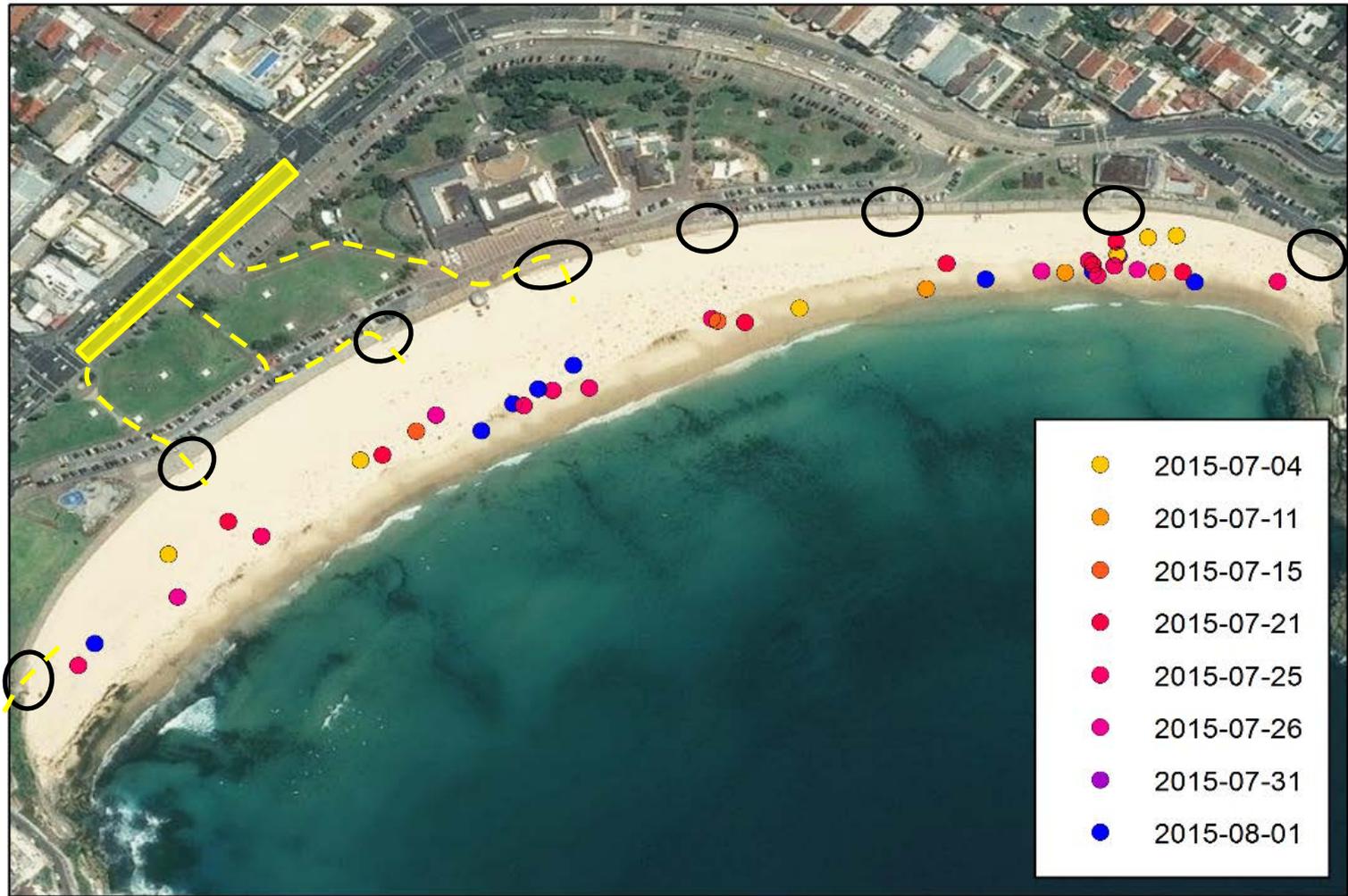


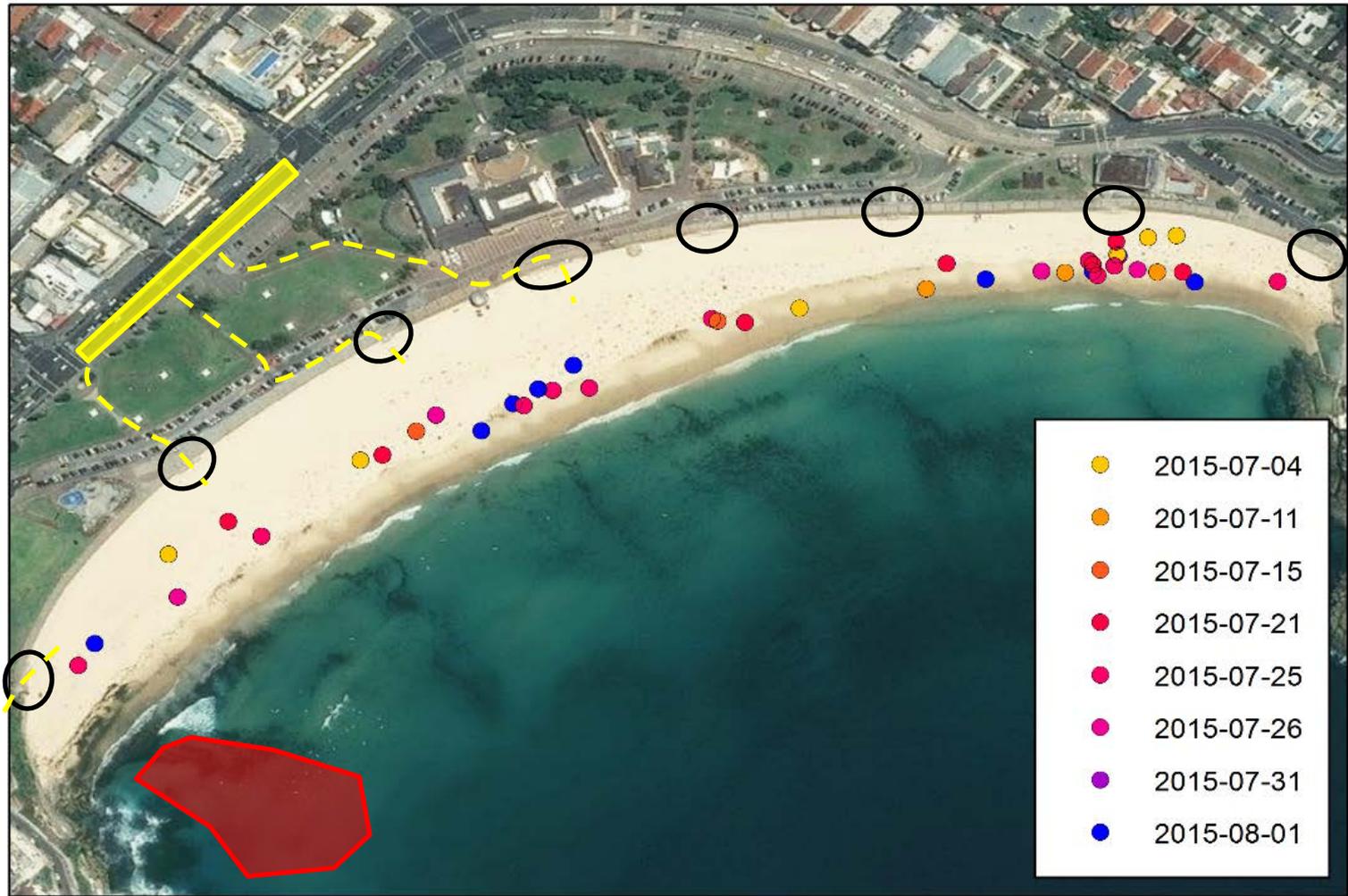




meters





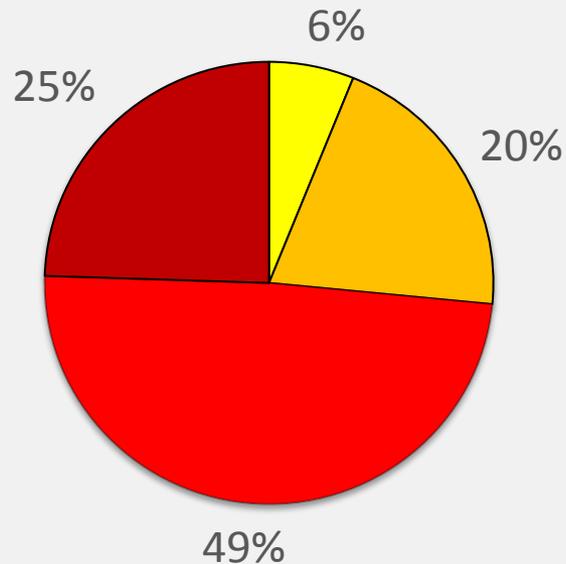


51% of subjects visit Bondi \geq once a month
20% at Bondi for the first time ever
29% go “rarely”



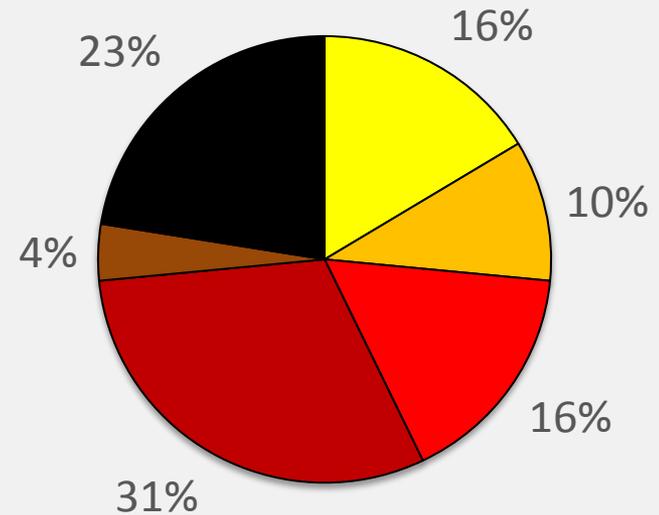
Perception of Ability

Self-rated Ocean Swimming **Ability**



- I don't swim in open water
- Weak
- Competent
- Highly Competent

Self-rated Ocean Swimming **Distance**



- < 25 m
- 25 m
- 50 m
- 100 m
- 500 m
- > 500 m

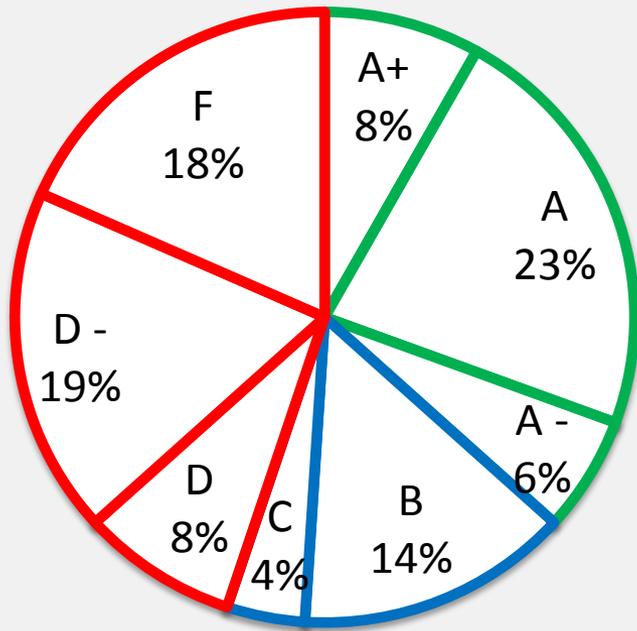
Perception of Ability

Estimated ability	Estimated max distance in open water					
	< 25 m	25 m	50 m	100 m	500 m	> 500 m
Unable	3	0	0	0	0	0
Weak	5	3	2	0	0	0
Competent	0	2	6	13	1	2
Highly competent	0	0	0	2	1	9

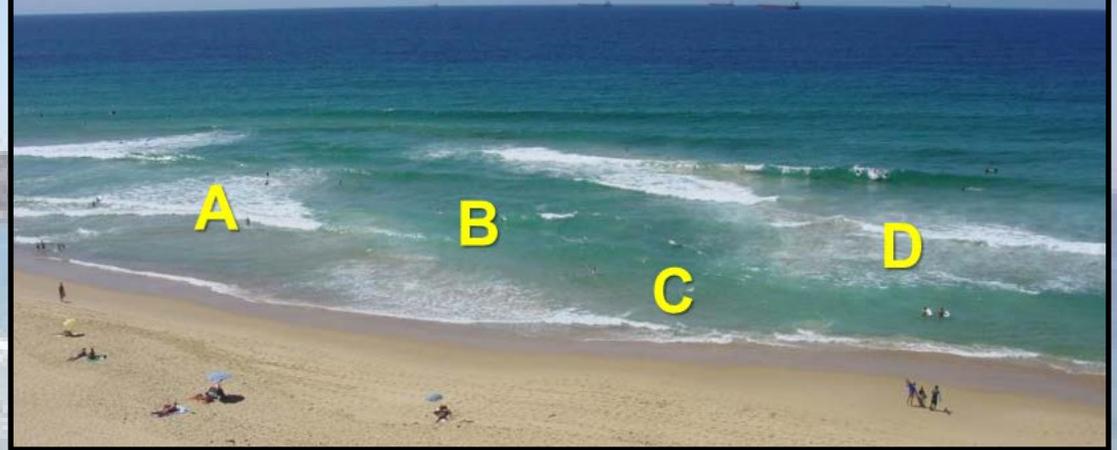
< 3	4-6	7-9	>9
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“Competent” has a wide range
 Are some are *overconfident*?

Score

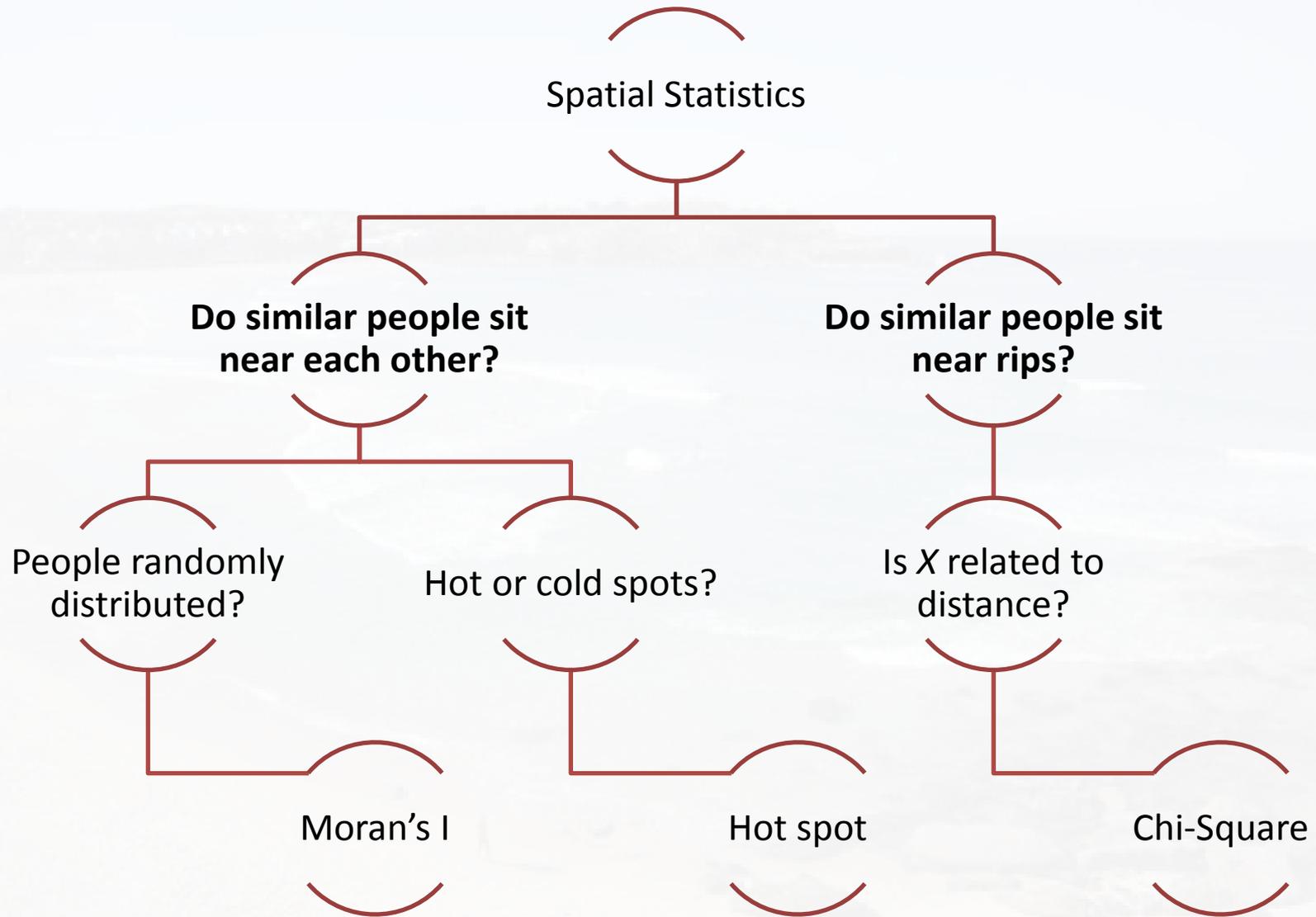


E = Nowhere



"Grade"	Score	Earned by getting...
A+	15	All 3 correct
A	12	2 correct, 1 close
A-	10	2 correct, 1 wrong
B	9	1 correct, 2 close
C	7	1 correct, 1 close, 1 wrong
D	6	3 close
D-	5	1 right, 2 wrong
F	4, 2, or 0	1 close, 1 close, or none close

Spatial Statistics



Hot Spot (Getis-Ord G_i^*) Analysis of Q8-10: Rip Picture Total Score



These are the two cluster centers for those who spotted the rip perfectly in every photo, and this is the cluster center for those who never identified the rip

Subject's answer to question

- 0
- 15

Cold spot = clustering of low values
Hot spot = clustering of high values

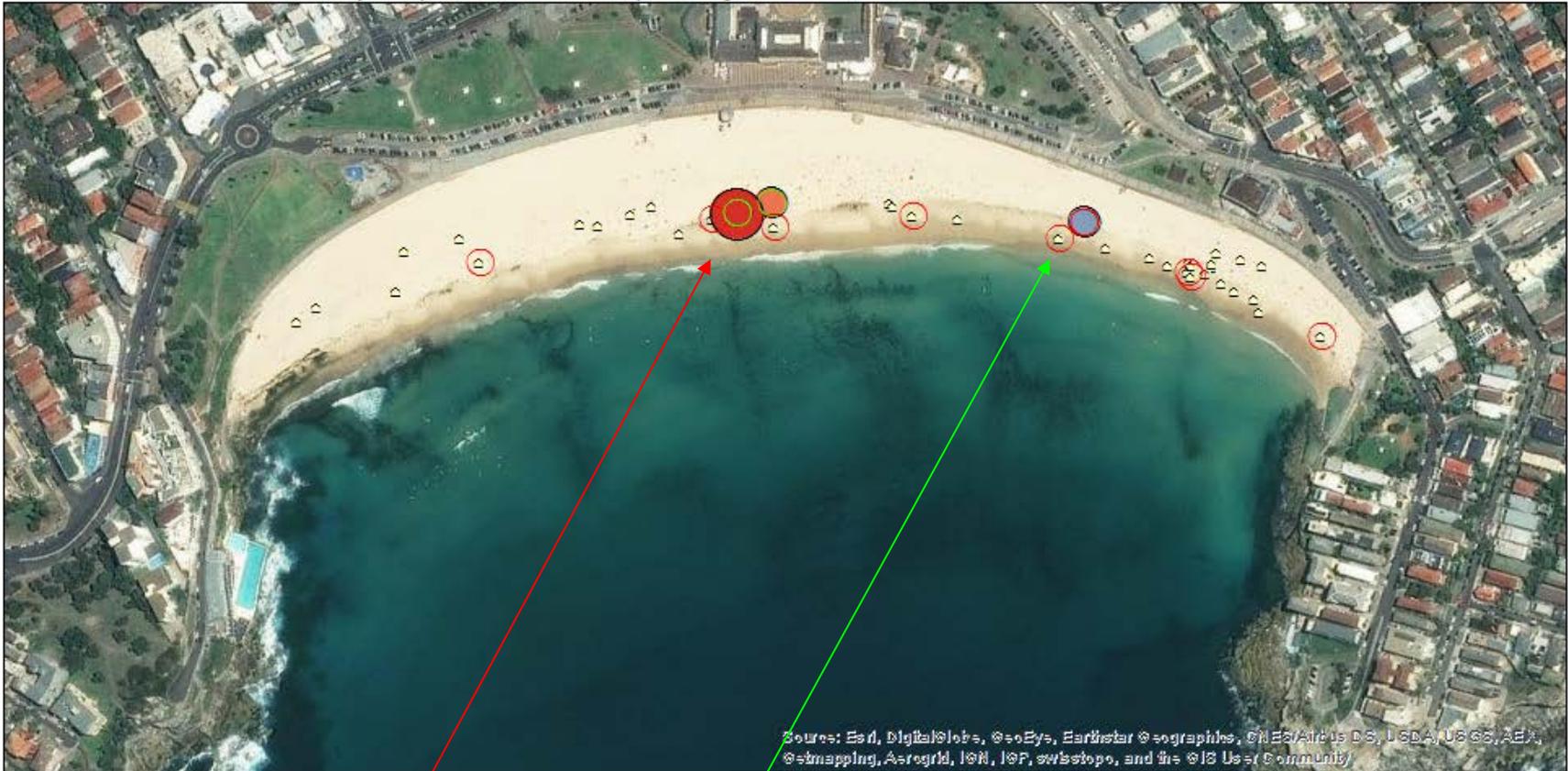
With many questions, low & high values reflect only the numerical value of the code given to a nominal answer (i.e. Female = 1, Male = 2) because many questions did not ask for numerical answers

Results and confidence level

- Cold Spot - 99% Confidence
- Cold Spot - 95% Confidence
- Cold Spot - 90% Confidence
- Not Significant
- Hot Spot - 90% Confidence
- Hot Spot - 95% Confidence
- Hot Spot - 99% Confidence



Hot Spot (Getis-Ord Gi*) Analysis of Q8-10: Self-rated Ability



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, Aero, @strapping, AeroGrid, IGN, IGP, swisstopo, and the GIS User Community



This is the cluster center for the most fearful swimmers, and this is the cluster center for those who self-rate as weak swimmers

Subject's answer to question

- Other
- Weak swimmer

Cold spot = clustering of low values
Hot spot = clustering of high values

With many questions, low & high values reflect only the numerical value of the code given to a nominal answer (i.e. Female = 1, Male = 2) because many questions did not ask for numerical answers

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444.HOBOTIX.COM

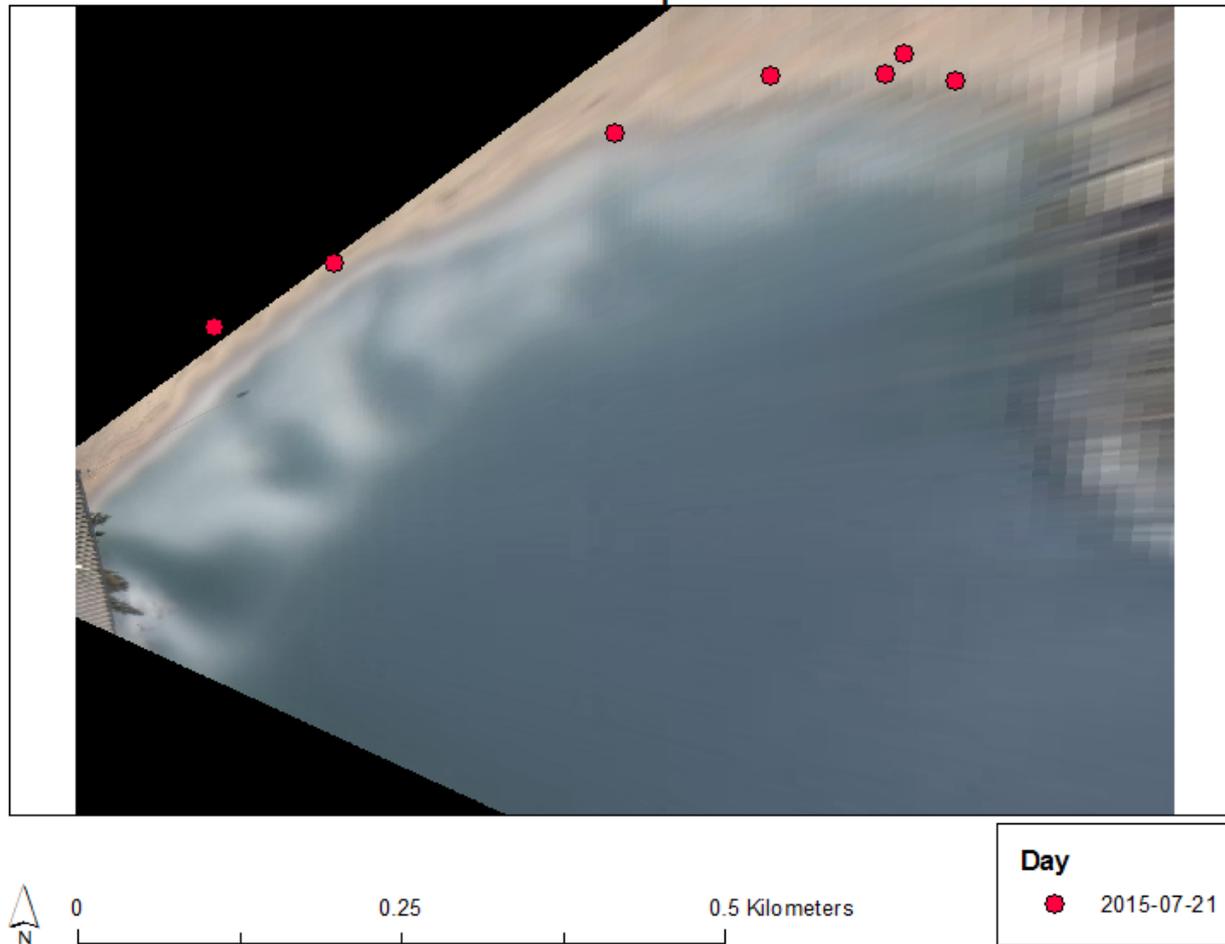
2015-07-21 EST 13:08:00

ARGUS camera



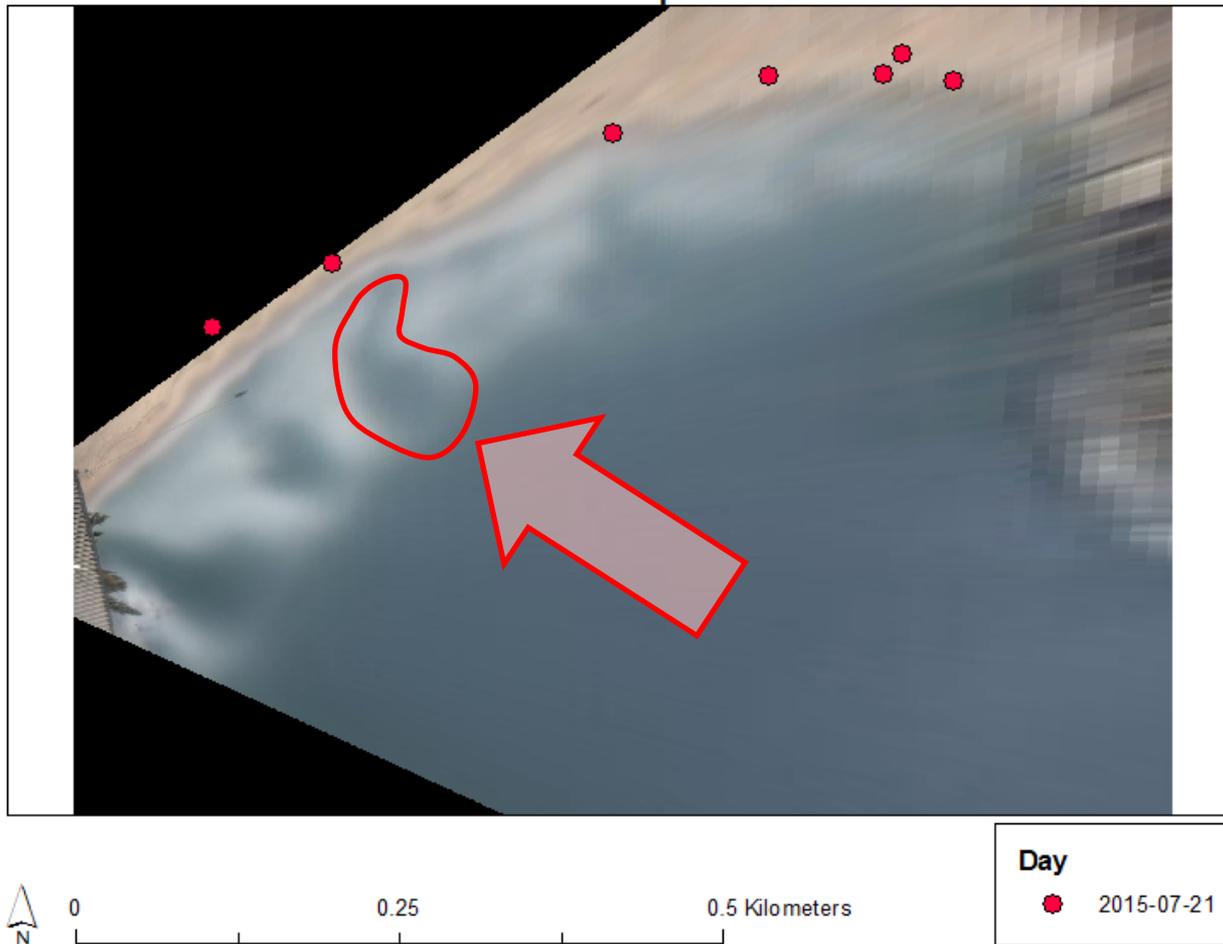
Georeference, ID Rips

Location of Interviews and Rip Currents on 2015-07-21



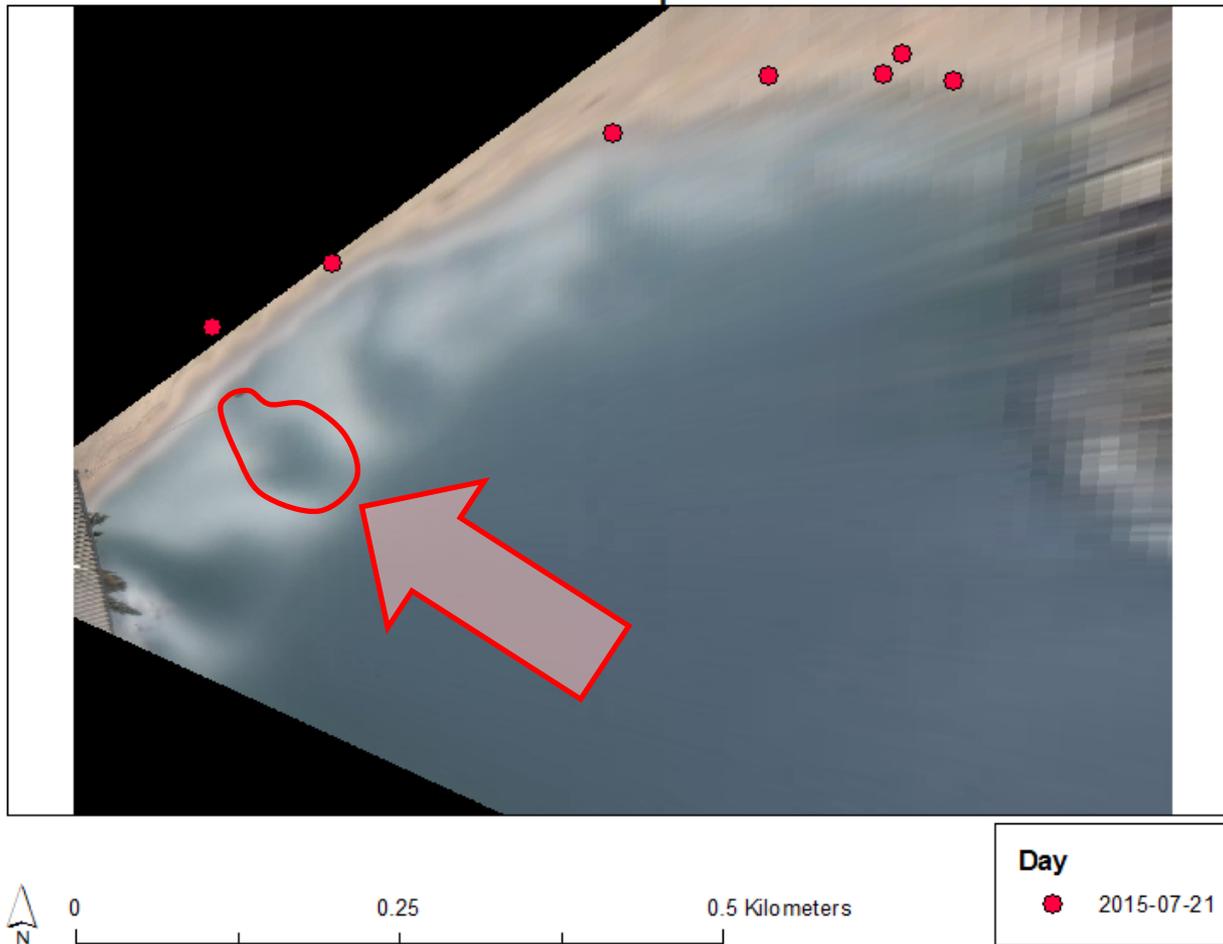
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Location of Interviews and Rip Currents on 2015-07-21



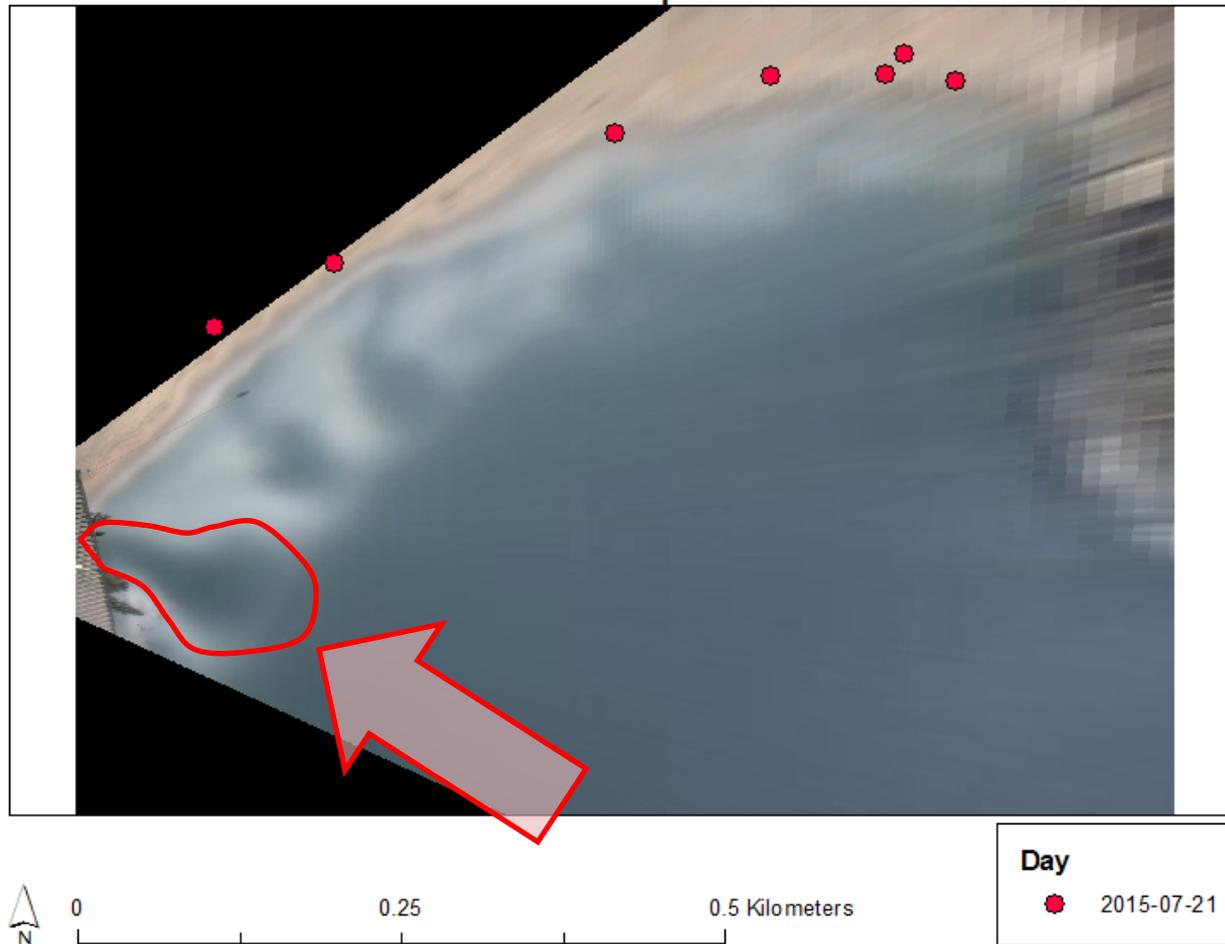
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Location of Interviews and Rip Currents on 2015-07-21



Georeference, ID Rips

Location of Interviews and Rip Currents on 2015-07-21



Groups examined so far...

Group	p value	Significance	Conclusion
Saw signs (or not)	0.872	None	No relationship
Photo Scores	0.957	None	No relationship
Frequent Bondi Visitors (v. not)	0.326	None	No relationship
Self-rated ocean swimming ability	0.042	95%	There is a non-random relationship here!
Self-rated ocean swimming dist.	0.080	90%	
Australian (v. not)	0.422	None	No relationship
From NSW (or no)	0.868	None	No relationship

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From NSW (or no)	0.868	None	No relationship

Are vulnerable swimmers *actually* attracted to rip currents?

No

- There is no significant relationship between subjects' proximity to a rip and their ability to identify a rip in a photograph
 - Or nearly any other variable
 - Their self-rated ocean swimming distance and ability are significant
 - This warrants further investigation

Why'd you choose to sit here?

"The flags"
#7111409



Why'd you choose to sit here?

“The flags”
#7111409



“Flags were too far. Got tired of walking.”
#7251437

Why'd you choose to sit here?

“Close to where we walked on to the beach.”
#8011452

“The flags”
#7111409



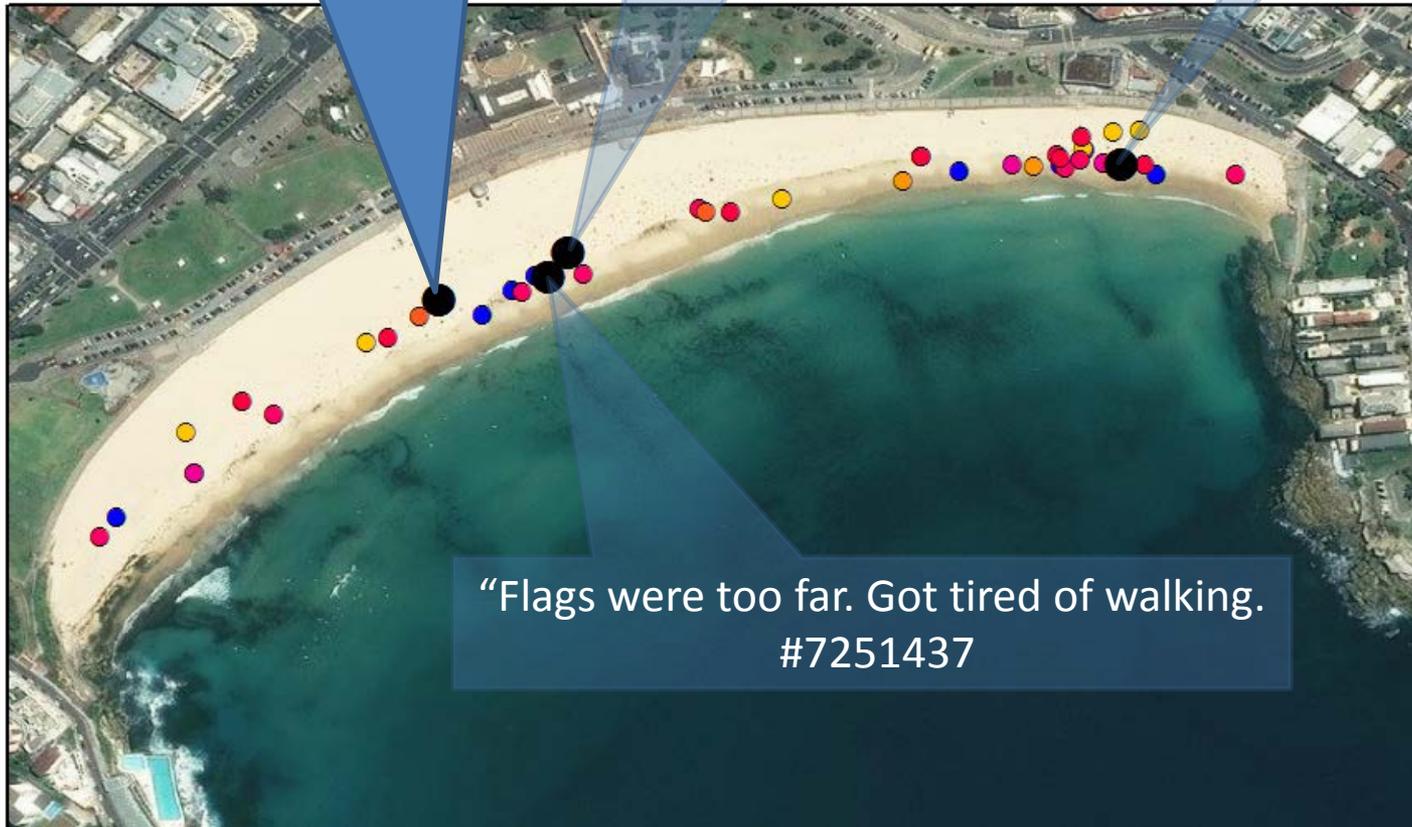
“Flags were too far. Got tired of walking.”
#7251437

Why'd you choose to sit here?

“There were a bunch of girls here!”
#7261334

“Close to where we walked on
to the beach.”
#8011452

“The flags”
#7111409



“Flags were too far. Got tired of walking.”
#7251437

People who fail to recognize rips in photos do not preferentially sit near them



People who fail to recognize rips in photos do not preferentially sit near them

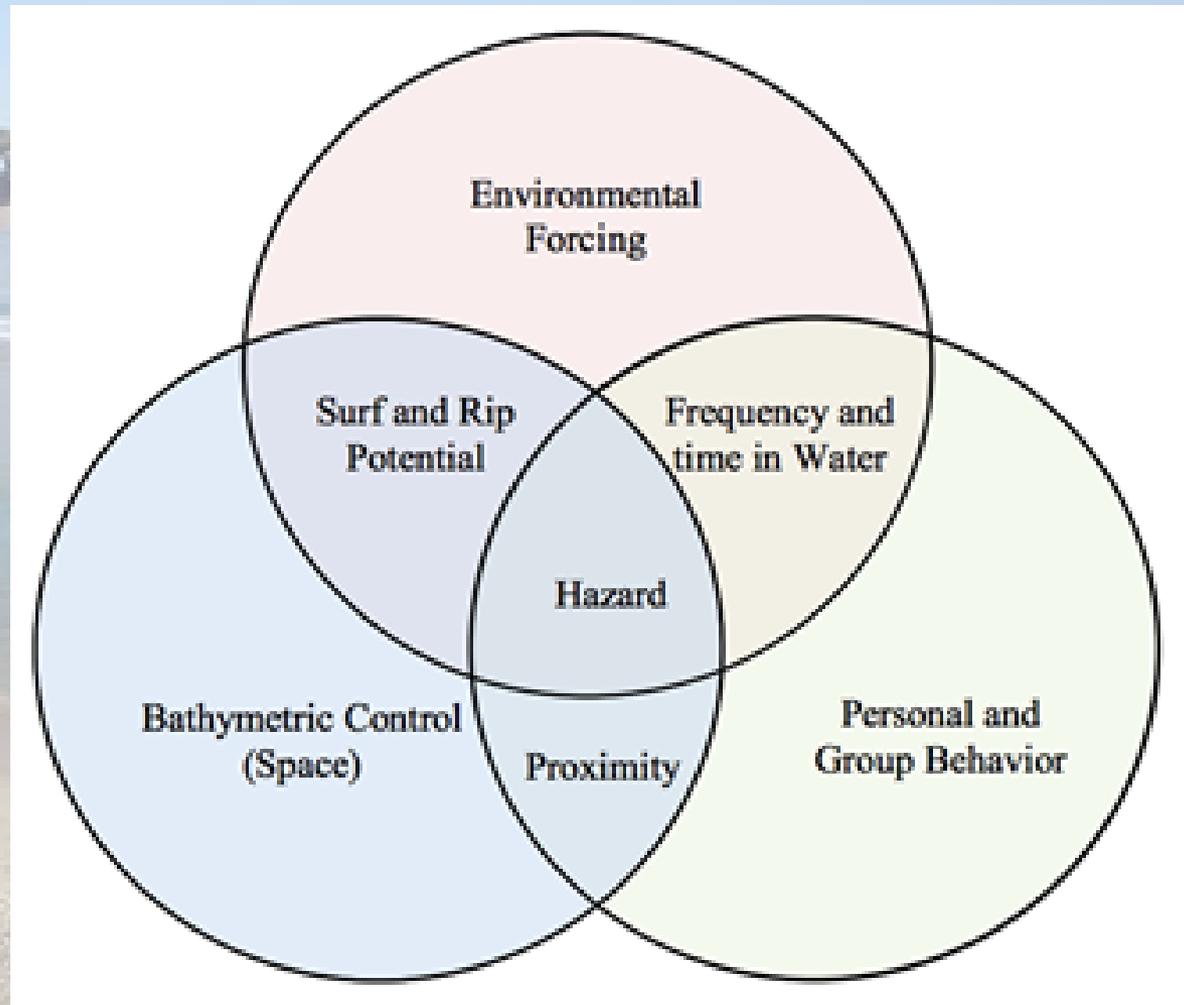
“...the selection of swimming locations based on convenience suggests that beach safety efforts need to **focus on guiding beach users to relatively safe locations** away from rip current activity.”

Houser, C., Murphy, T. and Labude, D. (2015)

“...the rip hazard is dependent on the alongshore covariation of the in both time **environmental forcing with the individual and group behavior** and space, even on what appears to be a relatively uniform beach environment”

Houser, C., Barrett, G. and Labude, D. (2011)

“Danger” Implies Human



Acknowledgements



Australian Academy of Science



UNSW
AUSTRALIA



TEXAS A&M
UNIVERSITY

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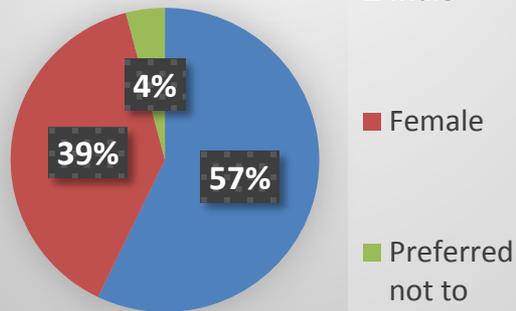
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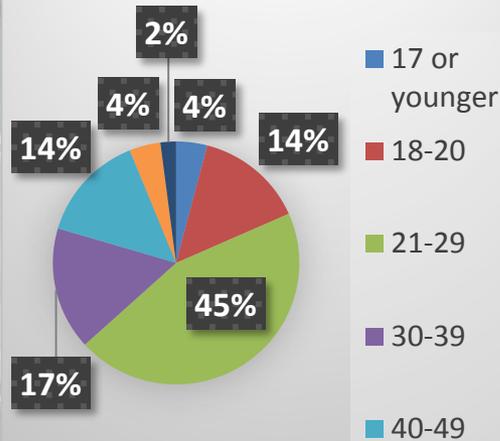
Personal Data/Demographics

Sex



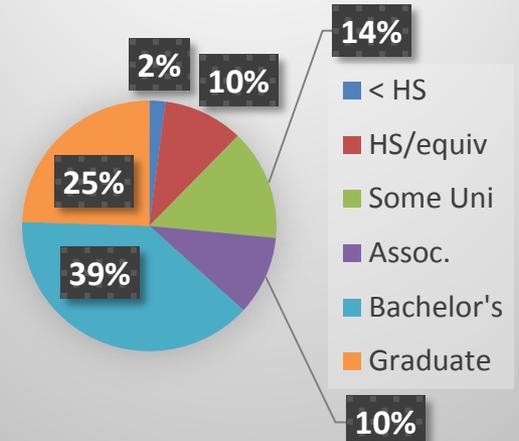
- Male
- Female
- Preferred not to answer

Age



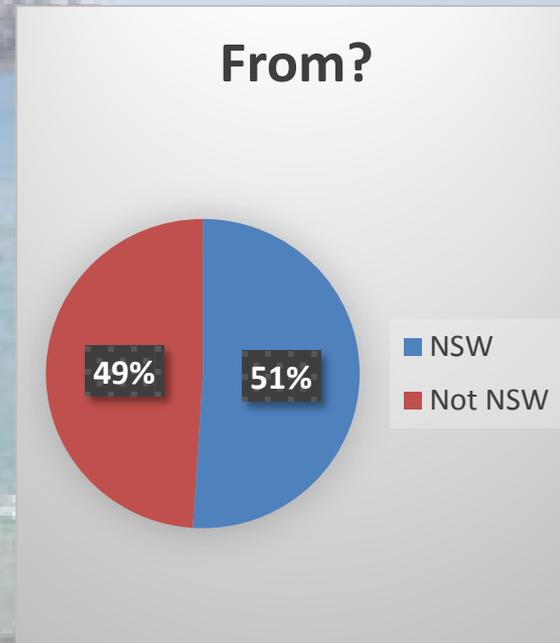
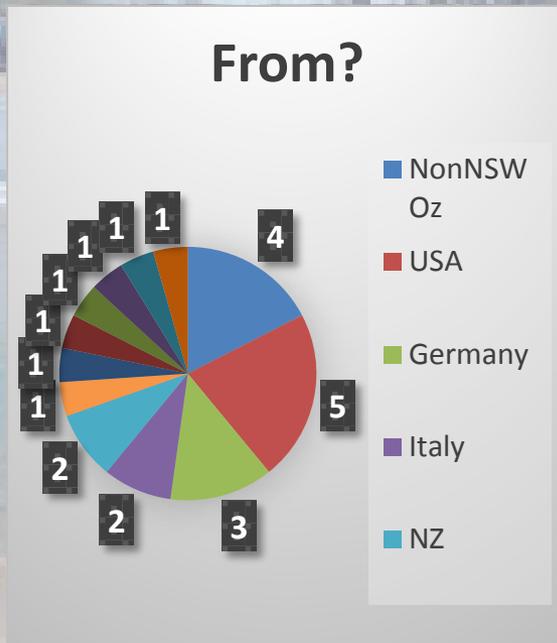
- 17 or younger
- 18-20
- 21-29
- 30-39
- 40-49

Education



- < HS
- HS/equiv
- Some Uni
- Assoc.
- Bachelor's
- Graduate

Personal Data/Demographics



Warnings and Signs

- Did you see any signs, flags, or other warnings when you arrived today?
 - No: n = 18 (36.7%)
 - Yes: n = 31 (63.3%)
- Where you're from local or not is irrelevant
 - Australian v. not & NSW vs. everything else, both evenly split

Aussie = 1, non = 0 * Did you see any signs, flags, or other warnings when you arrived today? Crosstabulation

Count

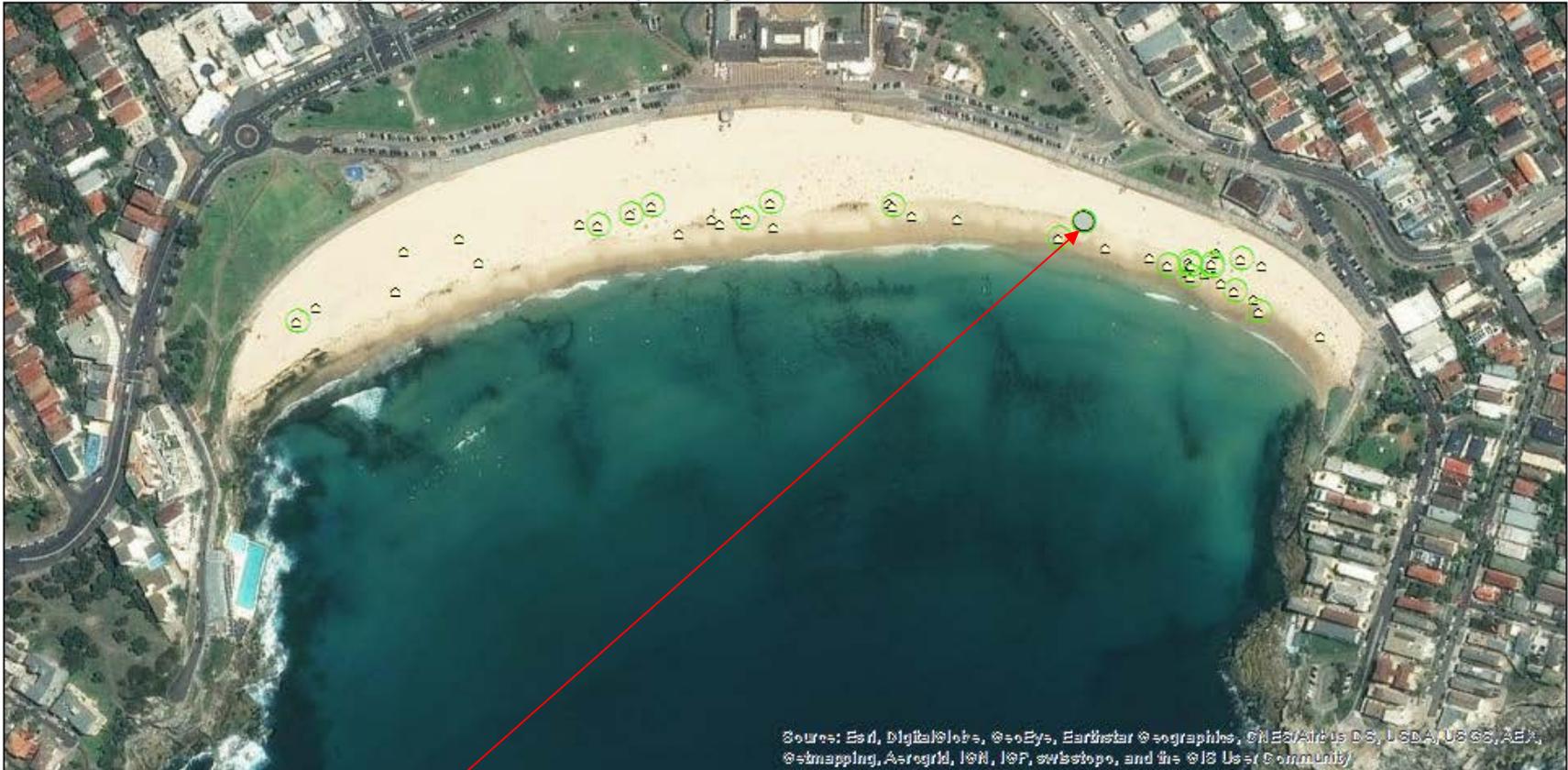
		Did you see any signs, flags, or other warnings when you arrived today?		Total
		No	Yes	
Aussie = 1, non = 0	Not Australian	9	11	20
	Australian	9	20	29
Total		18	31	49

Local(1) or no(0)? * Did you see any signs, flags, or other warnings when you arrived today? Crosstabulation

Count

		Did you see any signs, flags, or other warnings when you arrived today?		Total
		No	Yes	
Local(1) or no(0)?	not NSW local	11	12	23
	local	7	19	26
Total		18	31	49

Hot Spot (Getis-Ord Gi*) Analysis of Q8-10: From Australia, or no?



This is the cluster center for subjects from outside Australia

Subject's answer to question

○ Not Australian

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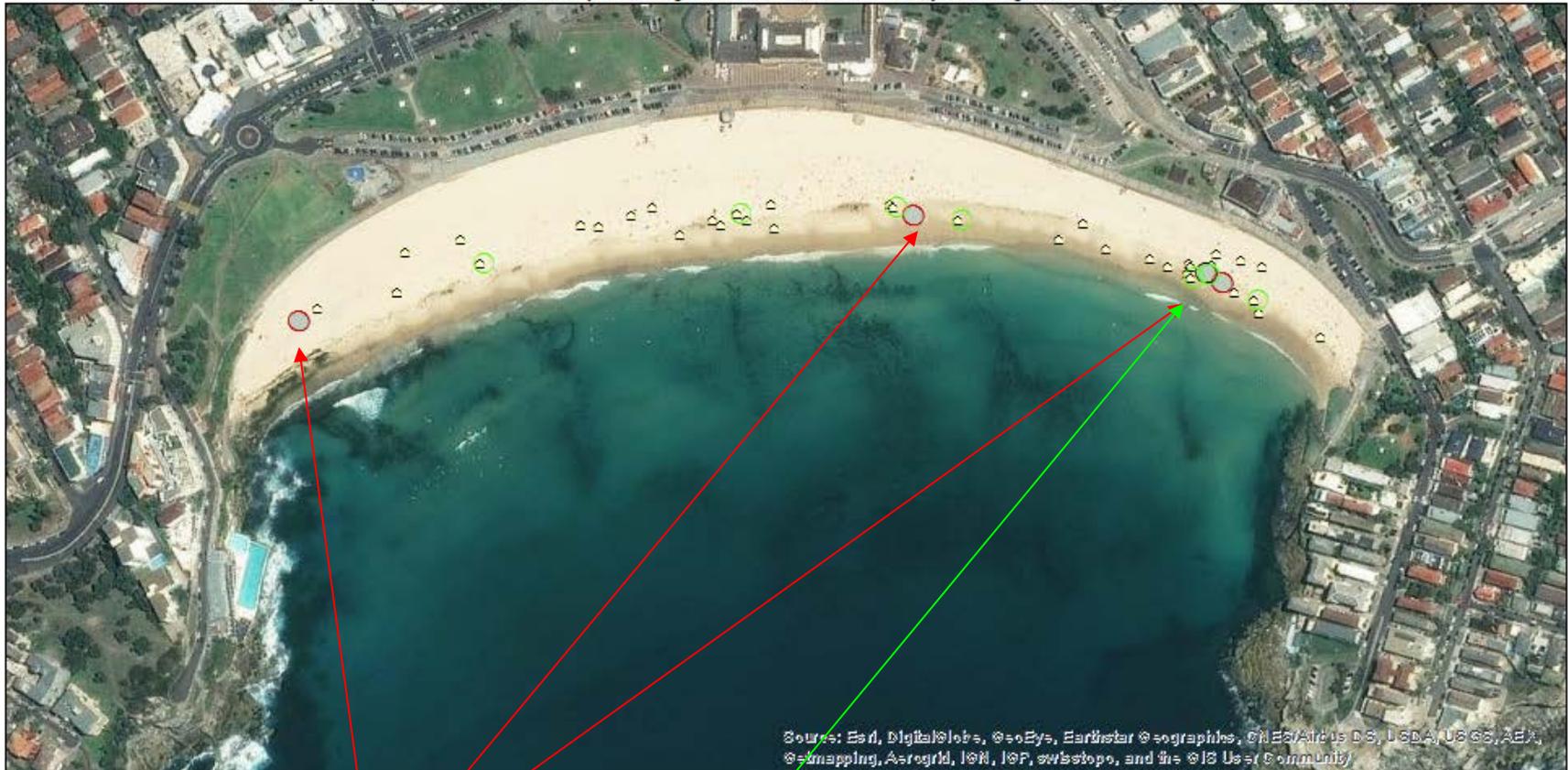
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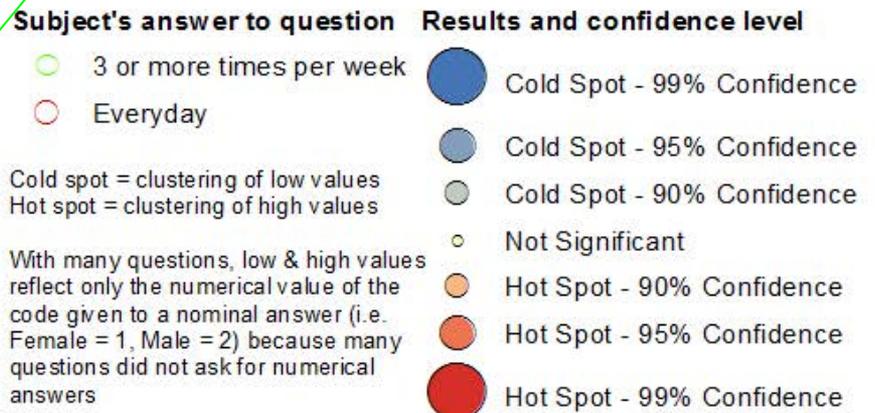
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- Hot Spot - 95% Confidence
- Hot Spot - 99% Confidence



Hot Spot (Getis-Ord G_i^*) Analysis of Q18: Frequency of visitation to Bondi



These are the three cluster centers for everyday visitors, and this is the cluster center for those who visit almost everyday



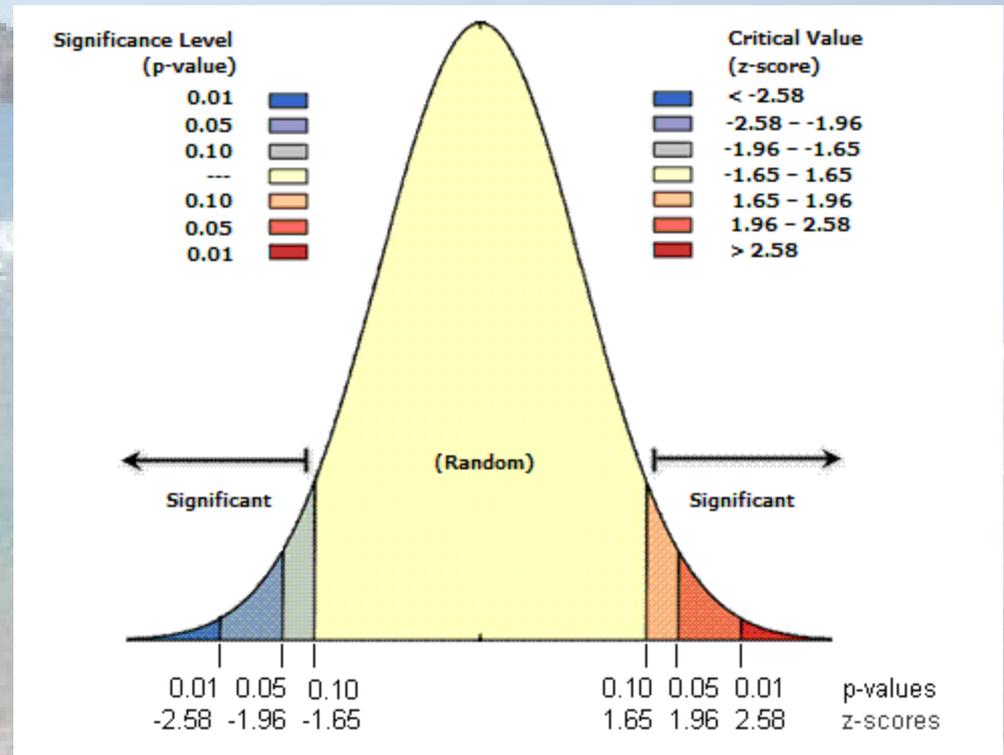
"Groups" examined so far

Group	Moran's I Result	Hot Spot Result	Conclusion
Saw signs (or not)	Random	Not clustered	Totally random
Photo Scores	Random	3 hot spots ($p < 0.10$)	2 adjacent centers for a cluster of perfect scores (15), 1 center for zeros
Frequent Bondi Visitors (v. not)	Random	3 hot spots ($p < 0.10$)	3 clusters of everyday visitors, 1 cluster of 3+ times per week
Self-rated ocean swimming ability	Not Random ($p = 0.0006$)		
Self-rated ocean swimming dist.	Random		
Australian (v. not)	Not Random ($p = 0.09$)		
From NSW (or no)	Random	Not clustered	Totally random

*maybe

Moran's I

Answers the question: Is the given attribute **randomly distributed?**



Hot Spot Analysis

Answers the question: Is the given attribute **clustered**?

- Generates a z-score and p-value for every feature
- If a feature has a:
 - high z-score + small p-value = spatial clustering of high values
 - low (large neg) z-score + small p-value = clustering of low values
 - z-score near zero = no apparent spatial clustering
- The higher (or lower) the z-score, the more intense the clustering.