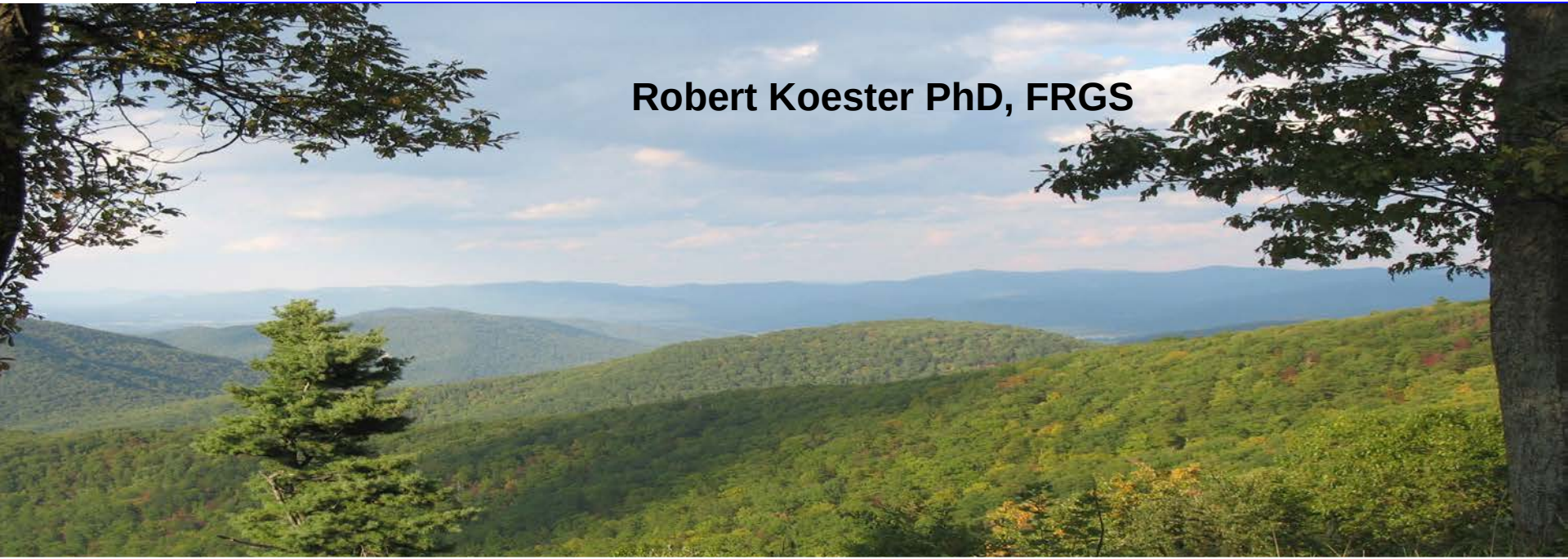
Updates to LPB + ISRID

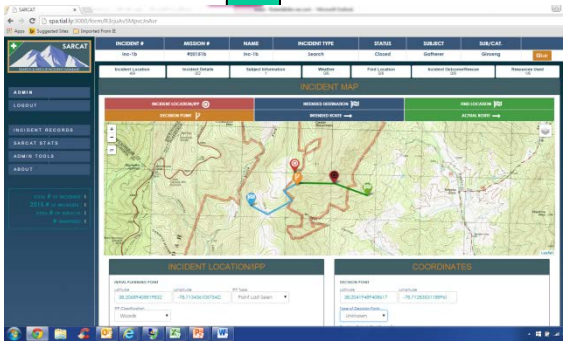


Robert Koester PhD, FRGS

Some of this work was supported with funding from the Science and Technology Directorate of the United States Department of Homeland Security

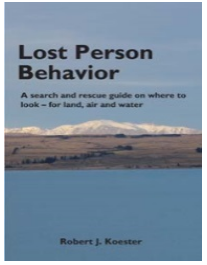
Lost Person Locator Project

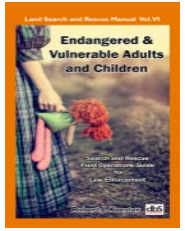
ISRID

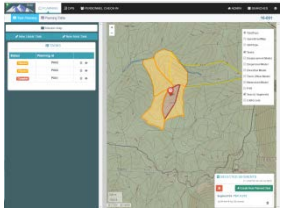


SARCAT

Summary Statistics



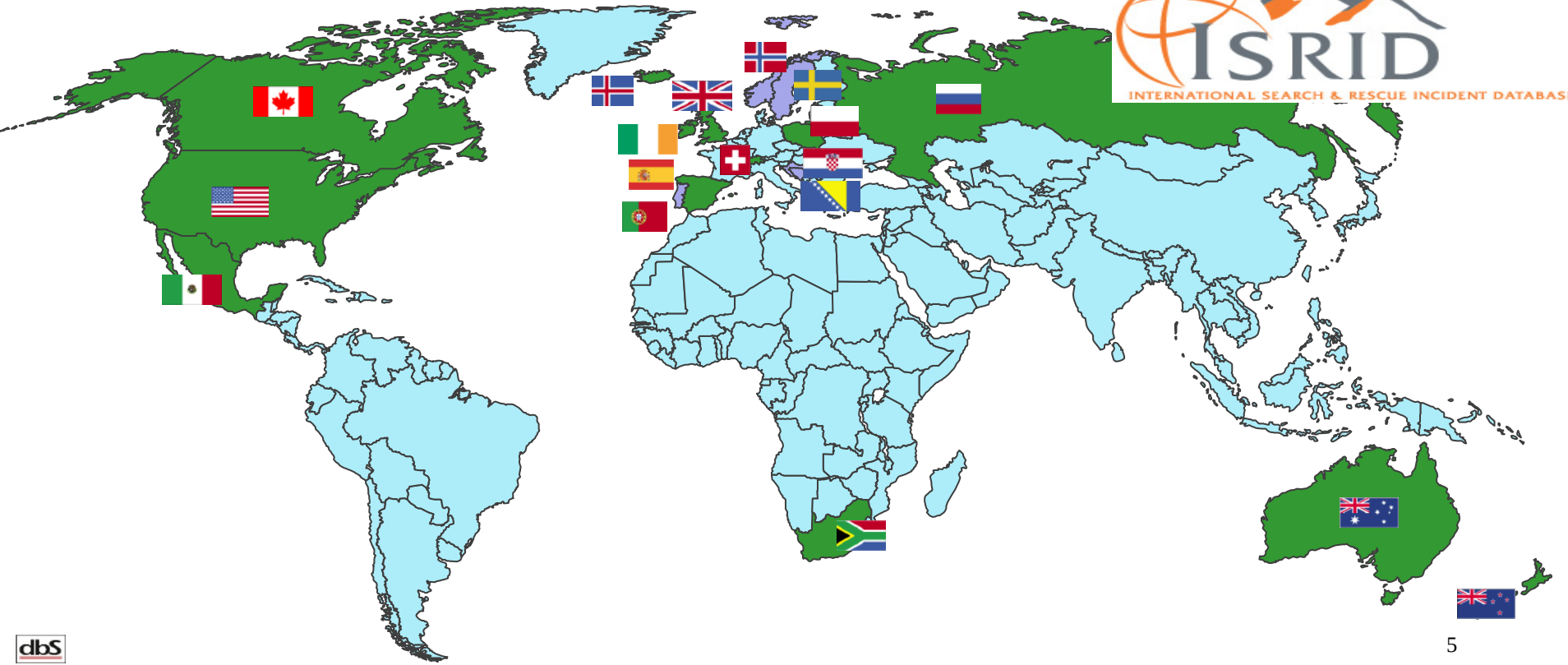




User Products

ISRID 1-3

Country Contributors



Up Coming Additions

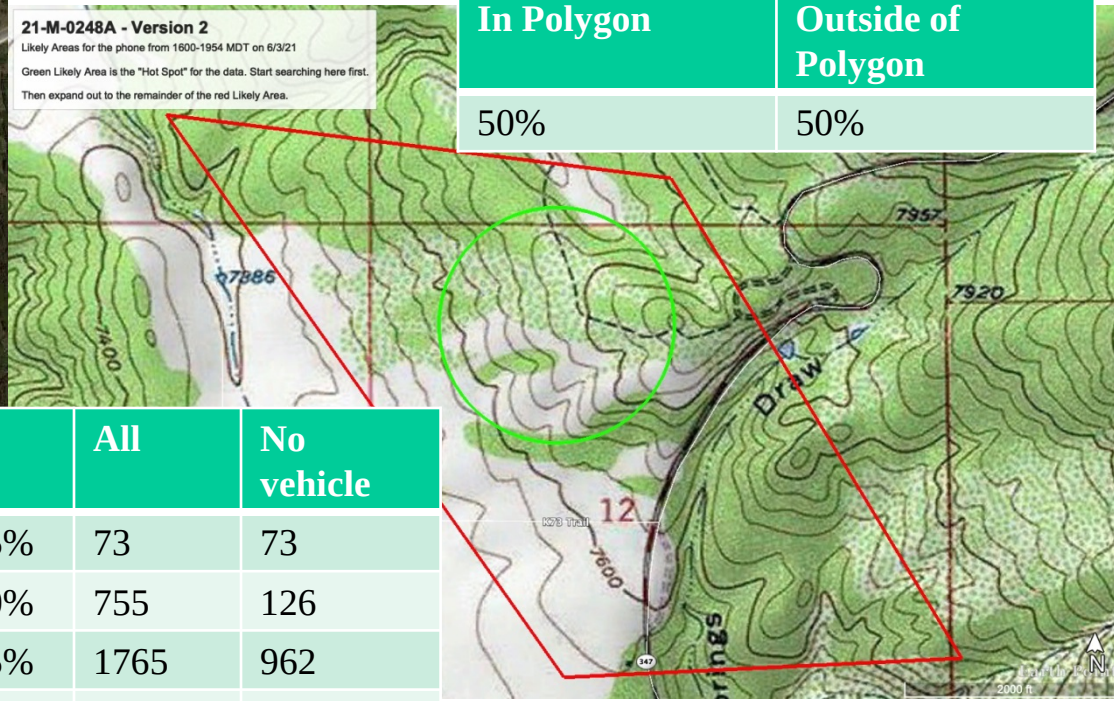
- More data
- New Subject Categories: BASE, vision, brain trauma
- New Subject Categories: Beacons, Cell Phone Forensics, Fugitive, Wide Area Disaster, Bridge jumpers, Scuba, AC
- New Scenario Categories: medical, evading, trauma, etc.
- New Model Statistics: Point, Watershed, rPLS
- More emphasis on scenarios and timelines

New Summary Statistics

Dementia (miles)

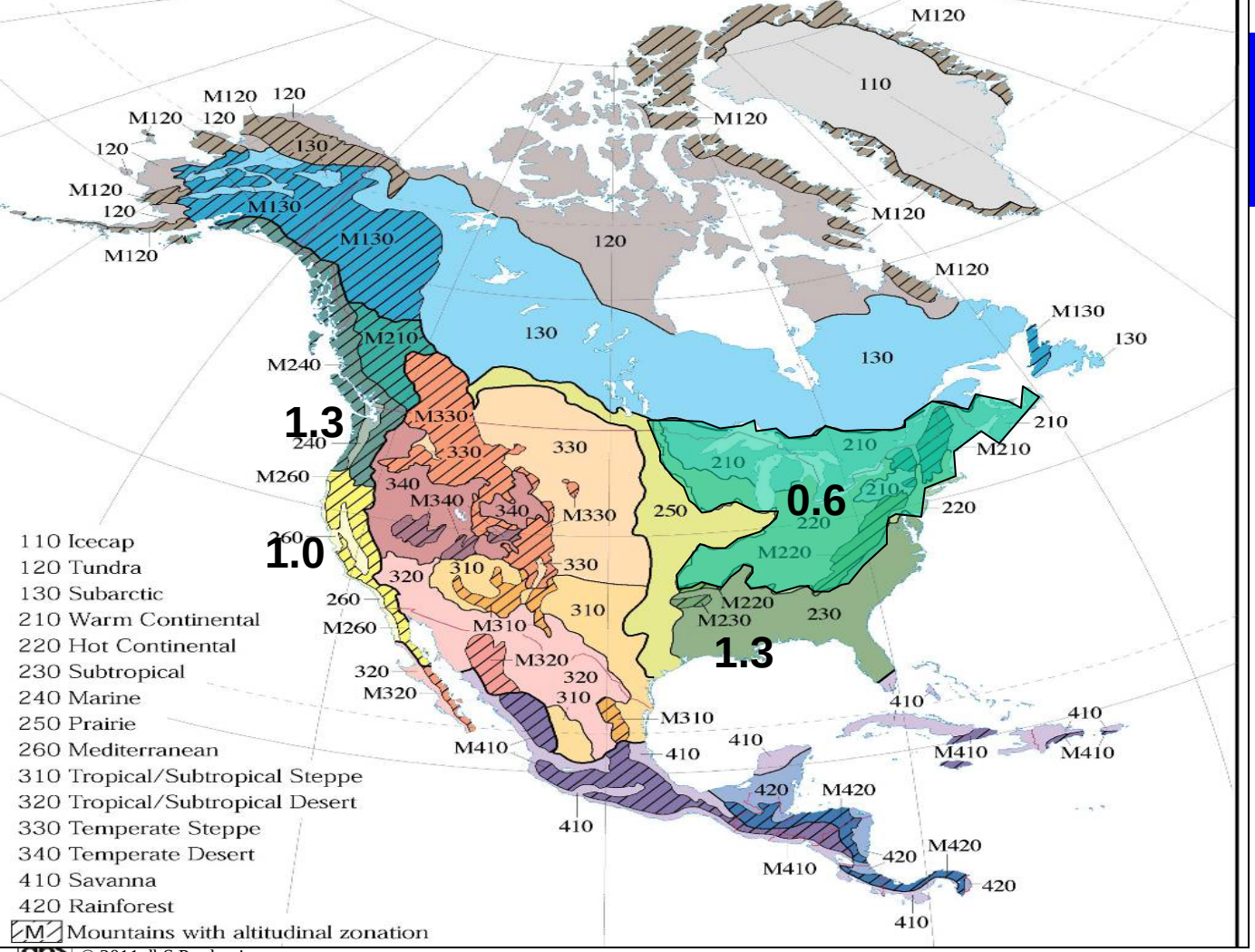
	ISRID 1.0		ISRID 2.0	
	Temperate		Temperate	
	Mtn	Flat	Mtn	Flat
N	**95**	**175**	**1207**	**320**
25%	0.2	0.2	0.1	0.2
50%	0.5	0.6	0.6	0.6
75%	1.2	1.5	1.6	1.5
95%	5.1	7.9	7.0	5.8

Cell Phone Forensics



In Polygon	Outside of Polygon
50%	50%

N	All	No vehicle
25%	73	73
50%	755	126
75%	1765	962
95%	6403	2468

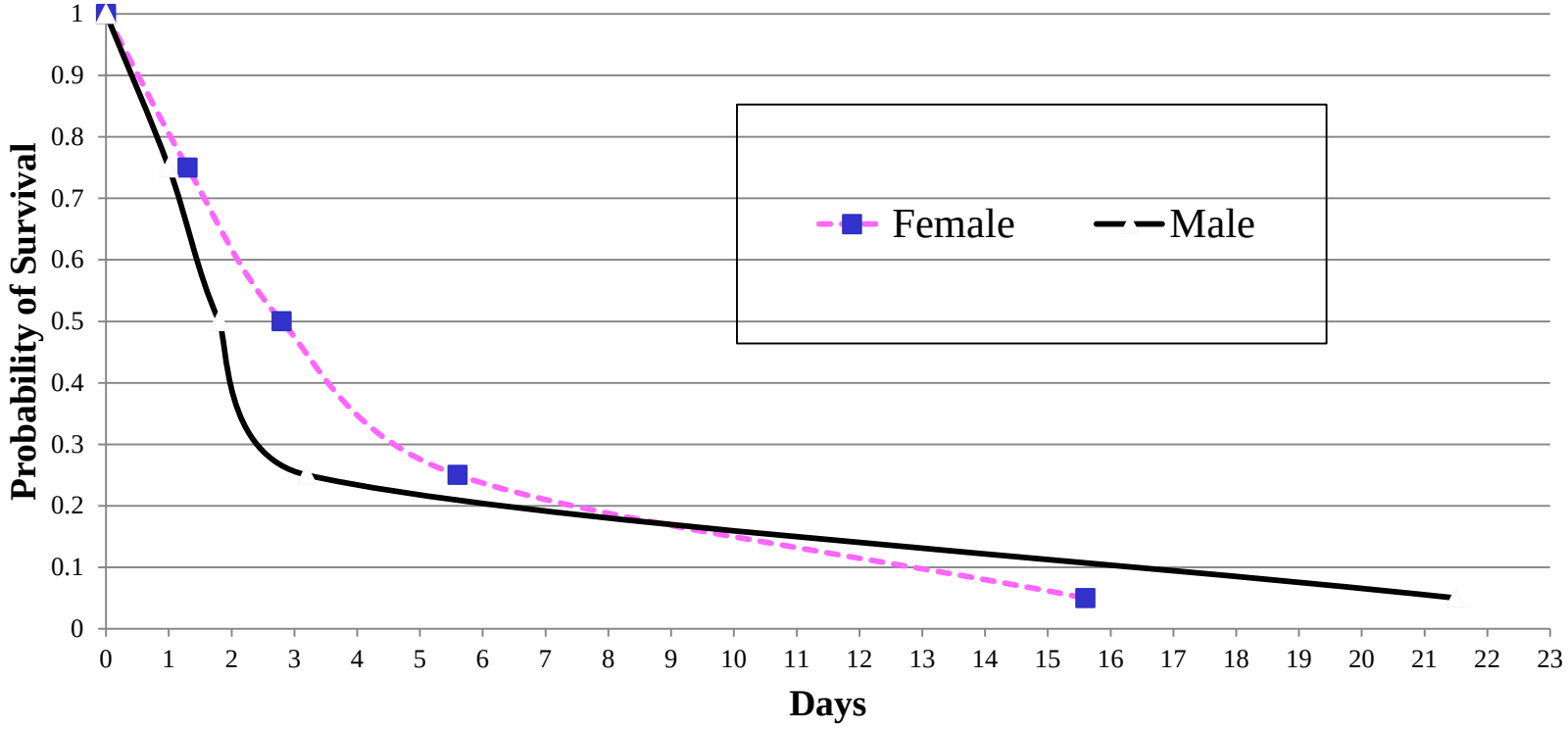


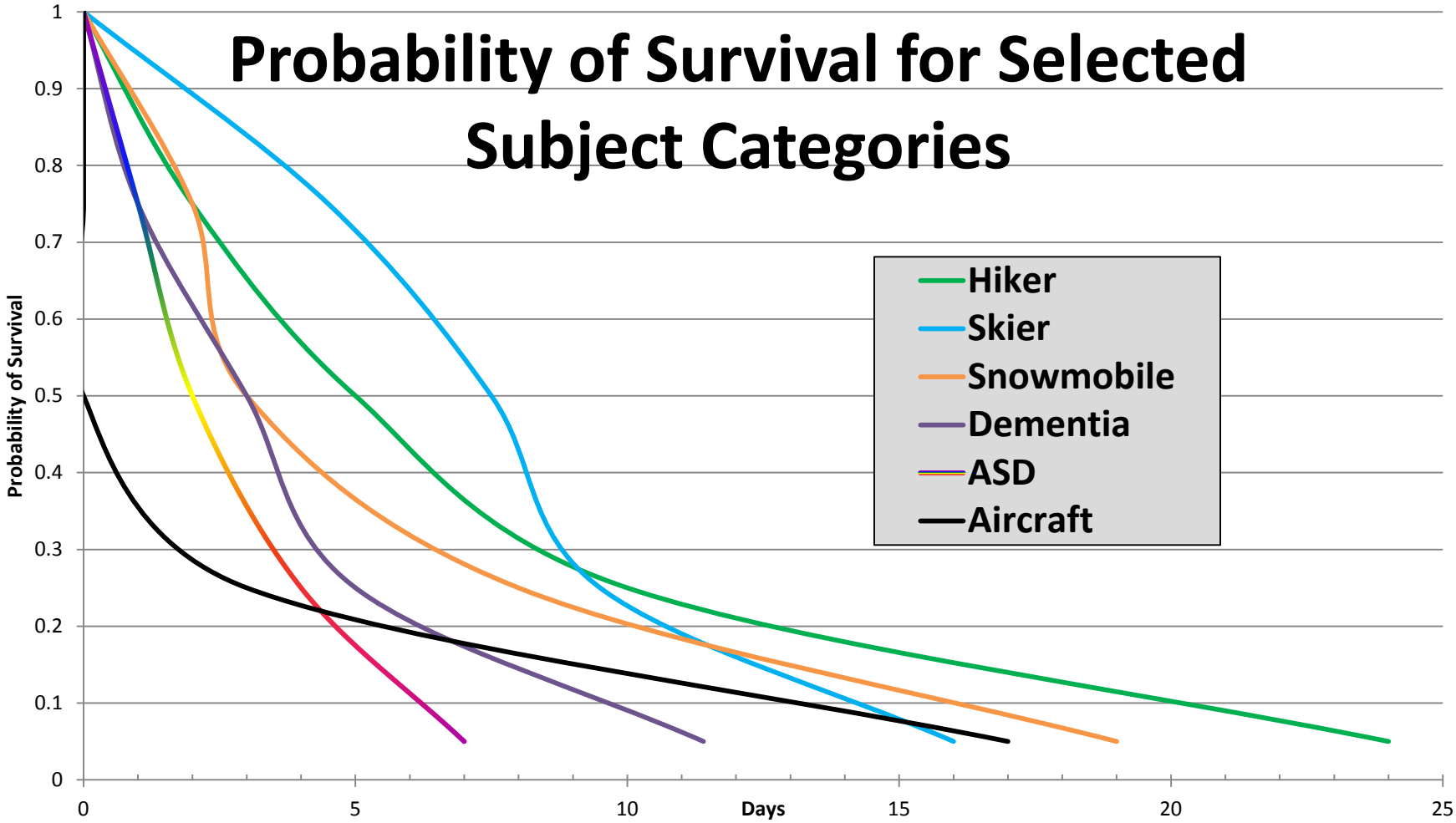
Male vs Female

No Significant Differences <u>in Distance</u>

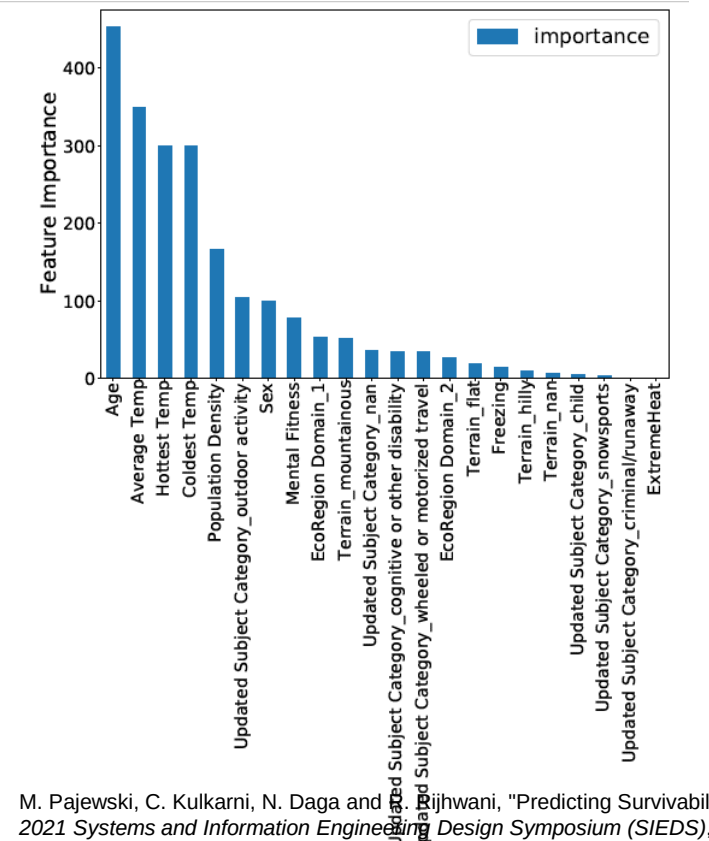
Hikers Dementia Despondent

Male vs Female Survivability

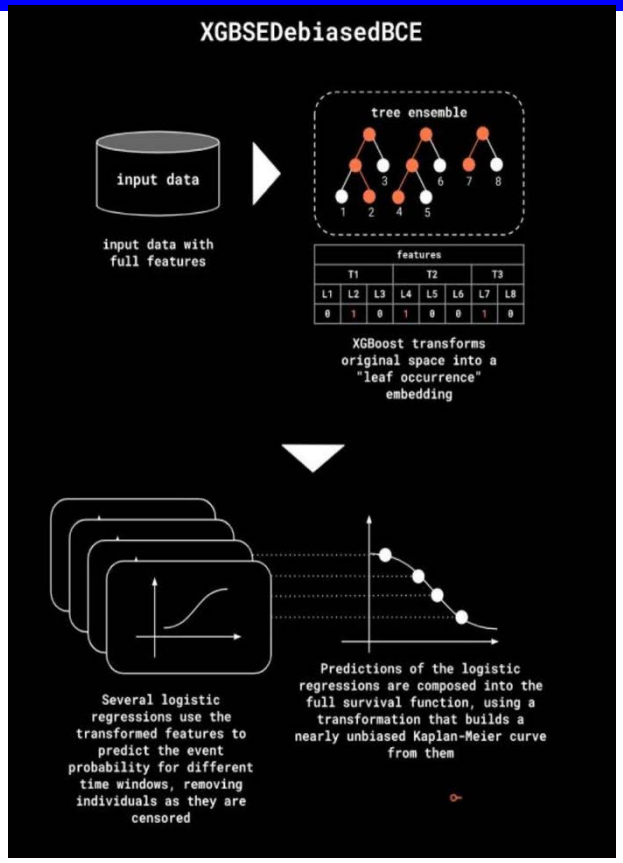



Probability of Survival for Selected Subject Categories
Probability of Survival
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
25
Days
Hiker
Skier
Snowmobile
Dementia
ASD
Aircraft

Survivability Factors

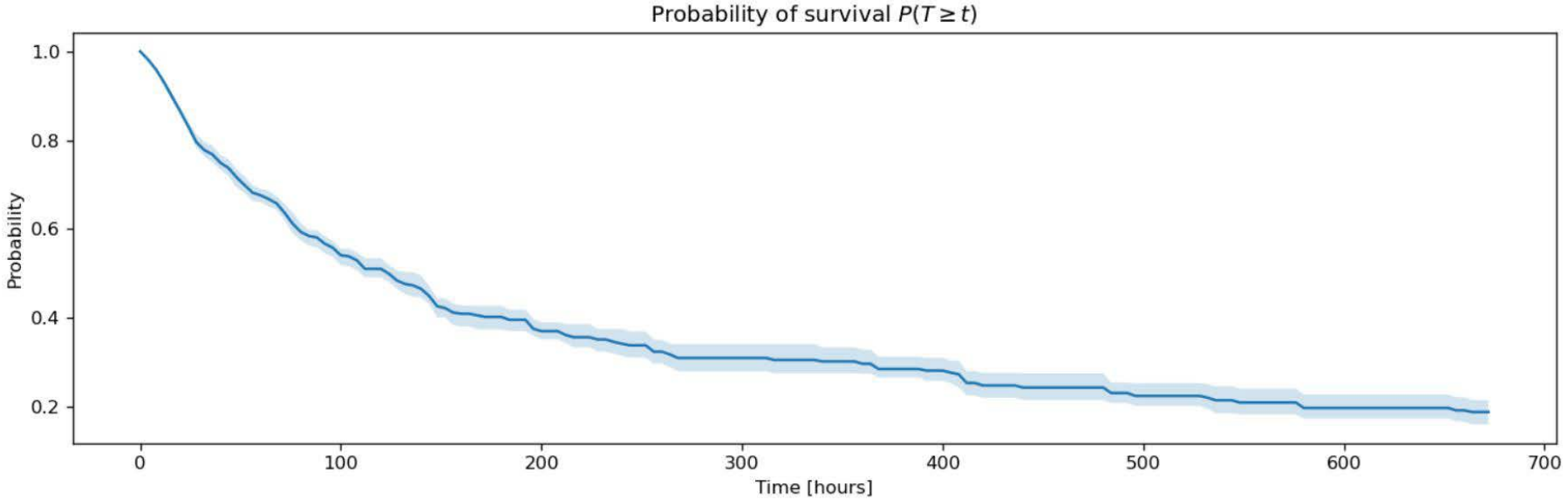


Age
Average Temp
Hottest Temp
Coldest Temp
Wilderness vs Urban
Subject Category
Gender
Mental Fitness
Ecoregion
Terrain



M. Pajewski, C. Kulkarni, N. Daga and B. Rijhwani, "Predicting Survivability in Lost Person Cases," *2021 Systems and Information Engineering Design Symposium (SIEDS)*, 2021, pp. 1-6, doi: 10.1109/SIEDS52267.2021.9483790.

Overall P Survivability vs Time



100 hours equals 4 days 4 hours

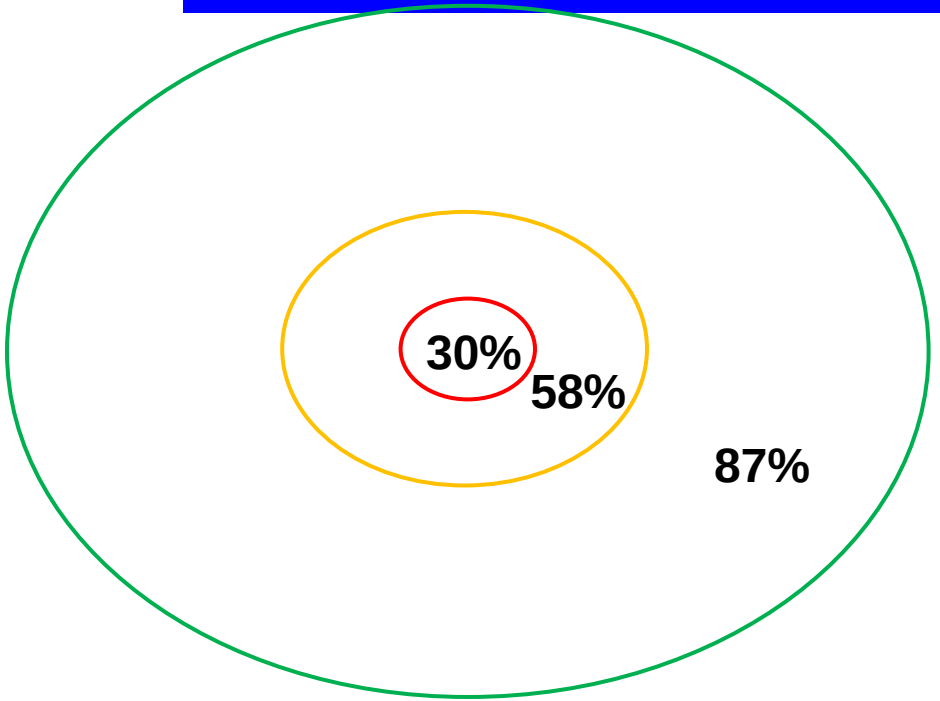
Modeling impact of Wx on Distance Traveled

Melanie Sattler, Khoi Tran, Haley Blair, Bryce Runey, "Modeling the impact of Weather on Distance Traveled by Lost Persons", *2022 Systems and Information Engineering Design Symposium (SIEDS)*, pp.104-109, 2022.

Age and Survivability

Age	all	>1	all	all	>1	all	>1	all	>1	all	>1	all	>1
90-99						91	25						
80-89				34	0	94	85					86	
70-79	0	0	50	33	13	90	73					74	25
60-69	33	0	86	37	33	88	79			43	0	88	80
50-59	0	0	86	44	33	97	100			74	33	90	80
40-40	56	33	97	50	28	100				77	80	91	73
30-39	62	0	89	60	40					84	62	90	66
20-29	67	40	94	53	43					94	93	93	78
10-19	84	50	96	64	43			95	81			94	81
01-09	89	25	100					92	69			95	75
	Abduction		ATV	Despndnt		Dementia		Child		Climber		Hiker	

Distance & Age (>65)



	<65	≥65
n	585	77
25%	0.8	0.5
50%	2.0	1.6
75%	4.8	3.2
95%	10.6	8.1

Factors

Factor	Spatial Model	Survivability	Comments
Local History	Likely	Likely	Highly specific to location
Local data vs ISRID	Yes, some ecoregion divisions	Likely	
Sample size	Yes	Yes	Need to collect more data
Appropriate user	All ISRID data tertiary data (collected from SAR response)		
Cultural	Unknown	Unknown	Lack of data
Seasonality	Likely	Likely	
Weather	Likely	Yes	Ongoing research
Sex	No	Yes	
Age	Yes	Yes	
Solo vs Group	No	Yes	
Physical condition	No	Yes	
Scenario	For some	For some	Medical
Personality	Unknown	Unknown	Lack of data

Scenario Analysis

- Gather information about the subject including timelines
- Look at scenario statistics, determine which search scenarios are possible
- Determine which search scenario are more probable
- Determine how each search scenario might

Scenario

Thumbnail Scenario

Four 18-year-old college students hike to summit of Old Rag. Subject bets friends he will beat them back to car by going cross-country from summit vs the trail.

Subject Category	Hiker
IPP	Summit of Old Rag Mountain
Destination	Trailhead
Direction of Travel	North down a cliff face
Intentions	Follow compass bearing north cross-country
Group status	Solo
Personality	Adventurous, competitive, risk-taker
Clothing/Equipment	Jogging shorts, polo, wool sweater, old shoes, compass
Experience	On previous hike but no navigation or survival training
Lost Before	No
Medical	Healthy. Hx of multiple broken bones due to daredevil activities
Cognitive	Typical

Scenarios

Scenario Analysis

Several different scenarios can account for why a search occurred. Each different possible scenario has a different likelihood (see subject categories) and a different operational impact.

Scenario	Planning	Field Impact
Avalance Avalance ocurred	• Search route • Assess avalanche danger to searchers • Obtain appropriate resources	• Locate avalanches • Look for sign into avalanche area • Use avalanche field techniques • Beware of further avalanches
Criminal Usually abduction and murder Location determined by perpetrator	• Agressive investigation • Parallel "lost" search • Large scale maps • See Abduction subject category	• See Abduction subject category • Exclude youth searchers
Despondent Suicides, suicidal or depressed	• Assess searcher safety • Minimize "young" searchers • See Despondent subject category	• See Despondent subject category
Drowning Both drowning and near-drowning	• Search water features repeatedly • Assess searcher safety and provide proper PPE • Lower water levels	• Search water repeatedly • Look for water exit points • Binoculars useful for other bank • High POA; undercut rocks, debris sites, strainers, low head dams
Evading Deliberately missing and actively hiding	• Search areas repeatedly • Use air-scent dogs and highly clue aware teams • Subjects often have good long-term survivability	• Attraction ineffective • Stop and listen for sounds of movement, talking to self • Look for sign, sleeping areas • Emphasis on places to hide
Investigative Subject located by investigative means. In hospital, shelter, jail, etc. Staged disappear-ance, miscommuni-cation, outside of search area Used transportation	• Agressive investigation • Aggressive public outreach	• Field searching will not locate subject • Interview potential witnesses encountered in the field • Family and friends may pass on critical information while talking
Lost Subject disoriented Most common overall	• Identify decision points • Use terrain analysis from each decision point • Look at each subject category • Several scenarios usually exist on how they might have become lost	• Each subject category is unique • Attraction is usually indicated • Recognize decision points. Look for sign at all decision points. • Subject may not be fully rational.
Medical Medical problem	• Search route and short distance off each route • Prepare medical plan • See medical subject	• Subject typically not far from intended route • When feeling ill, most will move off trail; seek sense of "protection" by rock or log. May not be highly visible
Overdue Knows location, but unable to get out of "woods" on time	• Search route and alternative routes • Start at destination and search towards IPP.	• Subject still on intended route • Attraction highly effective • May move off trail to camp at night. Site selection similar to most campers (flat, near water, sheltered, etc.)

Statistical Scenarios

ISRID	Hiker	Climber	Scenario Rank	Tactical impact
N	2242	65		
Avalanche			Zero	
Criminal			Low	
Despondent			Low	
Evading	1%		Possible	
Investigative	1%		Possible	
Lost	68%	49%	Highly likely	
Medical	2%	6%	Low	
Drowning			Low	
Overdue	16%	8%	Likely	
Stranded	4%	12%	Possible	
Trauma	7%	26%	Highly likely	

Scenario Analysis

Scenario	Planning impact
Investigative	Maintain investigative effort looking at companions or any other known criminal activities in the area, standard missing person search to determine if subject left the area through other means including being transported to another location, additional investigation into previous broken bones, any additional unknown medical or mental health issues. Develop a personality profile.
Drowning	Search along Brokenback creek to address drowning and catching feature to the north.
Evasive	Possible but unlikely that subject might be evasive. Cannot rely solely upon attraction. Attraction still valuable in this case, teams should be directed to shout name or whistle. Search teams need to search places subject could hide. Areas might need to be searched repeatedly.
Lost	Subject could still be lost. Previous history of the area suggests maintain containment by patrolling circuit hike. Also many subject have gotten onto the network of other trails, all of which require searching. Subject might have decided to start contouring instead of going straight down, so contour north face of Old Rag when safe.
Overdue	Possible subject moving slowly and simply overdue. Technical team to follow possible route from the top. Maintain containment at trailhead.
Stranded Trauma	For both stranded and trauma scenario conduct search of cliff area with technical teams. Current cloud cover precludes any aeronautical searching. Consider sUAV

Responses & Strategies

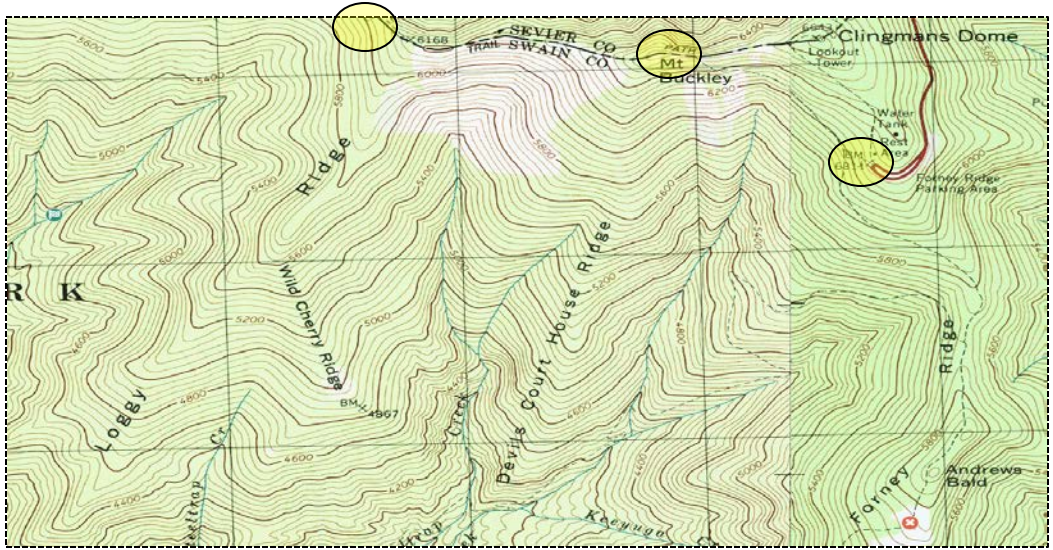
- The IPP – Start of Planning
- Getting Lost – Decision Points
- Still Moving – Terrain Analysis
- Poor decisions – Cognitive Bias
- Realizing your lost – emotional response
- Action - Strategies

Expanded list of decision points

Potential Decision Points	
• **Road intersection** • **Trail intersection** • **Trailhead** • **Trail-Social Trail intersection** • **Trail-Game path intersection** • **Start of drainage** • **Trail turns > 45º**	• Switchbacks • Sharp turns • Saddles • Stream confluence • Summits • Land type transition

When you can't find the decision point
Inchworm case

Decision Point application



Cognitive Bias

Name	Description
Availability heuristic	Tendency to estimate risk based upon how many examples come to mind quickly
Confirmation bias	Tendency to listen to information that confirms existing belief and ignore information that disagrees
Dunning-Kruger Effect	Subjects with low ability or limited knowledge or competence greatly overestimate their ability
Optimism bias	Overestimate probability of good outcomes and underestimate probability of negative outcomes
Sunk Cost Fallacy	Once we invest effort into a decision, it is difficult to change.

Realizing your Lost

- Fight, flight, or Freeze
- *"Where was the lake? What happened to that lake? He feels outside himself, or in another landscape. What if I don't find my tent? Idiot. Another bog. Staring at it, wondering if it is only a dream. A nightmare. Get hold of yourself. What's up with all the negativity? In one hour you're going to be wandering in the dark. And it could get cold. It could get very cold. You could freeze to death. Suddenly he's claustrophobic, barely able to breath, tears rim his eyes, vision blurs, he feels disoriented. He feels the panic he kept at bay for the last two hours starting to rise, he feels his temples pound. He can't believe anything.*

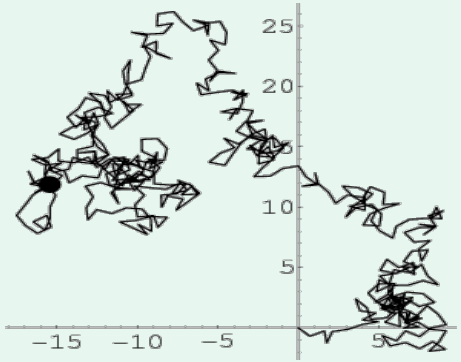
Symptoms of Dissociation[44]

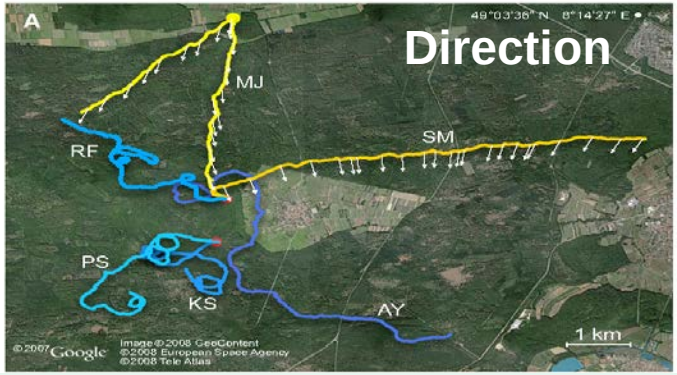
• Out-of-body experience • Feels like you are a different person • Emotionally numb or detached • Altered sense of time • Cannot remember how you got someplace • Hear voices • Intense flashbacks • Feels like going crazy	• Feel little or no pain • Tunnel vision • Become immobile • Become light-headed • Head feels full • Feel your heart pounding • Tingling

Derived from *Lost in the Wild* by Griffith. Used with permission.

Lost Person Strategies

Random

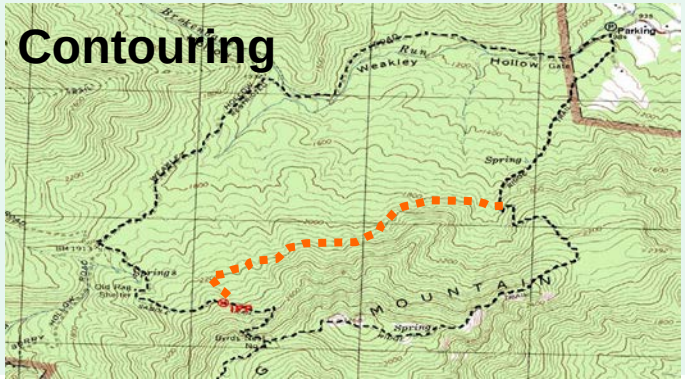


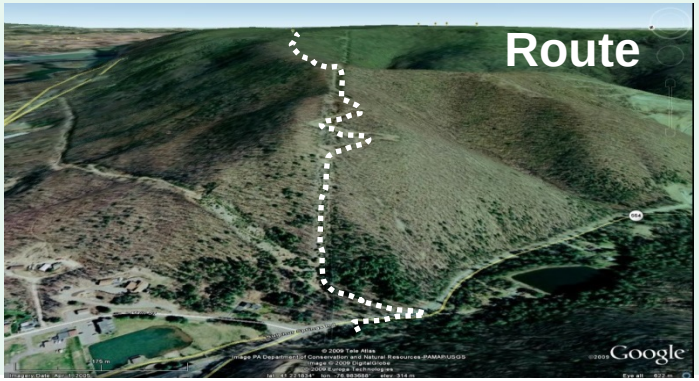


Others

- Backtracking
- Landmark
- Folk Wisdom
- View +/Cell
- Downhill
- Beacon
- Staying Put

Contouring



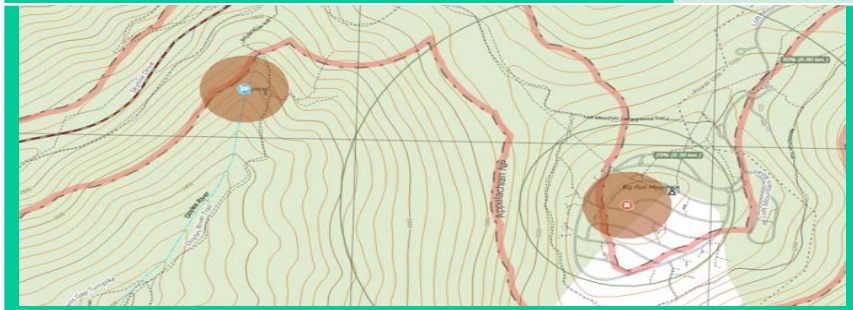


Point Model

Requirements

IPP, Destination

Advantages	Disadvantages
Easy to apply. No base map needed. High scores on MapScore. Easy to calculate Pden for each circle around IPP or destination. Usually high Pden value. Prioritizes searching around IPP and destination.	Doesn't take local terrain and vegetation into consideration. 100 meter somewhat arbitrary, no actual barrier. Destination often not recorded or available.



	ASD	TD Child
IPP	4%	13%
Destination	NA	11%

How to use

1) Plot IPP and destination (if available) onto map. 2) Draw a circle with 100 meter radius. 3) Look at table for percentage found within circle. 4) Prioritize the IPP and destination for search tasks.

When 2nd Edition Available?

- Good question
- 8 Chapters written
- 4 new chapters
  - Scenario Analysis
  - Lost Person Responses
  - Reflex tasking
- To do
  - ISRID data collection, 15 providers pending, estimate 30,000+
  - Clean data, ingest
  - Generate statistics
  - Update & new subject categories

Thank – You

Questions?
Got Data?

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