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CRADLE COAST CAT TRACKER PROJECT

Public report: August 2021

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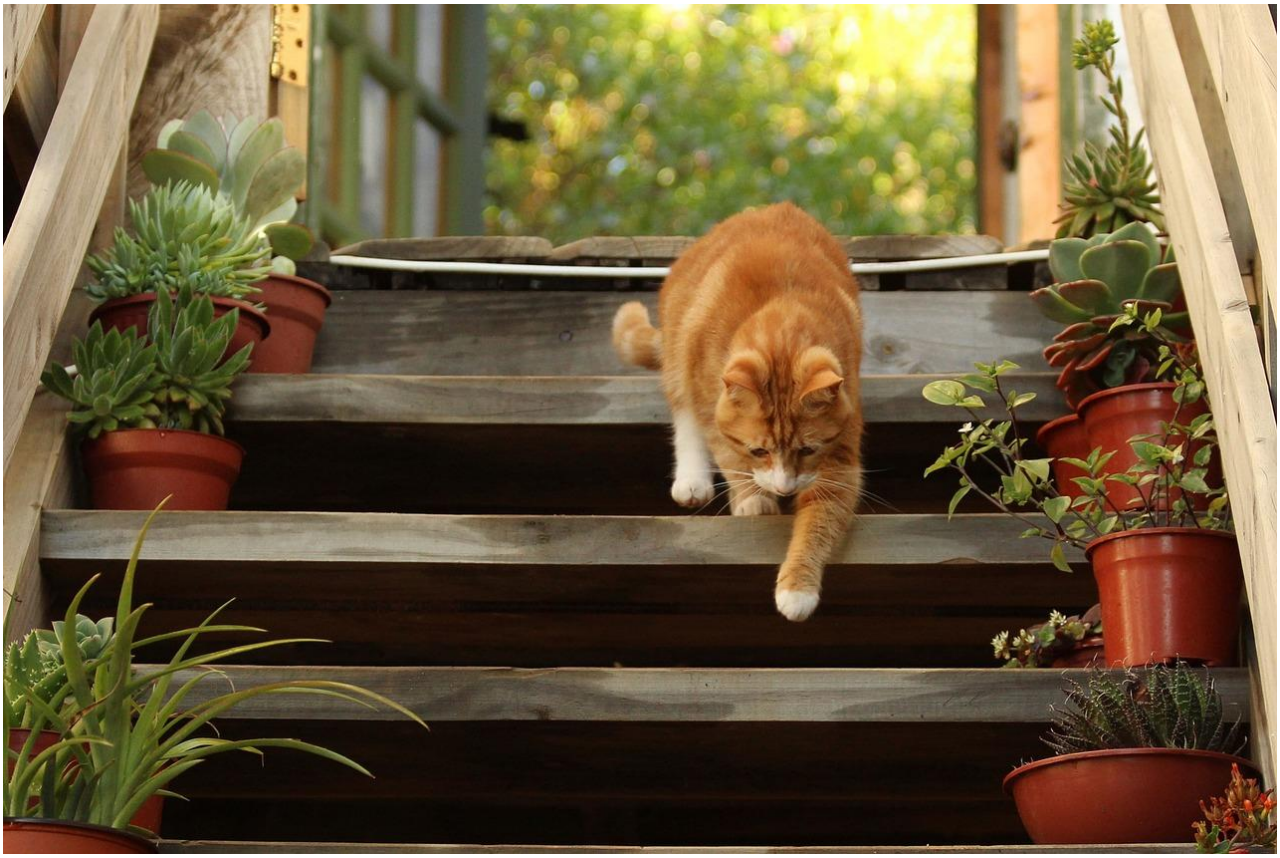
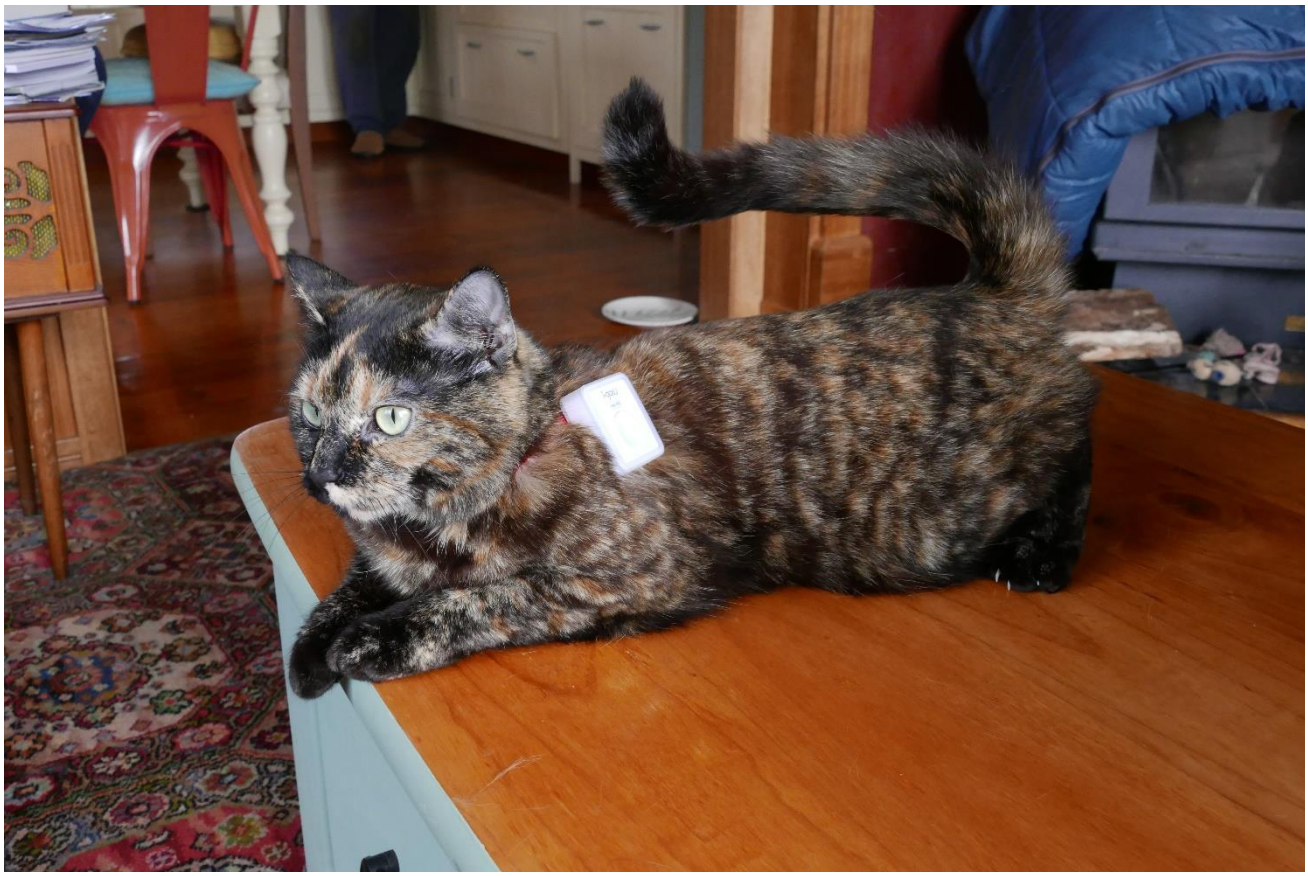


Thank you to all the fantastic volunteers who have participated in this project. It couldn't have happened without you or your lovely cats.



This project was a partnership between Cradle Coast Authority and the Department of Primary Industries, Parks, Water and Environment.

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Research approvals

This research was approved by the Tasmania Social Sciences Human Research Ethics Committee (project number 20261) and the Department of Primary Industries, Parks, Water and Environment Animal Ethics Committee (project number 15/2019-20).

SUMMARY

Cats that are allowed to roam freely encounter more dangers than cats that are kept at home. Roaming cats run the risk of car accidents, dog attacks, cat fights and disease transmission from other cats or wildlife. The knowledge of where their cat roams has previously not been available to cat owners. However, this knowledge is a key piece of information that owners require to be able to make informed decisions about the welfare of their cat. The aim of this project was to assess the home ranges of domestic cats in a peri-urban environment like the Cradle Coast region.

This was a pilot project to test the success of the tracking equipment and the sample size was limited to 20 cats. Eleven cats were successfully tracked for seven days using a light-weight GPS tracker attached to a harness fitted with break-away safety clips. The other nine cats either refused to wear the harness or lost their harness during the tracking period. While this is a small sample size it does provide us with an important insight into the home ranges of cats living in peri-urban areas.

The size of the home ranges of the 11 cats varied from 0.2 to 7 hectares, with a median size of 1.4 hectares. Cats from rural areas tended to have larger home ranges compared to cats from urban and urban-edge environments. For every cat we counted the number of properties that were covered by their home range. The median number of properties visited were 12.5, 15 and 4.5 properties for urban, urban-edge and rural cats. As expected, rural cats crossed fewer roads per day than urban and urban-edge cats, which is most likely because they have fewer roads in their home range (1, 3, and 3 respectively).

This project shows that cats in the Cradle Coast region regularly roam away from their owner's property visiting numerous neighbours and crossing approximately 3 roads a day. We hope that providing cat owners with information on how far the average cat roams and what potential dangers they may encounter will help them make informed decisions about their cat's safety and care.

INTRODUCTION

Cats play an important role in the lives of many people. They provide great companionship and affection and several studies have shown that owning a cat can improve both your mental and physical health. Cats are the second most popular pet in Australia after dogs. Approximately one in four households owns a cat and a lot of households own more than one. It is estimated that there are 3.9 million domestic cats in Australia (Animal Medicines Australia 2019).

Often we think of cats as highly independent and sometimes aloof animals. Although cats can be very social animals, they like to have these interactions on their own terms and often for only short periods of time. This means that a lot of the time they are out of sight, going about their own business. This has left many cat owners to wonder where their cat goes when they are not with them, especially if the cat has free access to the outdoors.

Cats that are allowed to roam freely encounter more dangers than cats that are kept at home. Roaming cats run the risk of car accidents, dog attacks, cat fights and disease transmission from other cats or wildlife. Additionally, roaming cats can become a nuisance to neighbours if they frequently visit their property, or they could be a threat to local wildlife if they enter nearby bushlands or reserves. The knowledge of where their cat roams has previously not been available to cat owners. However, this knowledge is a key piece of information that owners require to be able to make informed decisions about the welfare of their cat.

Previous studies in South Australia and New Zealand have tracked the movements of 428 and 209 cats (Roetman *et al*. 2017, Kikillus *et al*. 2017). The cats that were tracked in these studies mainly lived in a dense urban environment, which consisted of small fenced-off housing blocks interspersed with many roads. However, the environment of the Cradle Coast region of Tasmania is more rural and peri-urban, with settlements ranging in size from small rural localities to regional towns. Cats living in these areas are likely to encounter fewer and quieter roads, larger properties and will often have access to open agricultural land or neighbouring bushland. This reduction in obstacles could result in cats from peri-urban areas travelling further from home than urban cats.

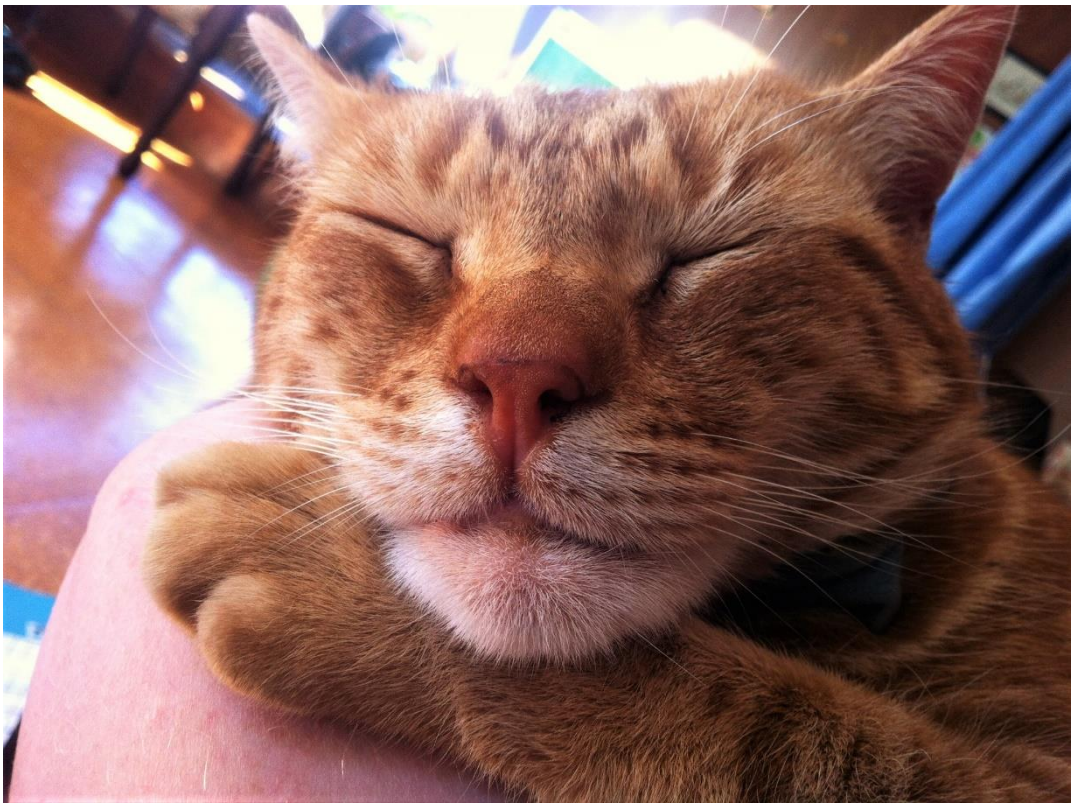
The aim of this project was to assess the home ranges of domestic cats in a peri-urban environment like the Cradle Coast region. The home range of an animal is the area which it uses on a regular basis; the area it lives in as well as the places it normally travels to for food and shelter. A home range doesn't include the occasional exploratory trips an animal might make to look for new food sources or a partner. This was a pilot project to test the success of the tracking equipment and the sample size was limited to 20 cats.

METHODS

Volunteer recruitment

Cat owners living in the Cradle Coast region of Tasmania could volunteer themselves, and their cats, for the project by completing an online questionnaire. All human participants were required to be 18 years or older and own a cat that was allowed to roam at least part of the day. Twenty-six people volunteered their cat, and 20 cat owners were selected to participate, based on their availability during the tracking period.

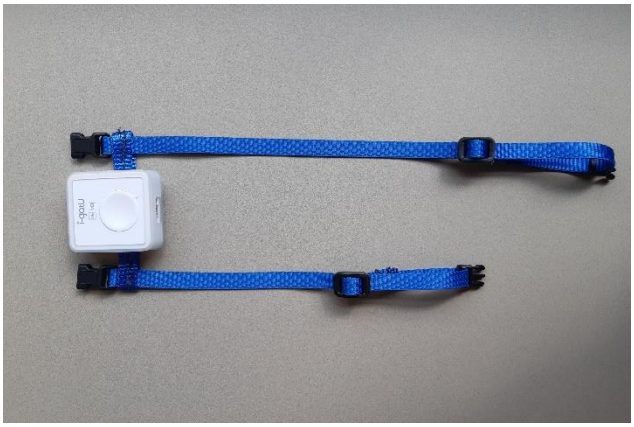
The participants were spread across the region, from Queenstown in the south-west to Squeaking Point in the north-east. The habitat the cats lived in reflected the variety in the region. Four cats were from urban areas, nine cats lived on the urban edge immediately adjacent to forests or agricultural land and seven cats lived in rural landscapes on large properties. The participating cats were an even mix of males and females and all the cats were desexed. The ages of the cats varied from one to 15+ years, with an average age of seven years.



Cat tracking

Cats were tracked using a light-weight GPS tracker (i-gotU GT-600) attached to a harness fitted with break-away safety clips. The GPS trackers weighed 39g and were the size of a matchbox. We posted the harness and GPS trackers to the participants, who then fitted the harness to their cat.

The GPS trackers were pre-programmed to start tracking two days after the harness was fitted to the cat. This gave the cats time to get accustomed to wearing the harness, as most of the cats had never worn one before. The GPS trackers were programmed to record the location of the cat every three minutes for seven days. The tracking of the cats happened over two periods, 3 to 10 December 2020 and 14 to 21 January 2021. Ten cats were randomly assigned to each tracking period. After the seven-day tracking period the owners removed the harness from their cat and posted the harness and GPS tracker back to us.



Harness and GPS tracker

Cat wearing the harness and GPS tracker

Data analysis

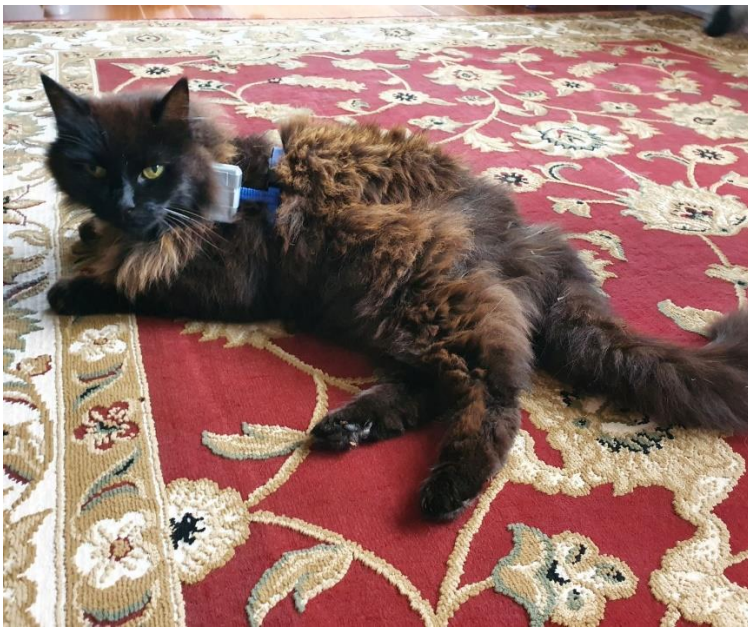
GPS trackers are most accurate when they have a clear view of the sky and they can easily connect to multiple satellites. Accuracy of the location data declines when the GPS tracker is under dense vegetation or inside a building. The i-gotU GPS trackers come with optimisation software that removes locations with an inaccuracy of more then 10m. The optimised data was then uploaded to Movebank (www.movebank.com), an online platform for storing animal tracking data, to conduct a manual check and apply a speed filter.

We used an online platform called ZoaTrack (www.zoatrack.org) to calculate home ranges. ZoaTrack uses the statistical software 'R' and the adehabitatHR package to calculate home ranges (Calenge 2006).

We used statistical analyses to compare the results between male and female cats, as well as night and daytime activity. However, the sample size was too small to use statistical analysis to compare the results among cats living in the three different residential settings.

RESULTS

Twenty cats were fitted with a harness, but two cats did not want to wear it and we advised the owners to remove the harness early. Of the 18 remaining cats, 11 retained the harness for at least six days and seven cats lost the harness and it could not be located again. The harnesses were fitted with break-away safety clips to make sure the cats could pull themselves free if the harness got caught on a branch or fence. Unfortunately, the clips were too easily pulled open and we lost 39% of the trackers.



Home range

There are many methods available for calculating animal home ranges, but one of the original methods is still commonly used: the Minimum Convex Polygon (MCP) method (Mohr 1947). Simply described, this method involves drawing the smallest possible shape (a polygon) around all the locations where an individual animal has been recorded. The area of the polygon represents the animal's home range and is usually reported in hectares.

One hectare is equal to 100 meters by 100 meters, or 10,000 square meters. One hectare is roughly equivalent to:

- Eight Olympic-sized swimming pools (these pools are typically 50 meters long and 25 meters wide)

As a comparison, the Burnie West Park Oval is approximately 1.6 hectares.

The online software allowed us to create 95% MCPs, which include areas where an animal spends 95% of its time and excludes extreme points that may not be part of an animal's typical range.

A minimum of five days of tracking data is required to accurately calculate the home range of a domestic cat (Roetman *et al*. 2017). We had 11 animals with a minimum of five days of tracking data.

The size of the home ranges (95% MCP) of the 11 cats varied from 0.2 to 7 hectares, with an average size of 1.8 hectares. However, an average is not always the best statistic to use as it can be skewed when a few data points are very different to the bulk of the data. The median can be a better representation as it represents the mid-point in the data. Half of the home ranges are smaller than the median, and the other half are bigger than the median. The median home range size was 1.4 hectares, slightly smaller than the average.

With 7 hectares Ollie had the largest home range. His home range was three times larger than the home range of any other cat in the project. Meika had the smallest home range at 0.2 hectares. Two maps showing the movements of Meika and Ollie can be seen below. The rest of the maps can be viewed in Appendix 1.

Name	Sex	Home range size (ha)	Number of properties in home range	Maximum distance from home (m)	Residential setting
Ally	Female	0.5	10	102	Urban
Billy	Male	1.4	15	185	Urban
Jax	Male	1.4	15	150	Urban
Meika	Female	0.2	3	100	Urban
Alabasta*	Female	1.7	15	175	Urban edge
Harry	Male	1.3	12	116	Urban edge
Tabs	Female	1.2	16	235	Urban edge
B	Female	1.7	4	180	Rural
Ollie	Male	7.0	5	300	Rural
Riley	Male	2.4	7	367	Rural
Wilbur	Male	1.0	2	127	Rural

*Full name: Dr Alabasta Rastus Boo Sausage "Panthor of Justice" Fitzpatrick MD QC (ret).

Male and female

We compared the home ranges between male and female cats using a statistical test (Mann-Whitney U test), but they were not significantly different. All the cats participating in the project were desexed, hence desexing status did not influence the results.

Residential setting

The 11 cats that that were tracked during the project came from a variety of residential settings. To compare their movements, we have assigned each cat to one of the following categories:

- Urban: The property is completely surrounded by urban development that consists mainly of smaller house blocks.
- Urban-edge: One side of the property borders urban development, while the other side borders either agricultural land or bushland.
- Rural: A large property with relatively few neighbouring properties, either completely surrounded by agricultural properties or bushland.

Cats from rural areas tended to have larger home ranges compared to cats from urban-edge or urban environments.

Residential setting	Average home range (ha)	Median home range (ha)
Urban	0.9	1.0
Urban-edge	1.4	1.3
Rural	3.0	2.1

Map of Ollie's movements

Map of Meika's movements

Daytime versus night-time movements

We separated the tracking data in daytime and night-time datasets based on the times of first and last light during the period the cats were tracked. We then calculated daytime and night-time home ranges. Nine of the 11 cats that were tracked were free to roam 24 hours a day, while two cats were kept indoors at night only. To compare daytime and night-time home ranges we only used the data of the nine cats that were free to roam 24 hours a day. We found that seven of the nine cats (78%) had a larger home range during the night, while two cats (22%) had a larger home range during the day. However, a statistical test (Wilcoxon Signed Rank Test) showed that the size of the night-time home ranges was not significantly different from the size of the daytime home ranges. While the data showed a trend that the cats in the project had larger night-time home ranges, the sample size is too small to determine this with certainty.

Home range	Minimum-maximum (ha)	Average (ha)	Median (ha)
Daytime	0.2 – 2.2	0.9	0.5
Night-time	0.1 – 6.8	1.6	1.2

Two cats were reported to be contained at home during the night. We looked at the movements of both these cats during the night over the seven days of tracking. Both cats showed activity outside of the house with home ranges of 0.1 and 0.5 hectares. These home ranges were smaller than their daytime home ranges, however, they clearly show that both cats were not effectively contained to the property at night.

Properties visited

The number of properties a cat regularly visits is not only related to the size of their home range, but it also depends on the residential setting they live in. Cats that live in dense urban areas, consisting of small house blocks, have the ability to visit more properties in a day compared to cats that live on the urban edge or in rural areas.

For every cat we counted the number of properties that were covered by their home range. The median number of properties visited were 12.5, 15 and 4.5 properties for urban, urban-edge and rural cats. As expected, rural cats visited fewer properties, but the number of properties will be highly dependent on the size of the farms. The larger the farms, the fewer properties the cat will visit.

Maximum distance from home

Rural cats are generally surrounded by large open spaces, such as fields, paddocks or bushland and are not confined by busy roads. Because of the difference in habitat we would expect rural cats to travel further away from their home compared to urban or even urban-edge cats.

The two cats with the shortest maximum distance travelled were two urban cats, Meika and Ally, who stayed within 100 and 102 metres from their homes, respectively. The two cats with the largest maximum distance from home were both rural cats. Reilly travelled up to 367 metres from his home while Ollie travelled 300 metres. While the four extremes followed our prediction, the remaining cats did not follow a set pattern and travelled any distance between 116 and 235 metres.

Roads crossed

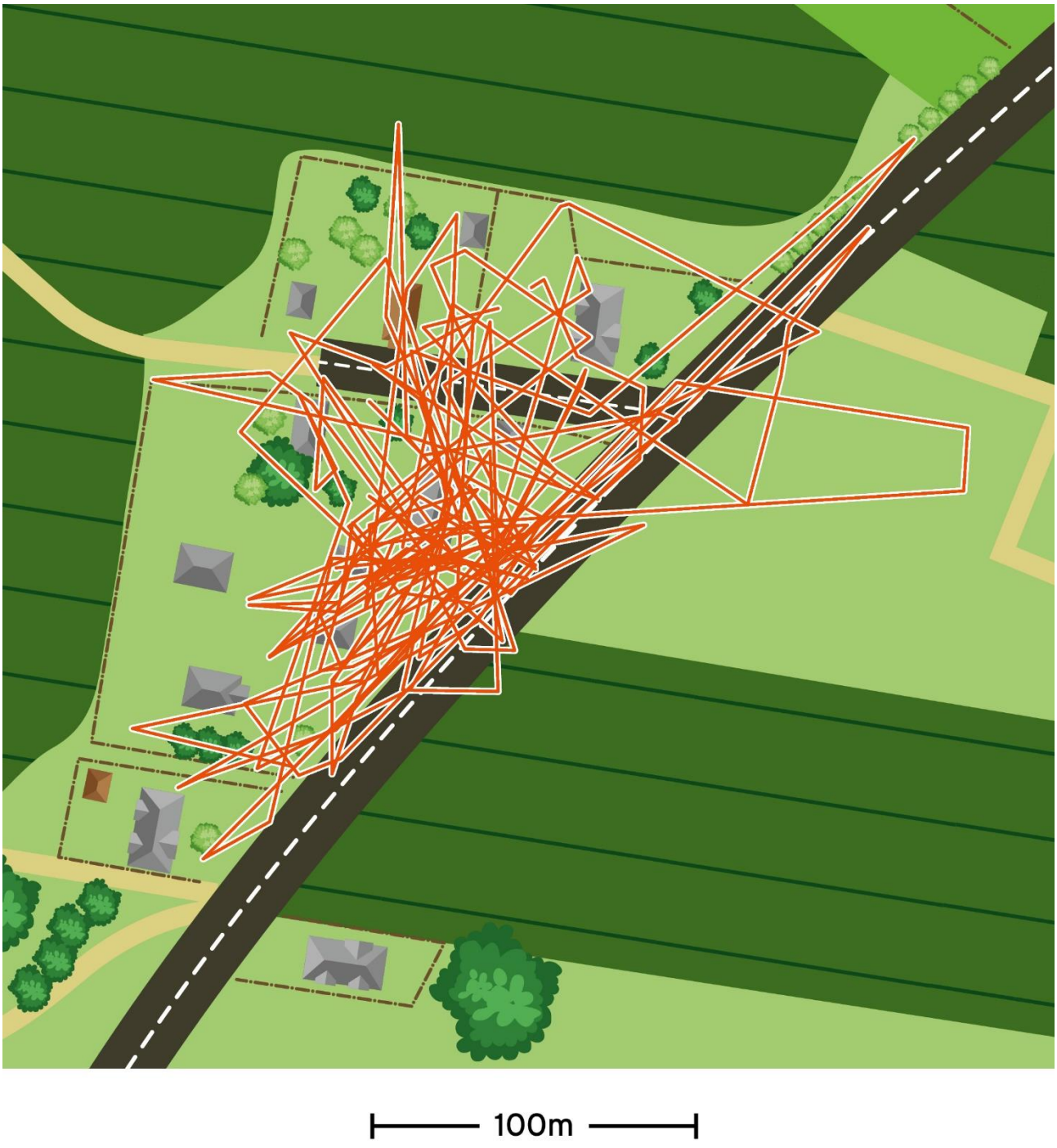
The number of roads a cat crosses every day can be extremely variable and will depend on the number of roads present in their home range and potentially the amount of traffic that uses the road. Heavy traffic could deter a cat from crossing the road regularly.

We counted the number of roads crossed per day for each cat.

Urban setting	Minimum-maximum number of roads	Average number of roads	Median number of roads
Urban	0 – 13	3.0	3
Urban-edge	0 – 13	4.0	3
Rural	0 – 8	2.2	1

As expected, rural cats crossed fewer roads, which is most likely because they have fewer roads in their home range. Two of the rural cats, B and Wilbur, didn't cross any roads during the time they were tracked. One of the rural cats, Reilly, lives next to a country road, which is a major artery through the region. While he doesn't cross the road very often, he spends a lot of time walking up and down the road to travel through his home range.

Map of Riley's movements



CONCLUSION

The project was designed to study the movements of domestic cats in peri-urban areas without impacting on the health and safety of the cats. We designed the harnesses to include break-away safety clips, but unfortunately 39% of the cats lost their harness. This is not uncommon behaviour for cats. A previous study examining the effectiveness of different collar types over a six-month period found that 64% of the cats managed to lose their collar with break-away safety clips at least once during the study period (Lord et al 2010). As a result, we ended up with a sample size of 11 cats. While this is a small sample size it does provide us with an important insight into the home ranges of cats living in peri-urban areas.

The average home range of the cats tracked in this project was 1.8 hectares, with a median home range of 1.4 hectares. Similar studies have been conducted in South Australia and New Zealand (Kikillus et al 2017, Roetman et al. 2017). The cats in the South Australian study had an average home range of 1.99 hectares and a median of 1.042 hectares, while New Zealand cats had an average home range of 3.28 hectares and a median of 1.3 hectares. The average home range of New Zealand cats was far larger than the median because of the inclusion of a few adventurous cats. Their most mobile cat roamed over a home range of 213 hectares! Our median home range is comparable to New Zealand cats and slightly larger than that of the cats in the South Australian study. The South Australian study was conducted in Adelaide and included mostly urban cats. The movements of cats living in dense urban areas such as Adelaide could be severely restricted by the presence of numerous high-traffic roads and obstacles such as garden fences and neighbouring dogs.

When we compared the home ranges of urban and rural cats in our project, we found that rural cats had larger home ranges. This supports the idea that the movement of cats might be restricted by their environment. Rural cats will experience fewer roads, quieter roads and fewer obstacles such as garden fences. Our findings are confirmed by an American study which looked at home ranges of domestic cats across six locations world-wide, including South Australia and New Zealand, and found that rural cats on average had home ranges that were 1.6 times larger than those of urban cats (Kays *et al*. 2020).

We separated our cats into two groups based on the size of their home ranges: sedentary and wandering cats. Based on previous research sedentary cats have a home range of one hectare or less and wandering cats have a home range larger than one hectare (Meek 2003). Three cats were classified as sedentary and eight as wandering cats. Our study had proportionally more wandering cats than South Australia and New Zealand, where the division appeared to be roughly equal. One of the reasons we might have more wandering cats in the study is because our study included more urban-edge and rural cats whose movements are potentially less restricted by busy roads and other obstacles.

Overall, cats in peri-urban areas appeared to have a larger home range compared to cats in urban areas. This is true within our study as well as across studies in other areas. However, every cat in the project crossed multiple roads a day and visited several neighbouring properties on a regular basis. Because of their freedom of movement roaming cats have a higher risk of encountering dangers such as other cats, dogs, cars and household poisons such as slug repellent and rat poison. This might be a more common occurrence than many cat owners realise. A nation-wide survey conducted in 2019 interviewed 5385 cat owners about their past and present cats (Elliott *et al.* 2019). A total of 66.3% of cat owners mentioned

that they had lost at least one previously owned cat to incidents related to an outdoor lifestyle. Car accidents were identified as the leading cause of death, but many cats just never returned home, and their owners do not know what happened to them.

We hope that providing cat owners with information on how far the average cat roams and what potential dangers they may encounter will help them make informed decisions about the care and welfare of their cats.

ACKNOWLEDGEMENTS

We would like to thank Dr Philip Roetman from ***Cat Tracker*** South Australia and Dr Heidy Kikillus and Dr Lisa Woods from ***Cat Tracker*** New Zealand for their advice and sharing of resources regarding project design and data analysis.

We again would like to thank all of the people that volunteered their cats for this project. Even though some of the cats lost the harness and we still don't know exactly where they roam, we hope you enjoyed the experience and can relate to the other cats in this study.

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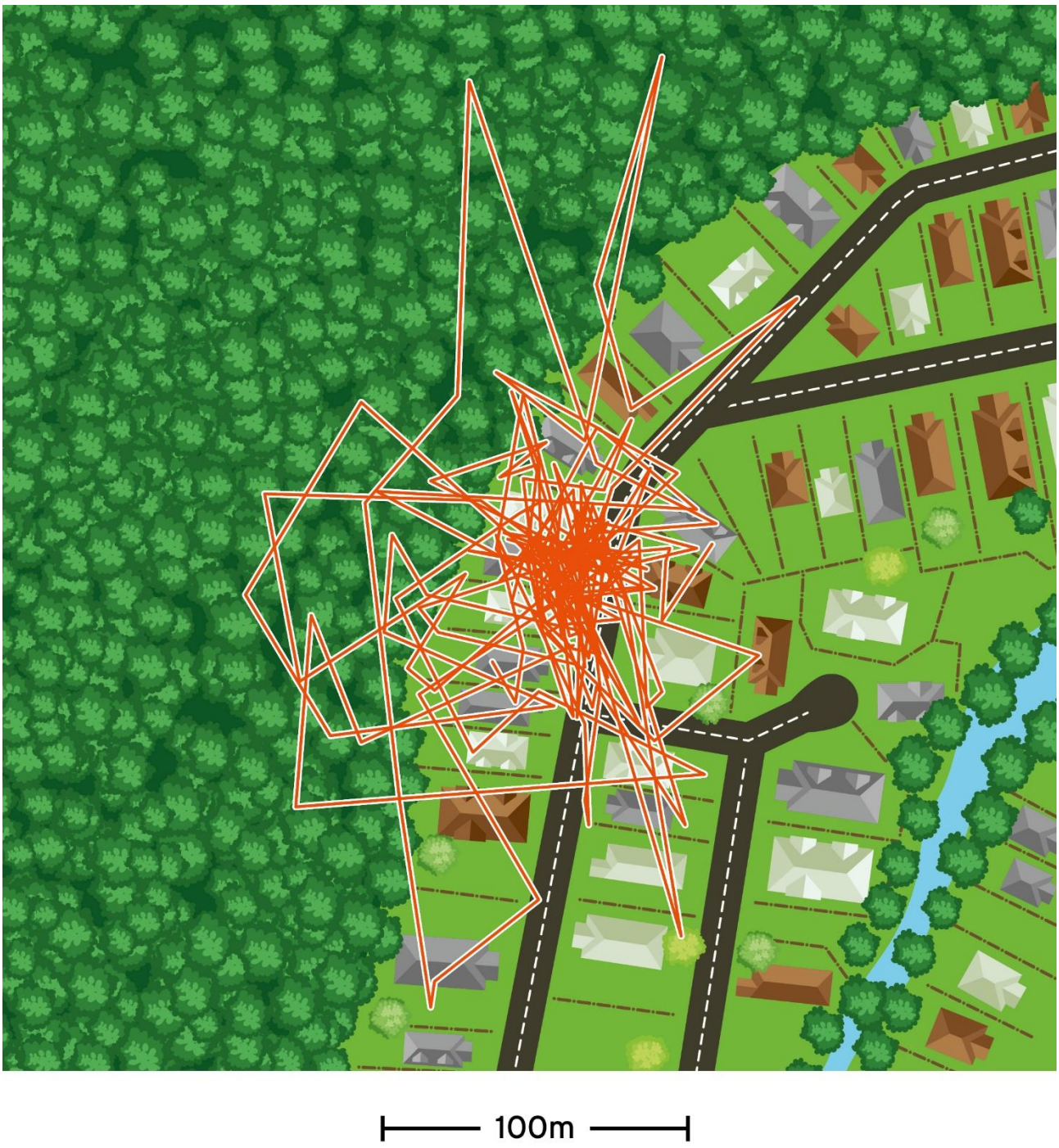
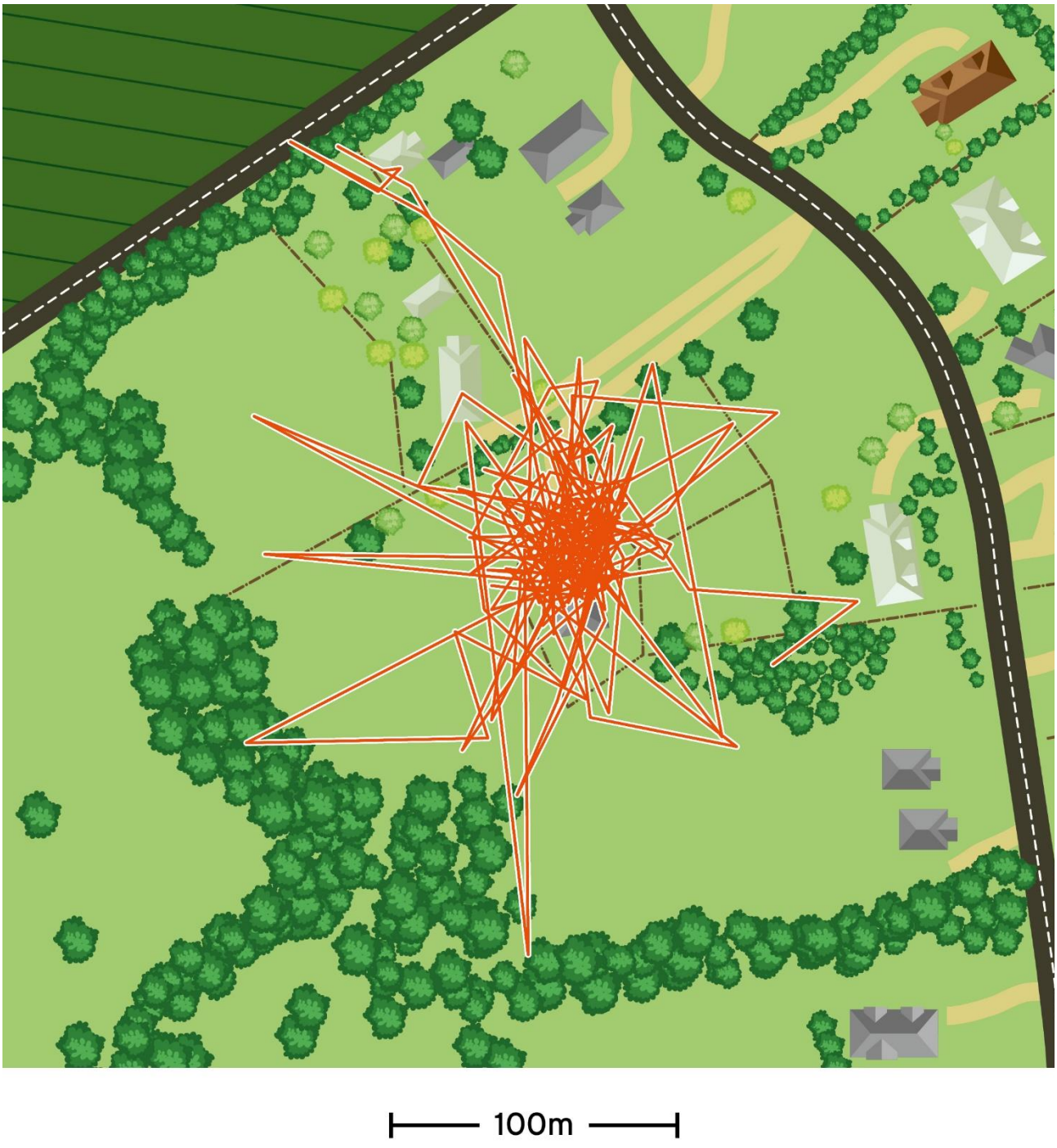
APPENDIX 1: ADDITIONAL CAT TRACKER MAPS

Map of Alabasta's movements

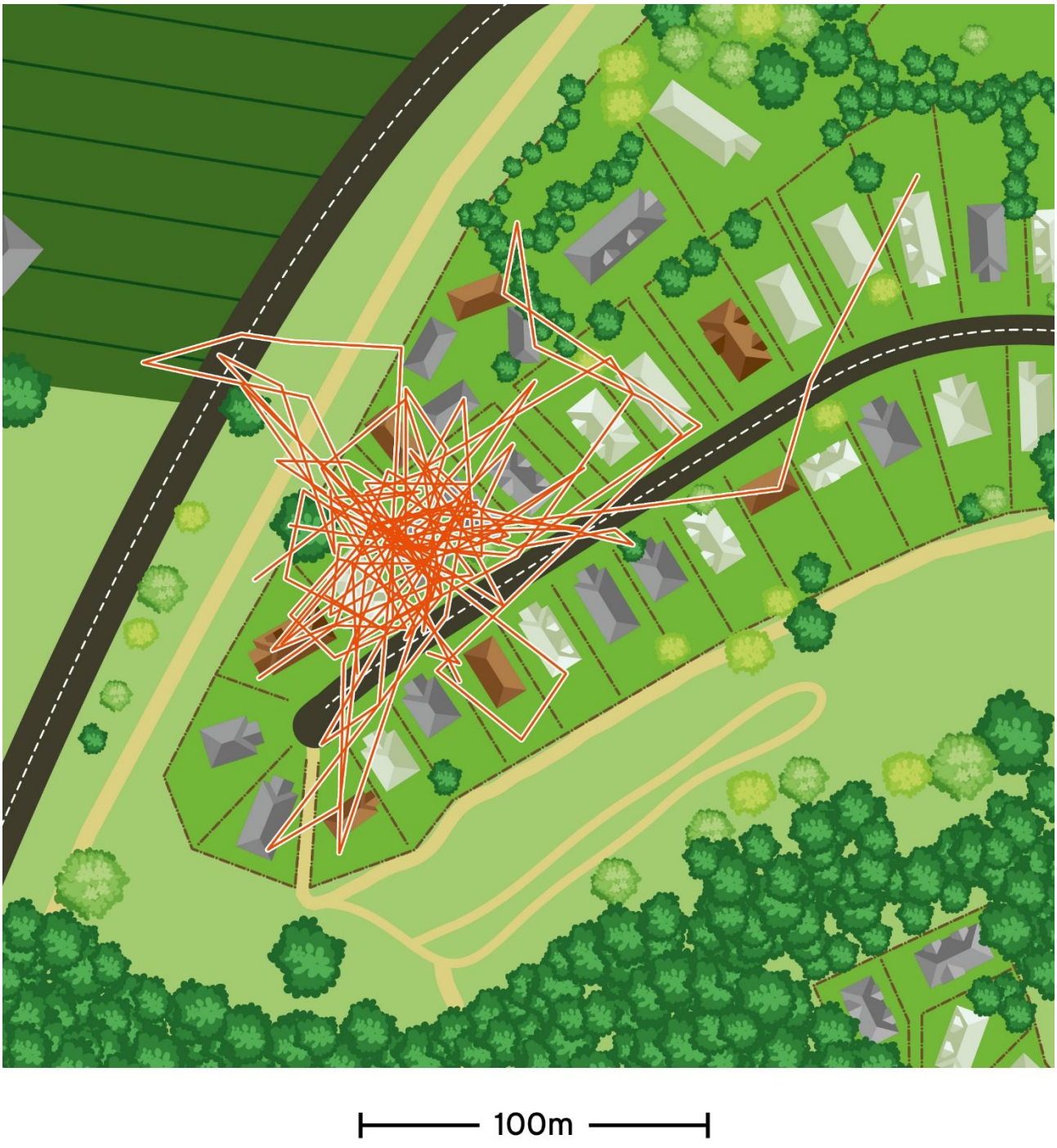


Map of Ally's movements

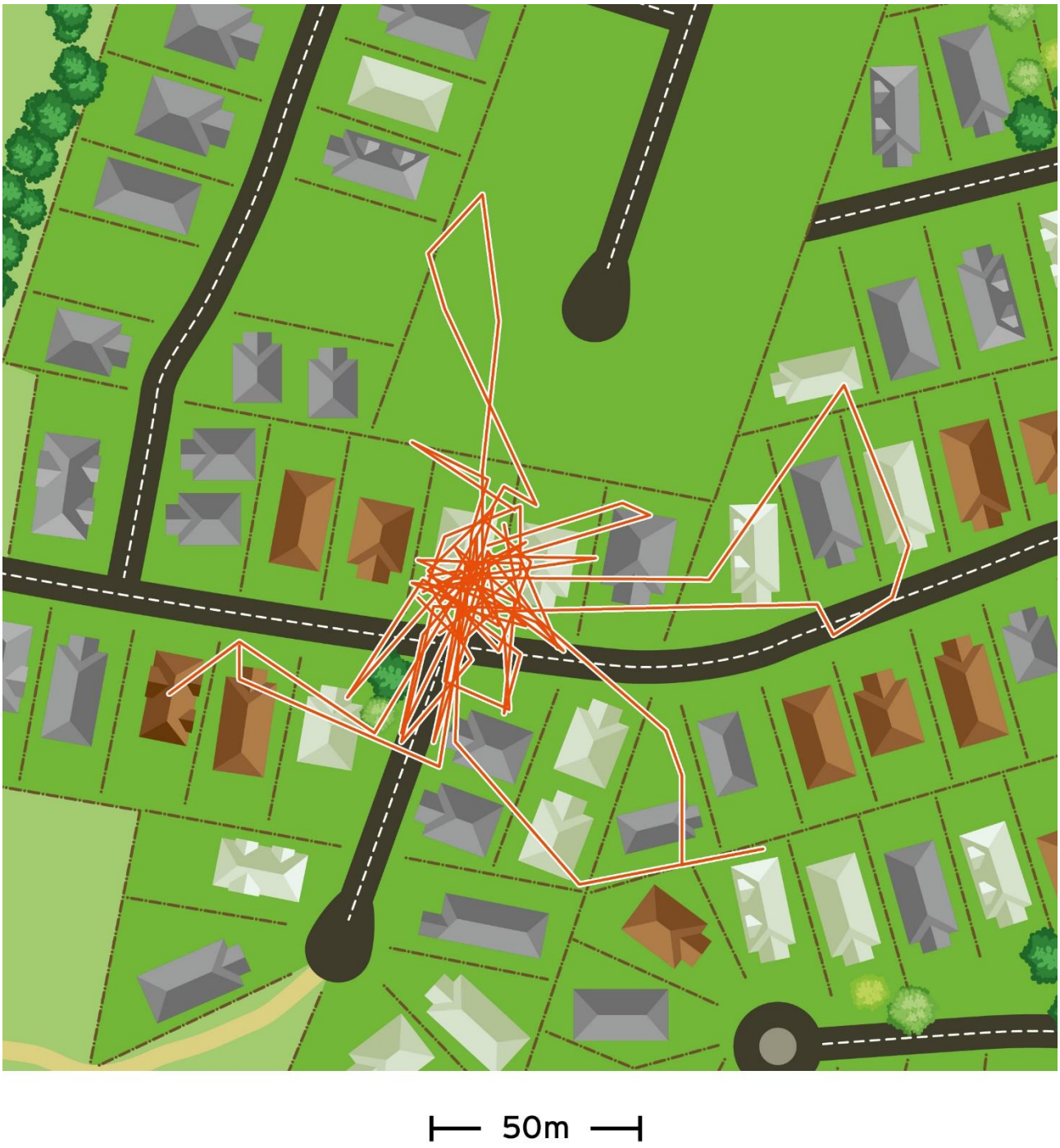
Map of B's movements



Map of Billy's movements

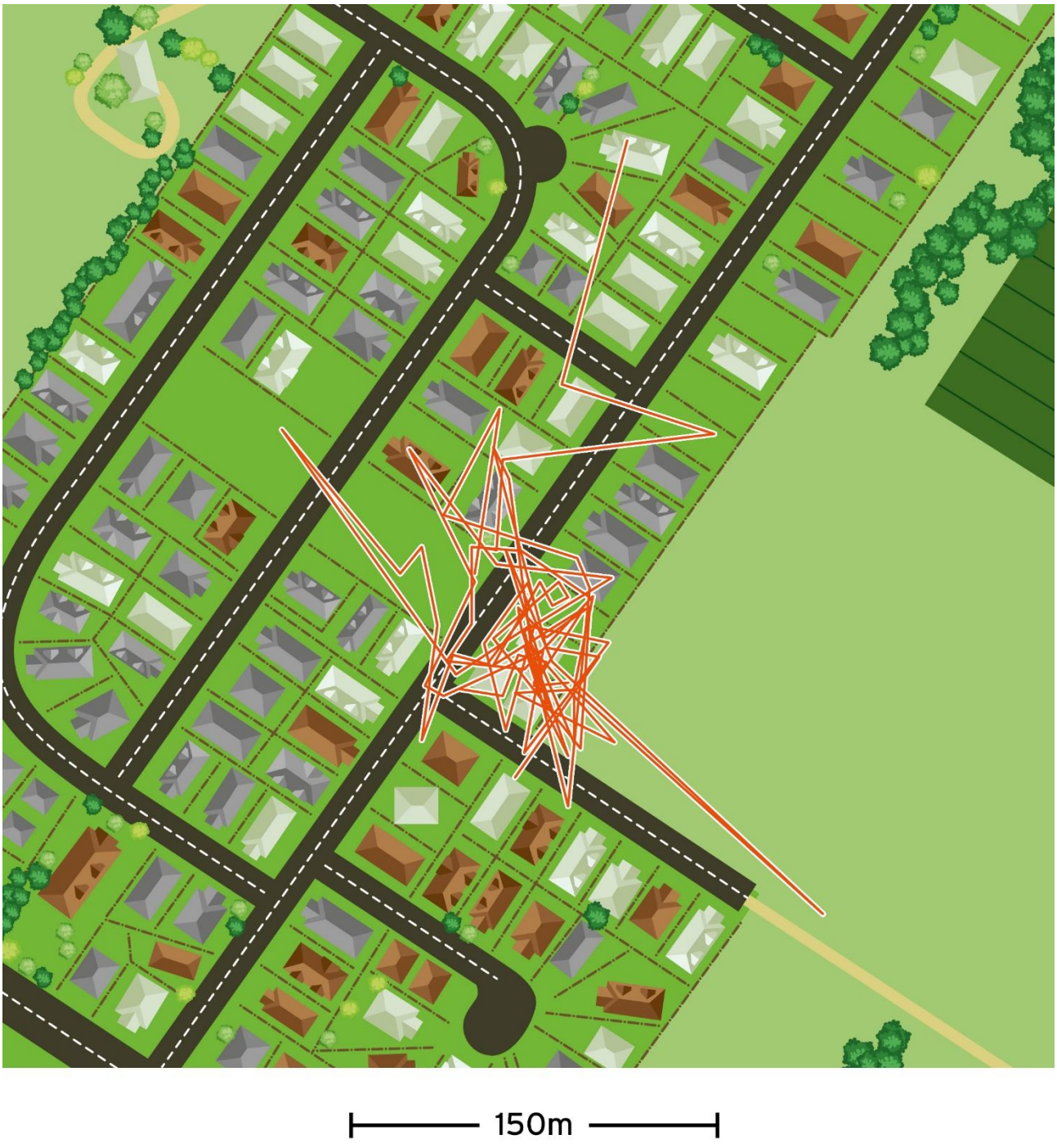


Map of Harry's movements



Map of Jax's movements

Map of Tab's movements



Map of Wilbur's movements