An Analysis of Missing Dementia in Urban Environment

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Table of Contents

List of Figures

List of Tables

Project Summary

Abstract

The search for persons with Dementia who have gone missing in an urban area is one of the more demanding tasks for SAR teams. Every year, members of the eighty-three Search and Rescue teams in the Province of British Columbia are asked by the local police to search for someone's parent or spouse who has wandered away from the safety of their home or care facility.

These missing people have no travel plans or destination or at least not that is discernible to the outside observer. There is also the possibility of them having taken public transit and not be in the search area at all. In these cases, the time it takes to locate them is often critical to their survival – "*People with Alzheimer's disease have a 50% chance of being injured or dying from exposure, hypothermia, or drowning if they are not found within 12 hours*."[1] Given the changeable weather patterns in B.C., if we can determine high probability areas in which to search, it may increase the likelihood of a successful outcome. A statistical model of how far and in what direction a person suffering from dementia is likely to travel might not only potentially save lives, but may also decrease the amount of time and resources committed to these types of searches.

The purpose of this analysis is to see if the data set forth by Robert J. Koester and others is applicable to a search for a missing dementia person in a West Coast Canadian urban environment.

Background

The SAR Manager's text of reference for searches of all types of missing persons is "Lost Person Behavior – A Search and Rescue Guide on Where to Look – for Land, Air and Water" by Robert J. Koester. Koester has created the International Search and Rescue Incident Database (ISRID) containing data on over 50,000 SAR incidents worldwide. The number of incidents involving dementia subjects in an urban setting is 336. In BC, on average, Surrey SAR does more searches for missing dementia persons than any SAR Team in the province. Surrey SAR maintains a database of all searches in their area for the past 12 years containing the type of search, the Place Last Seen (PLS) location and the found location.

Table 1 – ISRID table of statistical distance travelled by the subject from the IPP.

Dementia **Distance (Horizontal) from the IPP (kilometres)**					
	Temperate		**Dry**		**Urban**
	Mtn	Flat	Mtn	Flat	
n	**95**	**175**	**14**	**15**	**336**
25%	0.3	0.3	1.0	0.5	0.3
50%	0.8	1.0	1.9	1.6	1.1
75%	1.9	2.4	3.1	3.6	3.2
95%	8.3	12.8	6.1	11.8	12.6

The goal in Search and Rescue obviously is to find the lost/missing person. Current SAR Management theory starts the search with the PLS. From this point we establish the Initial Planning Point (IPP) which is generally the same location as the PLS. With information such as physical capabilities, mental health, previous history, terrain etc., a SAR Manager will create search areas and assign a Probability of Area (POA) to the search area. POA is a number that postulates the likelihood of a subject being in a given

area. Given the absence of clues, the POA is a statistically sound method of "where to search next".

Summary of methods

In order to proceed with this analysis, information on past searches was required. Contact was made with several of the Search and Rescue groups within Metropolitan Vancouver and teams were requested to send Task Reports on searches for missing dementia subjects for as far back in time as possible.

Three SAR Groups were able to supply data – Ridge Meadows SAR, Coquitlam SAR, and Surrey SAR. Once received, the data needed to be looked at to determine applicability to the project. Some searches were for elderly subjects who were not suffering from dementia, some searches were for subjects suffering from depression. Out of two hundred and seventy-five SAR incidents from the three SAR groups over a period of twelve years (2001 to 2012), fifty-one cases involving missing Dementia persons were suitable to be used for the analysis.
This data came in the form of excel spreadsheets or handwritten notes. A spreadsheet was written to contain all the pertinent data; file number, date missing, date found, place last seen, place found, gender, and weather. Some of the data was in Geographic Coordinates while some were in Projected Coordinates (UTM). As part of the analysis was to determine how far these subjects travel, all data was converted to UTM. Vector data for roads and waterways was acquired as well as raster elevation data.

A base layer was created using the vector and raster data. PLS and Found locations were then added as layers. This data was then clipped to define the area of interest.

Distance and direction travelled was calculated between the PLA and Found locations as well as Elevation data which were extracted from the raster layer for each location. From the aggregation of direction travelled information, a Mean direction of travel was determined for all the data points.

A five number summary statistic was calculated to produce that first quartile, median, third quartile and maximum numbers for the distance travelled data. This summary was then used to calculate the standard deviation as well as the median.

Deliverables

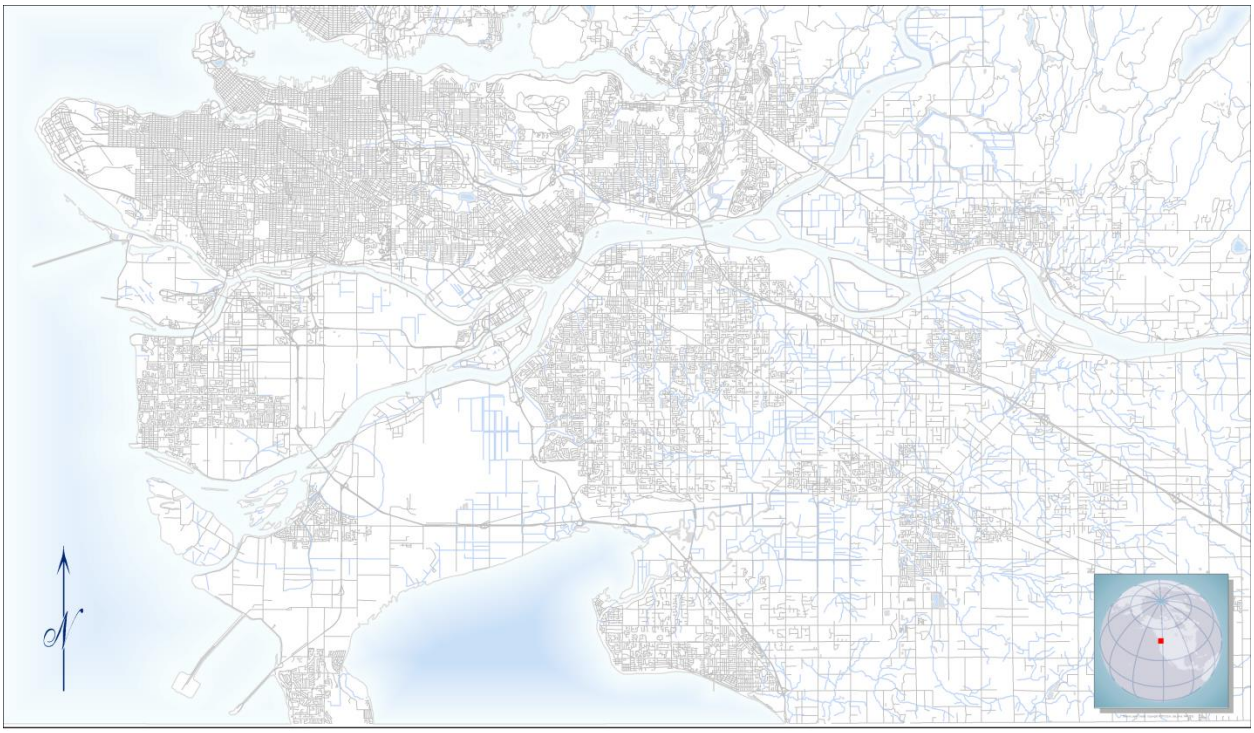
- Project report
- Map of the area of interest showing PLS and Found locations as well as direction of travel and Mean direction
- Table showing the twenty-five, fifty, seventy-five and ninety-five percentiles of distance travelled
- Table showing the twenty-five, fifty, seventy-five and ninety-five percentiles of direction travelled
- Chart comparison of weather and season

Methodology

Study Area

The area of study for this project was Metropolitan Vancouver, British Columbia on the west coast of Canada. In 2001 the total population of Metro Vancouver was 1,986,975 and the population of people 65 years and older was 242,495. By 2011 those numbers had increased to 2,313,330 and 312, 905 respectively.

Figure 1.



Study Area: Metropolitan Vancouver, British Columbia

0 2.5 5 10 15 20

Kilometers

Data

For this project the data that was acquired was from the NTS 50k series database:

- Road Layers:
  - 092g01_road_l, 092g02_ road_l, 092g03_ road_l, 092g06_ road_l, 092g07_ road_l, 092g08_ road_l
- Water Body Layers:
  - 092g01_water_b_a, 092g02_ water_b_a, 092g03_ water_b_a, 092g06_ water_b_a, 092g07_ water_b_a, 092g08_ water_b_a
- Water Course Layers:
  - 092g01_ water_c_l, 092g02_ water_c_l, 092g03_ water_c_l, 092g06_ water_c_l, 092g07_ water_c_l, 092g08_water_c_l
- Raster Data Layers:
  - 092g01_0102_deme, 092g01_0102_demw,
  - 092g02_0102_deme, 092g02_0102_demw,
  - 092g03_e, 092g03_w,
  - 092g06_e, 092g06_w,
  - 092g07_0100_deme, 092g07_0100_demw ,
  - 092g08_0100_deme, 092g08_0100_demw

Preprocessing

Create a new file geodatabase called “Search Data”. `

Merge road segments in to one dataset.

Merge waterlines in to one dataset.

Merge water bodies in to one dataset.

Create a mosaic dataset of the raster data using the “Mosaic” tool from the Data Management>Raster>Raster Dataset toolset.

Compile the raster datasets in to a new raster dataset using the "Mosaic to New Raster" tool in the Data Management>Raster>Raster Dataset toolset.

Create an "Area of Interest" polygon to define an area larger than just the limits of the PLS and Found data points. This was done to not only create an aesthetically pleasing map but to allow for future data points that may fall outside the existing data limits.

Clip the vector data layers to the extent of the "Area of Interest" polygon using the "Clip" tool from the Analysis>Extract toolset.

Clip the raster data layers to the extent of the "Area of Interest" polygon using the "Clip" tool from the Data Management>Raster Processing toolset.

From the data points for PLS and Found locations, create a point feature layer using the "Make an X, Y Event Layer" tool from the Data Management>Layers and Table Views toolset and save as a layer file.

Use the "Extract Values to Points" tool in the Spatial Analyst Tools>Extraction toolset to extract to elevation values of the PLS and Found locations from the Raster layer. These will be used to determine the change in elevation from PLS to Found locations.

Analysis

Calculate the distance travelled between the PLS and Found locations using "XY To Line" tool from the Data Management>Features toolset.

Calculate the direction travelled between the PLS and Found location.

Calculate the Mean direction of travel of all distances travelled using the "Linear Directional Mean" tool from the Spatial Statistics Tools>Measuring Geographic Distributions toolset.

Using the statistics function of the Search Data table for the TravelDist field, the five number summary was calculated.

Join the PLS and Found tables and add a new field "ElevDiff" and calculate the difference in elevation between PLS and Found location.

Results

The goal of this project was to determine if the data collected by Robert Koester was applicable to searches in the urban environment of the West Coast of British Columbia.

After analyzing the data, it seems that of the 51 cases, the mean distance travelled was 4.33 km with the shortest distance travelled 0 km and the furthest distance travelled 38.91 km. 25% of the subjects were located within 0.46 km of the PLS, 50% of the subjects were located within 1.49 km of the PLS, and 75% were located within 4.07 km of the PLS.

Figure 2.

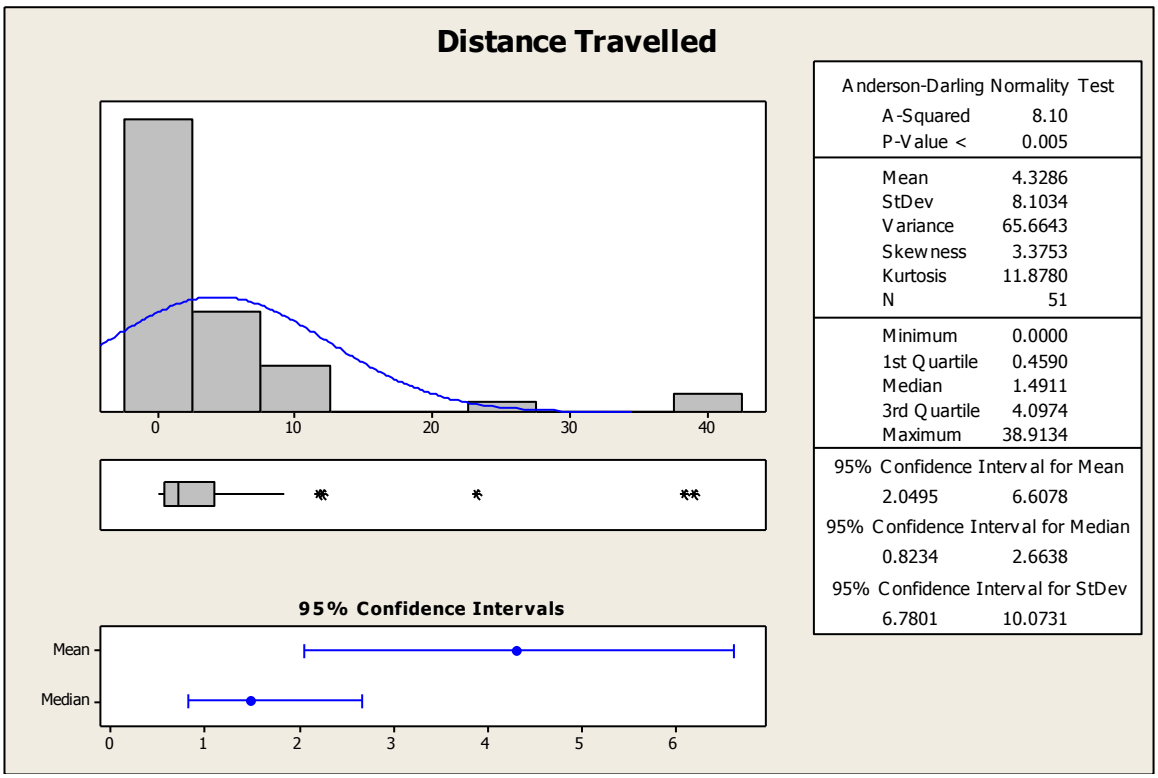
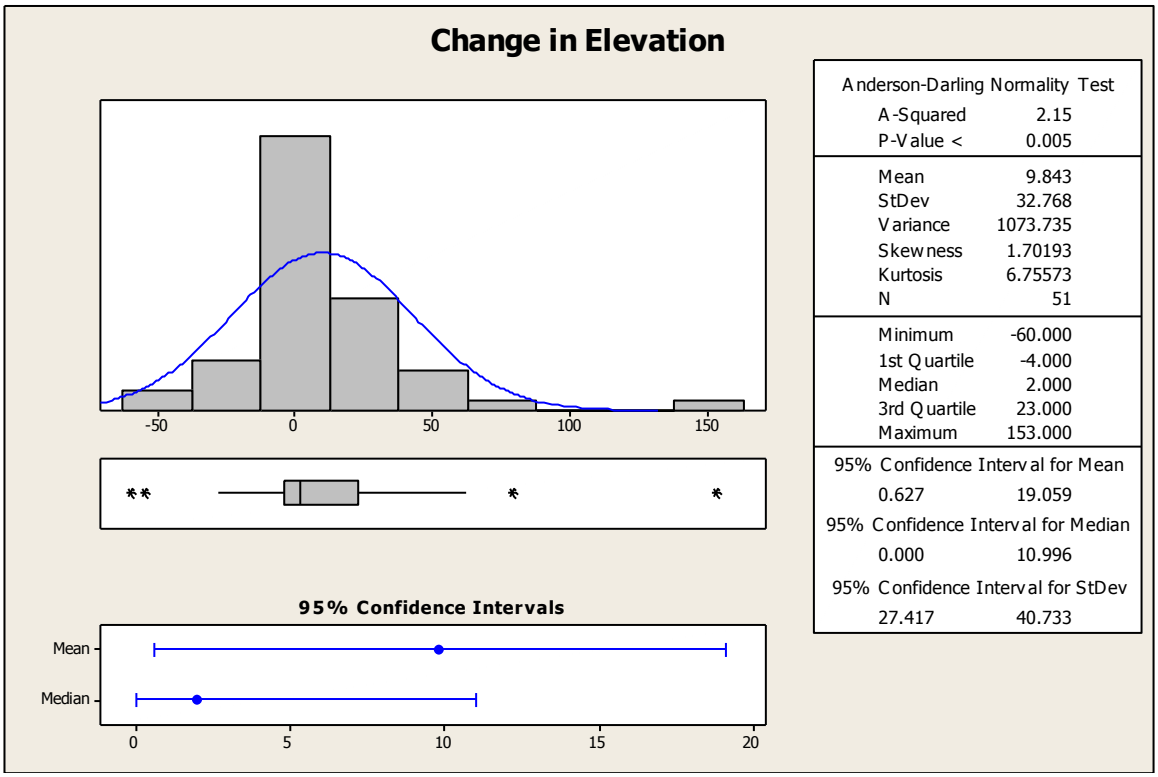


Figure 3.



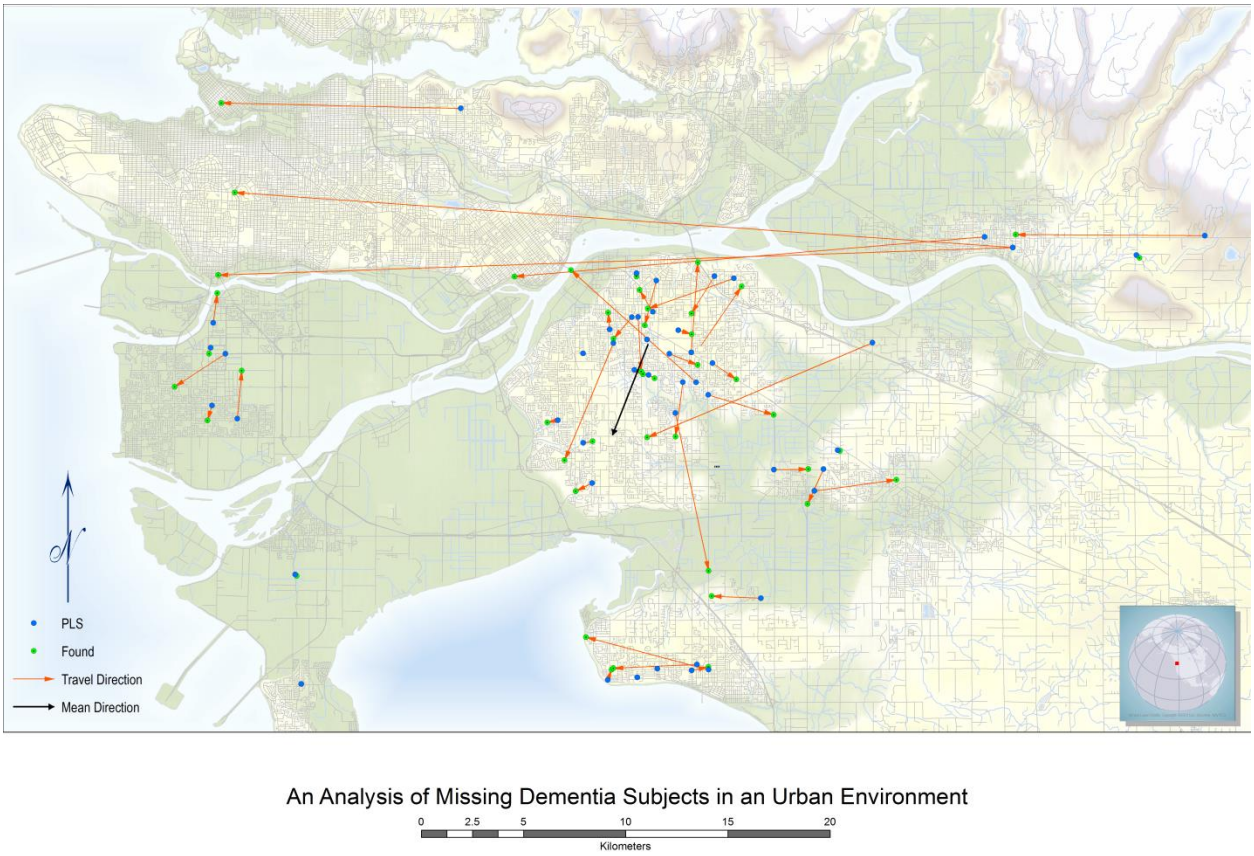
Calculating the change in elevation from PLS to Found location, , the mean change in elevation was 2 meters with the lowest change in elevation of -60 meters lost and the greatest change in elevation was 153 meters gained. 25% of the subjects were located with a change of -4 meters from the PLS, 50% of the subjects were located with a change of 2 meters from the PLS, and 75% were located with a change of 23 meters from the PLS.

Comparing the data, it appears that while there are similarities between the two sets of data, 95% of subjects on the West Coast travel approximately one-half the distance overall than do the subjects contained in the ISRID database.

Table 2.

	25%	50%	75%	95%
ISRID Distance	0.3 km	1.1 km	3.2 km	12.6 km
BC Distance	.46 km	1.49 km	4.1 km	6.61 km
ISRID Elevation	No data	No data	No data	No data
BC Elevation	-4 meters	2 meters	23 meters	19.06 meters

Figure 4.



Discussion

Acquiring useable data from the SAR groups proved to be more difficult than anticipated at the start of the project. Some teams had incomplete records. Often times the Found location was not written in the notes other than referring to a general location. This would entail researching each file with the SAR Manager and pouring

over maps to determine the exact Found location and noting the coordinates. Existing forms for collecting data do not reflect what is required to make a more detailed analysis of these types of searches. Other information that was not readily available in all cases was what level and type of dementia the subject was diagnosed with. Whether or not this would have a bearing on how the subject behaves when missing is unknown.

Recommendations for Future Work

A survey of all the SAR teams in BC would require a great deal of time and effort to accumulate all the data, but would be beneficial to determine if there are differences in travel patterns in the various regions of the province or even if there is a difference in the proportion of missing dementia subjects for each of the regions. As the reports are filled out by volunteer members, it is difficult to ask them to do more paperwork but a more complete database may, in the long term, help to shorten the hours spent on searching for this particular category of missing person.

Data:

a) Missing person data collected from Surrey SAR, Coquitlam SAR and Ridge Meadows SAR
b) Vector data downloaded from Natural Resources Canada website: http://geogratis.ca/geogratis/en/index.html
c) Raster data downloaded from the Geobase website: http://www.geobase.ca/geobase/en/index.html
d) Census data from BC Stats: http://www.bcstats.gov.bc.ca/Home.aspx

References

Lost Person Behavior; a search and rescue guide on where to look for land, air and water/Robert J. Koester. Published by dbS Productions ISBN 978-1-879471-39-9

Urban Search: Managing Missing Person Searches in the Urban Environment/Christopher S. Young & John Wehbring. Published by dbS Productions ISBN 978-1-879471-38-5

Surrey Search and Rescue, Don Burgess SAR Manager

Coquitlam Search and Rescue: Dwight Yokim SAR Manager

Digital Elevation Model: geobase.ca

Vector data: Geogratis.ca

The Alzheimer Society of Canada: Alzheimer.ca

BC Stats: bcstats.gov.bc.ca/Home.aspx