Automated traceability data capture and synthesis for Traceability (ADCaST)

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This document is prepared in partial fulfillment of the requirements outlined in the Going Forward 2 Traceability Pilot Program project funding agreement entitled "Automated Data Capture and Synthesis for Traceability (ADCaST)" Grant number AHAD-031350. This document contains content to support the deliverables listed under section 5.2 (a-e) entitled Final Report of the project agreement. Content associated with project financial operations, project management and other obligations outside of the assessment of overall project technical findings will be submitted using separately established templates and methods.

1 Executive Summary

This project looked at the suitability of remote pasture and remote logger readers in production settings in Canada. The objective was to assess whether cellular enabled RFID readers could be used to collect animal sightings data in production livestock management settings. Further objectives to assess the general utility of these sightings data records in the synthesis of animal movement records were detailed. Depending on location and setting it was found that passive collection of animal sightings records in remote and high volume settings was readily achievable with todays technology. Further it was determined that the synthesis of full movement records from passive sightings data was possible depending on the deployment setting of the ghost reader equipment.

An assessment of the utility of sightings data to the generation of movement records was performed using a dataset kindly shared by the Scottish Electronic ID authority. Assessments of varying read rates through critical control points and their impact on inferred full movement data patterns were studied. Simulated epidemic events were generated and standard epidemic curves and measures of network topology were assessed. This small exercise shows that 100% individual animal read rate is not required to support sufficient understanding of animal movement graph topologies to support epidemic mitigation efforts in critical control point surveillance program designs.

2 Introduction

2.1 Background

This document is presented in partial satisfaction of the requirements of the Project Agreement between the Alberta Agriculture and Forestry and the Canadian Cattle Identification Agency, entitled "Automated Traceability Data Capture and Synthesis for Traceability (ADCaST)". Schedule A of that agreement uses the format of a project application to outline a series of activities intended to explore and assess the use of ghost readers in the generation and synthesis of animal movement data in the Canadian livestock traceability system.

Further activities focused on the assessment of the utility of sightings data in a full movement tracking setting are outlined leveraging data provided by the Scottish Electronic Animal Identification Authority (SCOTEID).

This report is intended to summarize the successful completion of these activities, interpret and provide context to the utility of the outcomes of these activities and to suggest next steps in the process of incorporating these findings into general use in the Canadian livestock traceability system.

2.2 Project Overview

The first mention of the idea that passive reads from existing RFID reading equipment could compliment traditional movement reporting data collection processes in Canadian livestock traceability settings was raised as the concept of a by-pass reader in the final report of the CCIA's Radio Frequency Identification Systems Applied Research Study Phase 2B.

This concept refers to a RFID reader that collects and reports traceability data to the CLTS database without human labour requirements.

In 2010 and 2011, the technical state of the art meant that by-pass systems required dedicated computer hardware (laptop or desktop). Further, the output of these by-pass systems was a simple count of the number of head observed at that location in a period of time. While number of RFID reads captured at a location can help identify the importance of that location in the event of an epidemic, individual animal ID's could represent a substantial improvement.

This project explores the concept of a ghost reader, which for the sake of this evaluation represents a technological evolution from the by-pass readers discussed previously. Ghost readers as used in this project consist of a RFID reader system that is connected to a private data network which facilitates the real time submission of sightings data to a CCIA landing server with no human labour.

In addition to the activities aimed at the assessment of the feasibility of ghost reader use in the generation of animal traceability data, this project aims to investigate the impact to traceability associated with changes to surveillance programs made possible through the use of sightings data. Specifically a small simulation study to assess the impact to traceability imparted through the use of varying rates of animal sighting rather than full movement recording.

This project has a set of six main objectives which are supported by five end of project desired traceability technologies and capabilities. Specific project activities have been designed to support the assessment of these objectives and goals.

2.2.1 Project Objectives

1. The simplification of autonomous reporting of traceability data to the CCIA via the use of better and smarter technology.
2. Determine whether a private data network can be used to collect and report more data from more locations across Canada more efficiently than existing infrastructure.
3. Determine how much administrative burden will be reduced or eliminated through the collection of animal movement data using ghost-reader systems.
4. Test methods to lower the administrative burden on industry for the reporting of traceability animal movements using sighting events to synthesize movement events in the CLTS database, which could meet the CFIA epidemiologists' requirements for traceability.
5. Increase data integrity by eliminating manual data entry of animal movement data.
6. Support implementation of and compliance with proposed animal movement reporting regulations and a fully-functional livestock traceability system in Canada.

2.2.2 Desired Traceability Technologies and Capabilities (End of Project)

1. Use data loggers connected to existing RFID scanning systems at farms and co-mingling sites to report data directly to the CLTS database.
2. Reduce industry's reporting burden through the effective use of sighting data
3. Determine the level of sighting data required to synthesize movement events in the CLTS database that will be acceptable to governments for effective traceback.
4. Increase the speed of the implementation of traceability movement data reporting and use through easy-to-use technology.
5. Use a private data network to broaden the reach for the collection of traceability data in under-served rural areas where Internet service is poor or inaccessible.

3 Materials and Methods

3.1 Ghost reader development

The scope of this activity was to support the development of two fully automated systems to support the collection and submission of RFID reads to the CLTS via a sightings landing server at the CCIA. This work has the potential to dramatically change the quality of animal movement data and challenges associated with its collection. Two distinct remote reader systems were considered in the completion of this activity.

Remote Pasture Readers The first approach was to choose a commercially available remote RFID reader product and work directly with the vendor and CCIA IT to develop appropriate integrations with the CLTS Systems.

Remote Logger Readers The second approach was to work directly with an electronics manufacturer to develop a product that can be inserted between an existing RFID reader system and said systems associated computer equipment. This logger system has a dedicated connection to the CCIA's private data network allowing for the automated submission of sightings data.

Both Remote reader systems were tested in controlled environments with good cellular data coverage to ensure that in ideal conditions they performed as expected.

3.2 Ghost reader deployment

8 Remote pasture readers were deployed to a collection of locations through out Alberta. These locations represent the remote grazing holdings of commercial and purebred cattle holdings. The portable nature of the remote pasture readers allowed producers to drag the readers around during use so one reader could support the remote reading needs of producers utilizing shared leases or pasture settings well removed from their primary premises.

8 Remote logger readers were deployed to a collection of locations throughout Alberta. The locations represented in Figure 1, are feedlot locations selected for their large volumes and established use of RFID at animal intake.

Both automated reader types had common technical challenges on deployment, the Remote pasture readers needed modification to make them resistant to the environment that they were deployed in. The Remote logger readers had a variety of small challenges with firmware updates, and suffered connectivity challenges in the varied RFID reader systems represented in our test setting.

3.3 Sightings landing server development

The development of temporary landing server for sightings data `http://pdn.canadaid.ca` involved the development of a variety of novel software tools.

Sightings Data Repository The development of a minimal data model for the storage of sightings records was a prerequisite for the development of any of the dashboard or data submission API endpoints.

Sightings Data Dashboard The development of a web based monitoring dashboard for the remote readers (Pasture and Loggers separately) helped support project operations. Figure 2 shows one of the views in this dashboard.

Sightings Data API Endpoint A pair of modern authenticated and RESTFUL web endpoints to support the submission and verification of sightings events to the Sightings Data Repository were developed for each type of remote reader.

Figure 1: *Current Remote Logger Reader Locations*

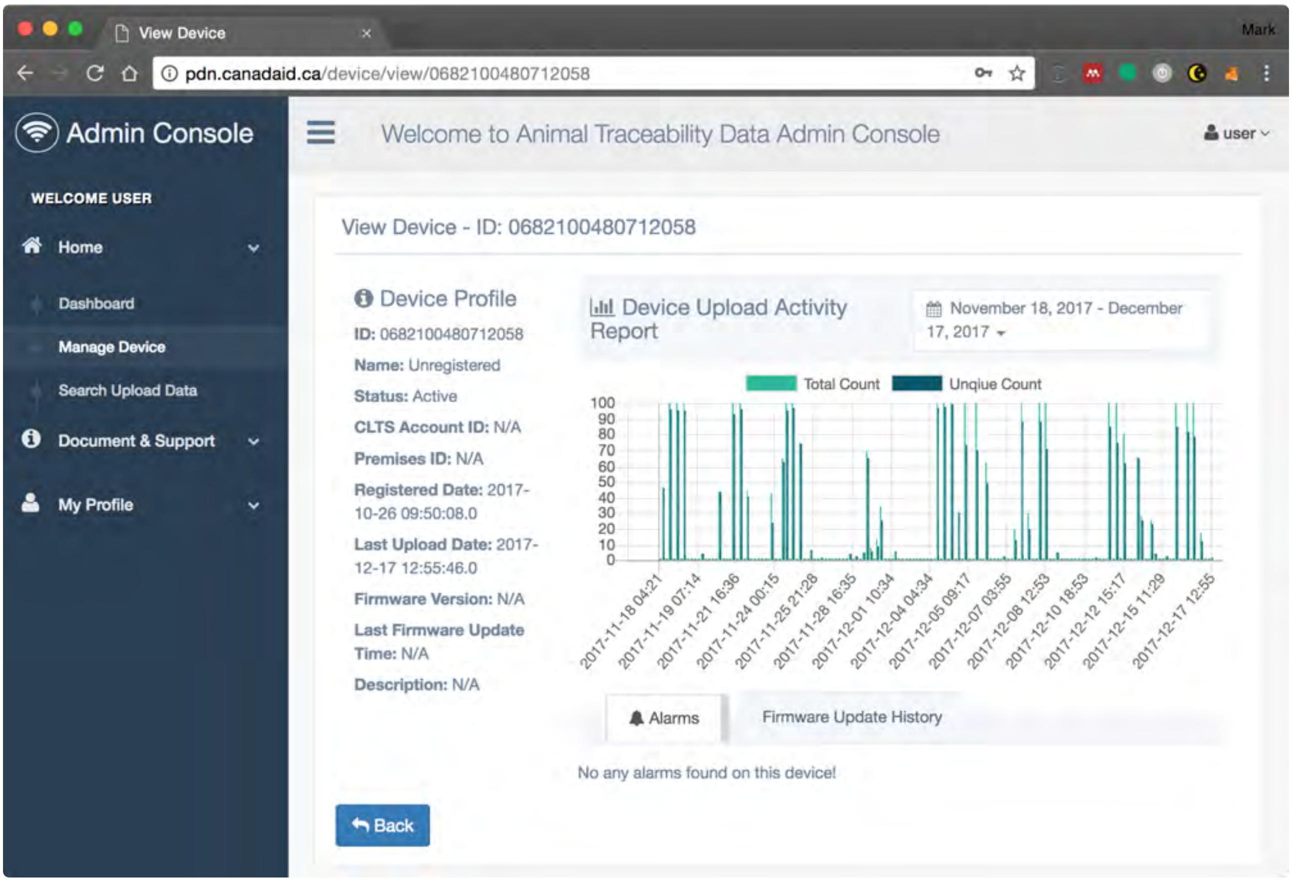

Figure 2: *Remote reader web dashboard*

Table 1: *Sightings model detail*

Variable
ORIGINAL_OWNER
DEPARTURE_CPH
DESTINATION_CPH
READLOCATION_CPH
LOT_DATE
TIMESTAMP
MOVEMENT_TYPE
ANIMAL_EID
ISSUE_CPH
ISSUE_DATE
READ_LOCATION_TYPE
DEPARTURE_LOCATION_TYPE
DESTINATION_LOCATION_TYPE
CCP_ROLE

3.4 Movement synthesis from sightings data

Inferring movement records from sightings data is an activity that is readily automated, this project focused on two settings with different levels of suitability for automated movement record creation.

The ability to develop algorithmic approaches to convert sightings data from different settings into movement records will vary based on setting and species. In this study the process of transforming sightings from the remote logger readers was as simple as identifying the premises of the Feedlot setting where the animals were read, and creating a move in record for animals on their first observation by the remote logger reader. Creating movement records using the remote pasture readers was not attempted as deployed in this study the remote pasture readers were moved within a premises.

3.5 Assessing the utility of sightings data in epidemic traceback

The assessment of the utility of Sightings data in Epidemic modeling exercises is a big topic. For the purpose of this study a single years worth of sheep movement data from the Scottish EID authority was obtained. This data contained full movement records of 2.7 million individual animals. Each record, contained data elements to reflect a full movement in accordance with the ScotMoves system standard. The subset of these variables important to this study are presented in the table 1.

For any individual animal move, variables reflecting the origin, destination and point of observation, as well as the ownership, movement type, date time and location types are recorded. This full movement data serves as a good gold standard set of movements on which we can simulate different rates of sighting data use.

Deviating from the full movement reporting gold standard data, we prepared directed network graphs of animal movement where 0%, 50%, 60%, 70%, 80%, 90% and 100% of individual animal moves through markets were recorded. Network plots for 50%, 70% and 100% read rate are presented. Under each of these different models of network connectivity we simulated an outbreak of Tuberculosis at a random location in the network, using a SI model of epidemic spread where animals at time 0 are all susceptible to infection and as time progresses using the connectivity of the network and the probability of exposure animals become infected based on transmissibility, time and exposure. Epidemic curves, SI curves and network parameters were generated for each graph.

4 Results

4.1 Ghost reader and sightings data landing server development and deployment

The three activities associated with deploying two new Remote RFID reader systems to Albertan livestock management settings were deemed to be successful in this project.

Remote pasture reader The customization of a novel hardware solution for RFID reading from an international vendor to the Alberta setting was a success of this project. Challenges with solar deployments and battery management are magnified in a cold climate, cellular connectivity, and equipment durability all presented

Table 2: *Remote reader statistics*

RFID System	Batches	Unique Tag Cnt.
Rmt. Logger Rdr.	32,047	121,981
Rmt. Pasture Rdr.	7,170	1,044

Table 3: *Sightings model detail*

Variable	Description
LOGGER_ID	Remote reader ID
UPLOAD_TIME	Date and Time of Batch Upload
LATITUDE	Latitude of sighting record
LONGITUDE	Longitude of sighting record
UPLOAD_ID	Batch ID
LINE_NUM	Within batch record count
TAG_ID	Individual Animal Tag ID

logistical and engineering challenges. These challenges were all addressed and successful deployment of 8 remote pasture readers units with multiple uploads of identification data per day from October 19, 2016 through November 1, 2017. Table 2 contains counts of batches and unique tag reads for each type of reader during the study period.

Remote logger reader The hardware and software development of a novel piece of equipment to log RFID read events from existing RFID systems using an Alberta vendor for use in the Alberta setting was a success of this project. Many challenges developing a piece of equipment to seamlessly integrate with existing RFID systems were overcome and addressed. Specific challenges around the remote updating of firmware over cellular networks, and the minimization of stakeholder burden associated with the operation and setup of the equipment were managed. Successful management of challenges allowed for the remote deployment of 8 remote logger readers with multiple uploads of identification data per day from November 7, 2016 through November 17, 2017. Table 2 contains counts of batches and unique tag reads for each type of reader during the study period.

Sightings data landing server The development of a set of data models and the associated web application software to provide an interface to support the real time reporting of automated sightings data without human intervention was a success of this project. A minimal set of variables was defined and exposed via an authenticated API interface to allow the Remote logger and pasture readers to automatically submit sightings records. Table 2 shows counts of batches and tag reads submitted. Details of the sightings model are presented in Table 3. Minimally a sighting has elements to record ID, date and time, and location. The model as defined has capacity to include detail on batch submission if reader location and design justifies batch submission.

4.2 Movement synthesis from sightings data

The ability to algorithmically create movement records from sightings data will vary from setting to setting. In this project the generation of movement records based on GPS based change in animal location to a point not encompassed by a premises definition was not explored, rather rules based approaches were considered.

Remote logger readers Focusing on observations submitted by the Remote logger reader equipment, the simplest algorithm for movement record inference is to take the first occurrence of a read of a tag by any specific Remote logger reader as a move-in record at the registered premises of that reader device. With this simple rule, one could implicitly generate movement records for 121,981 individual IDs in this project.

Remote pasture readers Focusing on observations submitted by the Remote pasture reader equipment, this project did not deploy remote pasture readers into settings that would constitute movements in the traditional sense.

4.3 Assessing the utility of sightings data in epidemic traceback

For the purposes of this exercise a set of assumptions were made.

Table 4: *Network Properties*

Market Read %	0	50	60	70	80	90	100
Number of Nodes				18227			
Number of recorded moves	21643	125031	121650	116010	108446	94504	36404
Average Weighted Degree	174.03	234.5	246.35	258.23	270.29	281.94	286.48
Average Undirected Path Length	3.761	3.002	3.003	3.067	2.998	3.012	2.968
Strongly Connected Components	4350	11809	11725	11665	11630	11605	11585
Weakly Connected Components	18213	1047	1045	1041	1039	1039	1042

1. That disease spread in an epidemic or outbreak is transmitted animal to animal.
2. That a single infected animal at a premises means that all animals at that premises are exposed.
3. That disease transmission occurs across strong connections not weak ones.
4. That for the sake of simulation an SI model of an epidemic is sufficient to demonstrate the utility of sightings data.

4.3.1 Network Diagrams

The ScottMoves system contains detailed geographic information systems data for every county, parish and holding in Scotland, this county, parish, holding construct is the basis of their premises (CPH) ID program. CPH numbers are the identifiers for all premises, with premises designated as Critical Control Points (CCP) identified by holding substrings that start with 8. Only markets and abattoirs are considered CCPs. Using a combination of movement type, location type, and direction of movement data, we were able to develop a network graph of all sheep moves by type colored by destination in the year 2012 (2.7M moves). Each individual animal move was counted as 1 unit of weight for each edge (connection). Nodes in the graph are scaled by number of edges, and they are colored by their type. Figure 3 shows all movements as recorded in the ScotMoves database in 2012.

Notable features of figure 3 are the predominance of moves through markets and collection centers or to abattoirs. The authors suspect that this type of graph would be similar in structure to the movement and connectivity of the Western Canadian beef movement graph during parts of the year.

Figure 4 shows the network when 50% of market reads are missed. Notable features of figure 4 are the dramatic increase in the number of edges compared to figure 3. As we are dealing with the same number of animals moving, the loss of half of the market reads leads us to infer that 50% of individual animal moves were from farm - farm, farm - abattoir or other destinations.

Figure 5 shows the network when 70% of market reads are missed. Notable features of figure 5 are the decrease in the number of edges compared to figure 4. As we are dealing with the same number of animals moving, the re-observation of 20% of the market reads over figure 4 leads us to reduce the number of distinct edges instead opting for a smaller number of higher weight connections between nodes. We should still note that missed individual animal moves at a market are inferred to be farm - farm, farm - abattoir or other destination moves.

Network topological properties of the varying read rate based graphs are presented as table 4.

With the varied connectivity graphs in hand, simulation studies of the spread and propagation of a network outbreak of TB were performed in each graph and epidemic curves and susceptible/infected (SI) curves were prepared (Figure 6).

5 Discussion

This project was centered around six main objectives. Collectively these objectives help to assess and quantify the state of the art in autonomous animal traceability data collection, and attempt to assess the utility of data collected in this format to national traceability objectives.

The collective goals of easing the burdens associated with individual animal movement reporting, increasing the quality of individual animal movement data, and supporting the implementation of and compliance with proposed regulation regarding animal movement reporting are well covered in this project.

Additional work to assess the utility of this novel data in the quantification of disease transmission through animal movement networks was facilitated through the generous contribution of data from the ScotMoves program of the Scottish Animal ID Authority.

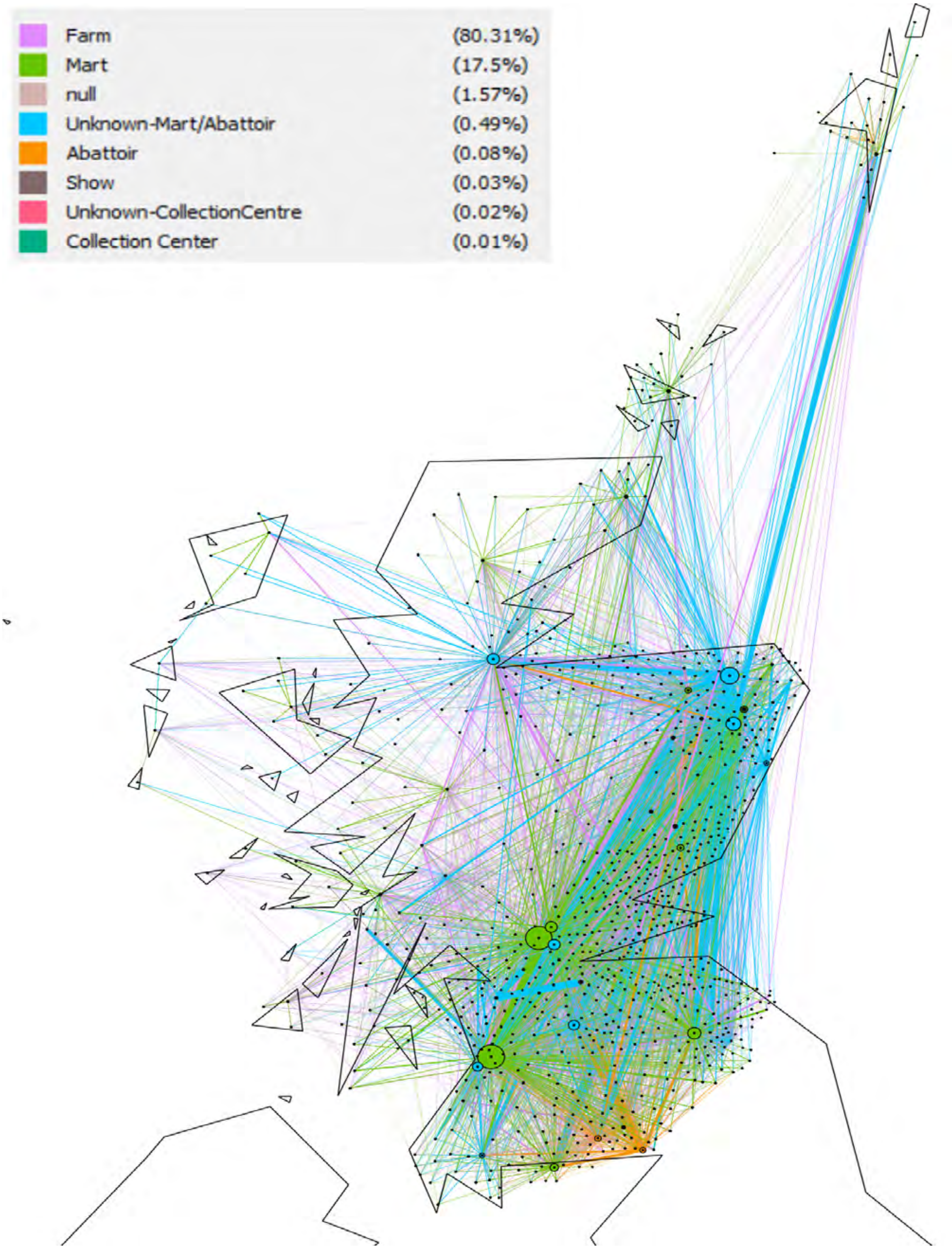

Figure 3: *Full graph of Scottish Sheep Movements 2012*

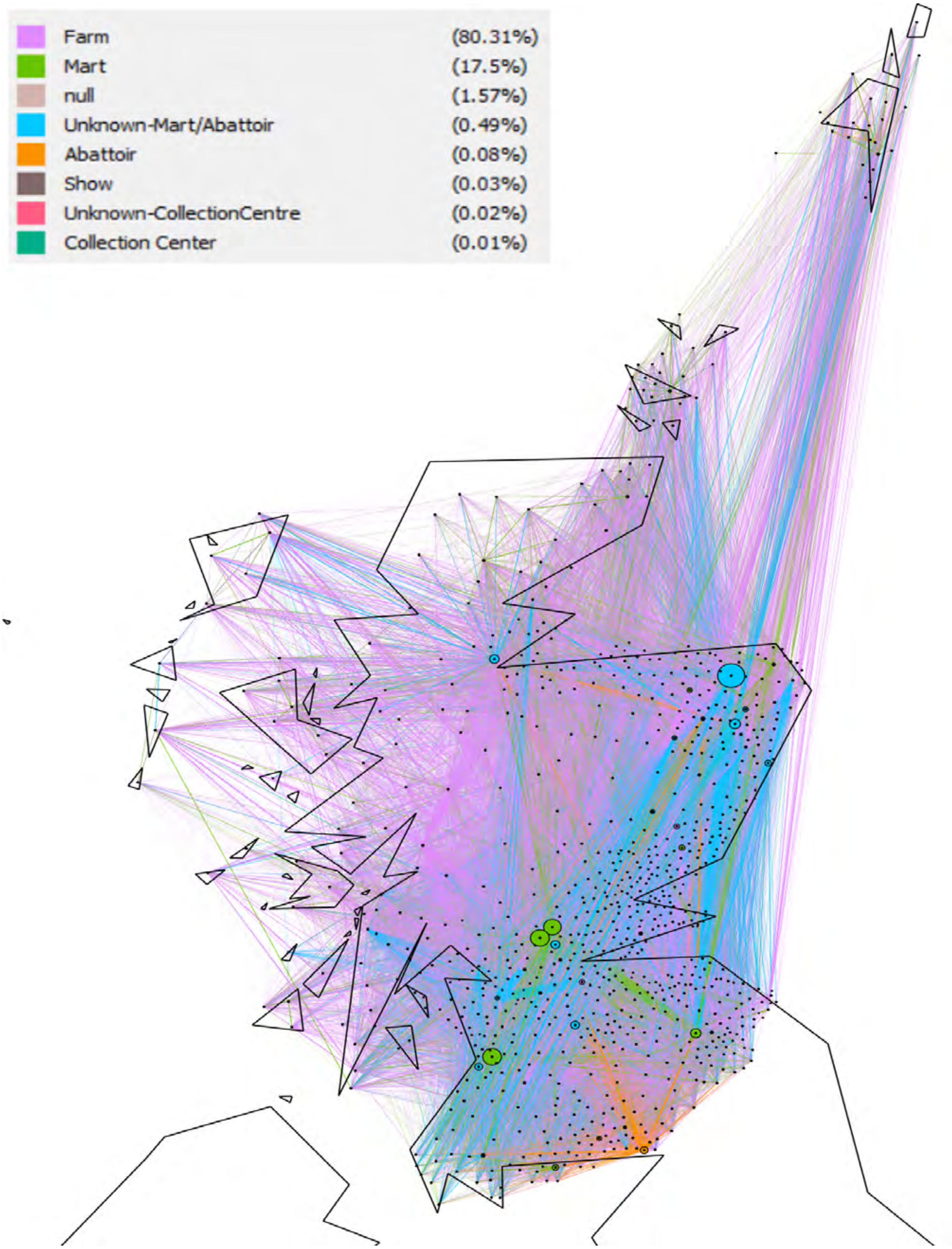

Figure 4: *50% read rate through markets graph of Scottish Sheep Movements 2012*

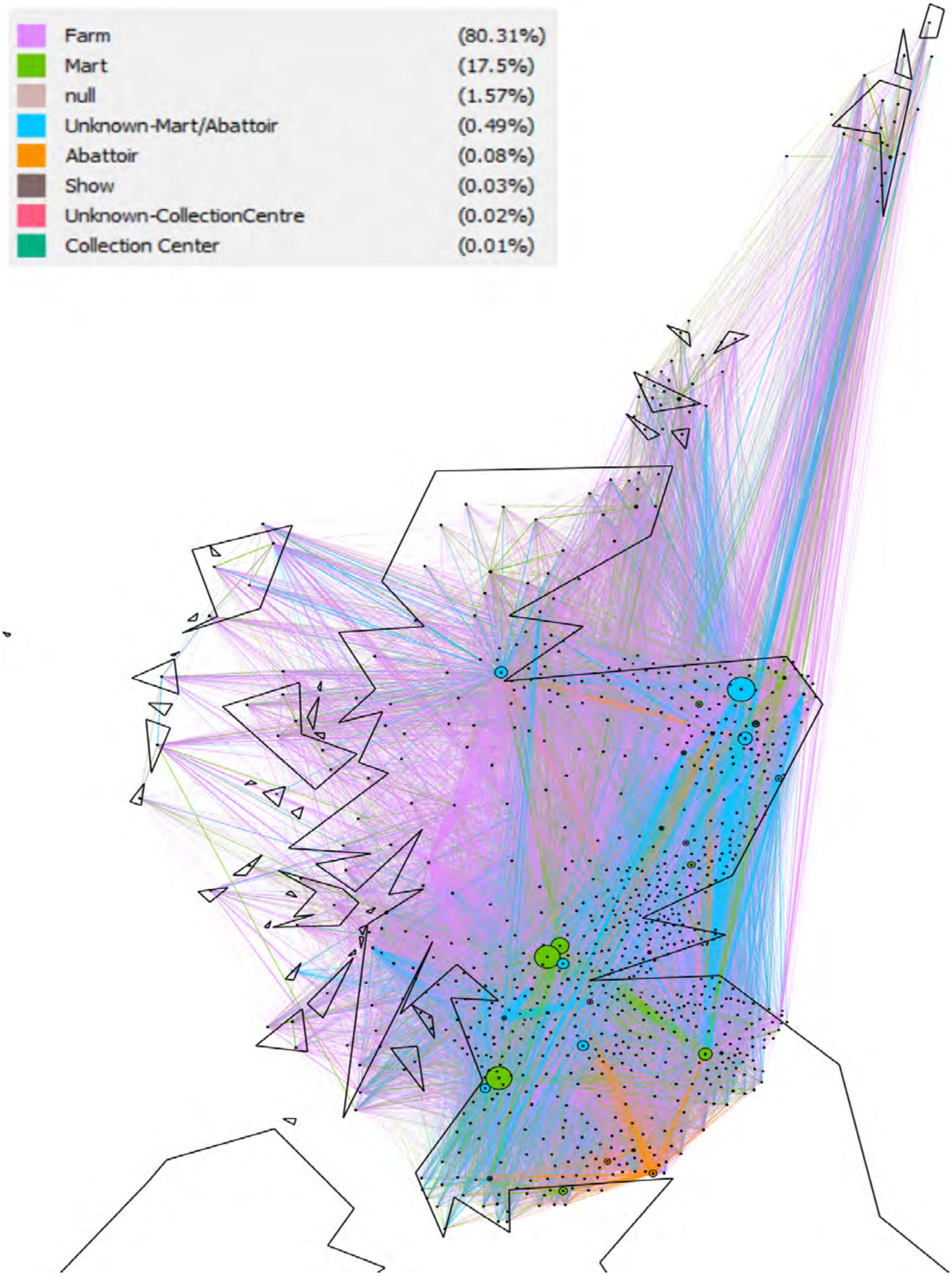

Figure 5: *70% read rate through markets graph of Scottish Sheep Movements 2012*

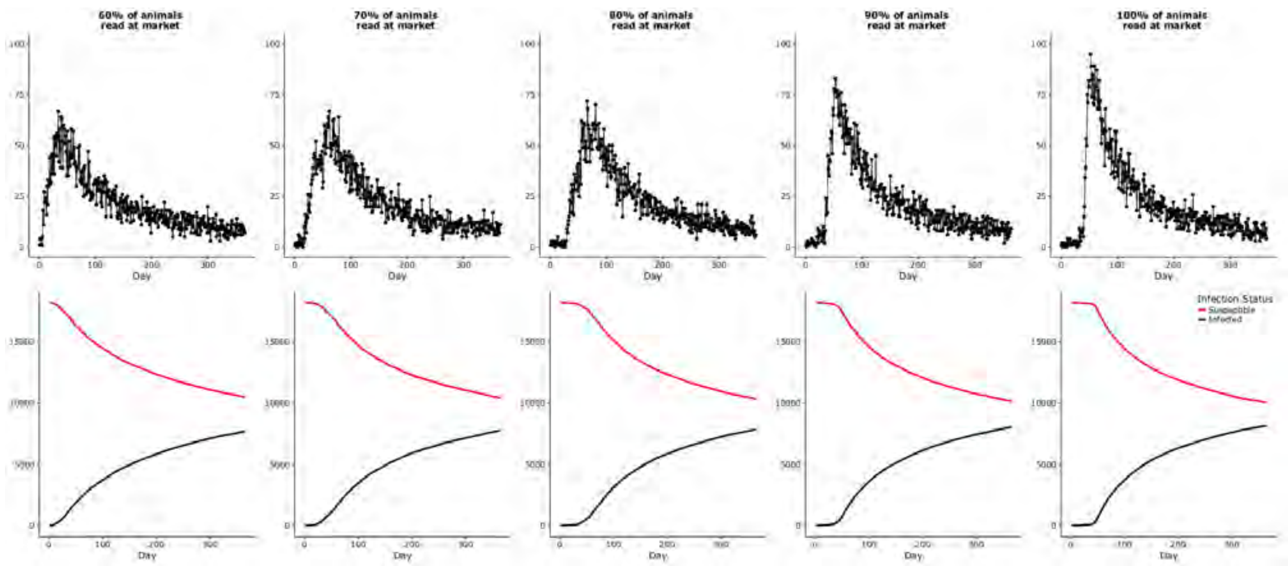

Figure 6: *Epidemic and SI curves for various read rates in market settings*

This projects objectives were supported through the development and deployment of new hardware and software solutions, automated data management pipelines and through the application of spatial epidemiological modeling techniques. The challenges and successes of each phase of this project are outlined below.

5.1 Reducing burden of and increasing quality of sightings data collection

In the Remote pasture reader setting, accurate and timely capture of animal identification and location was achieved with only trivial increases in management burden over and above the maintenance of a portable mineral feeder in pasture. The daily operation of the Remote pasture reader once initial configuration was complete was as simple as ensuring that the equipment was moved to new pastures when animals were moved, the design decision to mount the equipment on the equivalent of a calf sled made this responsibility something that was readily achieved.

In the Remote logger reader setting, accurate and timely capture of animal identification and location information was achieved with little to no increase in management burden. In the feedlot settings identified mandatory reporting of move in records was the standard. While this was a pilot project, the solution deployed has the capacity to completely automate this responsibility.

5.2 Increase volume of individual animal records of movement

The objective to increase the volume and timeliness of animal movement reporting via sightings equipment was satisfied in this project.

The use case and varied settings for deployment of the Remote pasture reader could lead to a variety of opportunities to automate the synthesis of movement records through passive environmental RFID scans. As deployed in this project, the Remote pasture readers were successful in the real time submission of animal sightings to the CLTS landing server. Three specific scenarios were considered where movement data could be synthesized from the sightings data generated by the Remote pasture reader.

Scenario 1: Move-In record synthesis Remote pasture reader equipment in holding yards could be used to reliably generate sightings data records for inbound loads of animals. These sightings coupled with move-out sightings from other locations could reliably lead to the automated generation of movement records.

Scenario 2: Inventory registry In epidemic modeling activities, the reliable quantification of animal inventory in an ongoing and automated fashion by premises is a key concept used in the estimation of any specific sites overall risk to epidemic spread. In this project, it was very common for participating sites to raise questions about the utility of the reader data to operations and herd management.

Scenario 3: Move-Out record synthesis In the same way that a sighting on arrival at a premises could contribute to the creation of a movement record, the final sighting on record at a premises could represent one half of a movement record assuming a suitable sighting at a new premises could be matched.

The Remote pasture reader systems have the capacity depending on placement and configuration to contribute to automated or algorithmic creation of movement records. Broad adoption of passive RFID reader equipment would be necessary to support fully automated movement reporting.

The use case and single setting for deployment of the Remote logger reader in this study allowed for the assessment of two movement reporting scenarios.

Scenario 1: Move-In record synthesis Remote logger reader equipment in processing facilities could be used to reliably generate sightings data records for inbound loads of animals. These sightings coupled with move-out sightings from other locations could reliably lead to the automated generation of movement records. The required reporting of move-in records for feedlots with greater than 1000 animals in Alberta, was readily satisfied by this technology.

Scenario 2: Move-Out record synthesis In the same way that a sighting on arrival at a premises could contribute to the creation of a movement record, the final sighting on record at a premises could represent one half of a movement record assuming a suitable sighting at a new premises could be matched. In the feedlot settings used in this study, the normal destination for move-out records is a processing plant or abattoir, mandatory tag retirement in these settings would contribute to the timely synthesis of movement records in an automated fashion.

With respect to the reporting of move in records in the feedlot setting the Remote logger reader was able to report all animal move in records in real time, with little to no burden to the operators. The utility of this tool was not lost on operations staff with many questions about the project and the potential to incorporate the capacity of the new system into their formal reporting obligations in an ongoing fashion after project completion.

The utility of sightings data in the generation of movement records is high. A variety of factors contribute to the utility of sightings data generated in an individual setting in the generation of movement data.

5.3 Epidemic modeling using variable rates of sightings data

The ability to define a graph of animal movements using typed nodes and weighted edges (connections) is readily possible with full movement data. Full movement data is readily imputed in many settings in the Canadian livestock production ecosystem. The opportunity to reduce the burden of full movement recording by replacing movements through one type of node (markets) with variable rates of animal sighting data collection is explored and presented in this project. The network graph of sheep movements in Scotland is market centric. Markets are considered critical control points in the Scottish animal movement system and provide subsidized industry support for movement reporting as neither an origin or destination but rather as a critical control point and RFID read location. From a statistical modeling perspective, this positioning allows for the incorporation of the market node types unique, high degree, but low commingling rate status to be appropriately reflected in epidemic modeling exercises through modifications to disease transmissibility through markets and other approaches.

In this project, we artificially degraded read rates from the gold standard by 10-50% and assessed the changing properties of a resulting simulated epidemic of a disease with transmissibility and environmental persistence properties similar to Tuberculosis. In the gold standard data, very stereotypical epidemic and SI curves are observed over a 365 day period of observation with no mitigation efforts. Degrading the read rate through markets results in changes to the animal movement network that manifest in our simulation as degraded ability to simulate an epidemic. Poorer information on true network connectivity, reduced volumes of information on commingling based exposures and more direct farm-farm movements were inferred when in fact we knew that those animals traveled through the market. While the network graphs observed with higher and higher rates of missed reads in the market setting were less suited for transmission of disease, it is important to note that they were not simpler. In fact the inferred moves from farm to farm created when animals were not scanned at the market make the graph more complicated.

It is important to note that in many epidemic scenarios, the use of individual animal ID is important for isolation and record-keeping purposes. However, the containment and eradication practices employed are generally at the level of the entire node/herd/premises. This important distinction is not made to support or discourage the use of individual animal ID or group centric movements but rather to raise the idea that risk based surveillance and less than perfect record-keeping practices are two themes that in light of the economic burdens associated with traceability data capture and synthesis should be on the table as part of any system design conversation.

Looking at table 4 and figure 6, you will note that the behavior of our simulated epidemic only changes slightly as you degrade read rates in the critical control point that is a market setting by 10-30%. These authors argue that engaging stakeholder groups like markets, feedlots, and other commingling sites with goals based on realistic and achievable goals, that have the potential to be fully automated for small costs, could change those conversations dramatically.

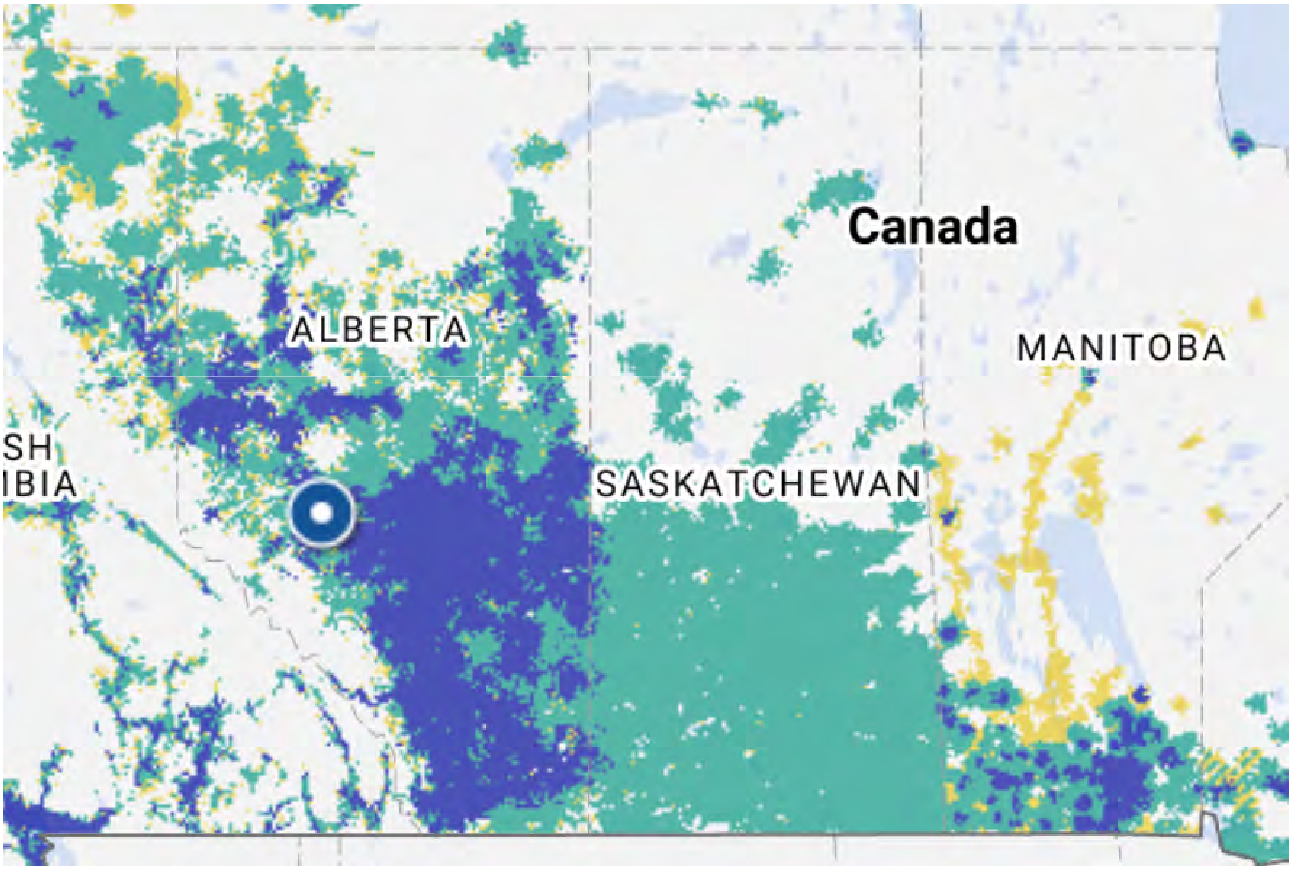

Figure 7: *Cellular Coverage Map, Western Canada*

5.4 Evaluation of project objectives

Objective 1 The simplification of autonomous reporting of traceability data to the CCIA via the use of better and smarter technology.

The largest success in this project was the development and deployment of two separate pieces of equipment to support the goal of reducing the burden on industry for the reporting of traceability animal movements. Passive collection of RFID sightings allowed for the automated collection and submission of 123 023 individual animal tag reads during the one year study period. Once installed and configured the Remote pasture readers needed minimal maintenance of the battery and solar systems, while the Remote logger readers needed no notable maintenance.

Objective 2 Determine whether a private data network can be used to collect and report more data from more locations across Canada more efficiently than existing infrastructure.

The application of a private data network solution lead to large reductions in the burden to producers associated with passive RFID data system network connectivity. Reasonable quality cellular coverage is widely available in the remote production locations and the choice of a private data network backed solution keeps the burden of networking, off of the producer. Figure 7 shows estimated cellular network coverage where network speed would support the data volumes suited to operate network enabled RFID readers.

Objective 3 Determine how much administrative burden will be reduced or eliminated through the collection of animal movement data using ghost-reader systems.

Depending on setting, the opportunity to configure ghost readers to report animal sightings with no burden to the producer is clearly demonstrated in this project. The application of the Remote logger reader in feedlot processing settings had the capacity to fully automate the submission of regulatory required move-in records for these facilities. Algorithmic approaches clearly demonstrated the opportunity for the synthesis of full movement records from the originating premises for the same animals.

Objective 4 Test methods to lower the administrative burden on industry for the reporting of traceability animal movements using sighting events to synthesize movement events in the CLTS database, which could meet the CFIA epidemiologists' requirements for traceability.

As written the proposed animal identification section of the health of animals act, requires full movement recording. No mention of sightings based animal movement tracking is made, however clear opportunities to infer full movement records from sightings, and to implement a system to verify and register full movements from algorithmically processed sightings data are clear and viable.

Objective 5 Increase data integrity by eliminating manual data entry of animal movement data.
The use of network enabled ghost readers eliminates the requirement of producers to take manual action against RFID records to submit them to the CLTS. This elimination not only reduces burden but also removes the opportunity for human error. Cattle handling environments are not ideal environments for computer operation. Automating the preparation and submission of traceability data on ruggedized equipment could help eliminate dependence on fragile technology in production settings.

Objective 6 Support implementation of and compliance with proposed animal movement reporting regulations and a fully-functional livestock traceability system in Canada.
The collective goals of increasing the volume and quality of traceability data in the CLTS database will help support the goal of a fully-functional livestock traceability system in Canada. Further work would be advised to support the adoption of a common set of metrics to quantify progress towards national traceability objectives. As written the regulation makes no mention of risk based surveillance, nor does it comment on rates of compliance.

5.5 Evaluation of Desired Traceability Technologies and Capabilities (End of Project)

Desire 1 Use data loggers connected to existing RFID scanning systems at farms and co-mingling sites to report data directly to the CLTS database.
This desire has been satisfied. Next steps include the development of a production quality sightings landing server, and the publication of an open set of standards for the automated submission of sightings data to the CLTS system.

Desire 2 Reduce industry's reporting burden through the effective use of sighting data.
The proof that this desire is feasible has been satisfied. Next steps to see real industry benefit are to outline settings where movement data can be inferred from sightings data and to help drive industry adoption of networked ghost readers in these settings. The development of new sightings equipment and the potential to subsidize procurement and maintenance costs of this equipment in high volume or risk settings has the potential to dramatically reduce industry reporting burden of traceability data.

Desire 3 Determine the level of sighting data required to synthesize movement events in the CLTS database that will be acceptable to governments for effective traceback.
This desire is partially satisfied in this study. The technical approaches to quantify the impact of different levels of missing reads in market settings are well demonstrated using the Scottish data. Depending how you define a successful national traceability data system it is clear that perfect read rates in high volume settings do little to help extend our understanding of the animal movement network beyond what we can see with partial rates of observation. In the setting studied, higher read rates in markets helped to simplify the inferred graph of animal movements, reducing the number of potential paths for a disease outbreak to traverse and reducing the traceback.

Desire 4 Increase the speed of the implementation of traceability movement data reporting and use through easy-to-use technology.
As identified in Desire 1, 2 and 3, the proof that these technological solutions can contribute meaningfully is in hand. To satisfy this desire, the development of open standards off of this work, efforts to clarify the role of sightings data in regulatory compliant movement reporting, and industry adoption of ghost reader technology are required.

Desire 5 Use a private data network to broaden the reach for the collection of traceability data in under-served rural areas where Internet service is poor or inaccessible.
This desire is satisfied and well demonstrated. While cellular network connectivity is not perfect, the penetration of this form of networking has widely outpaced Internet service provider based network access. Above the simple presence of cellular networks in rural areas, the automated or pre-configured nature of these devices is believed to have been a big contributor to the projects success.

6 Conclusions

This project found success in a variety of places and raises a set of new policy and technical questions to be considered.

The overall activity of developing, deploying and testing ghost reader solutions in the Alberta environment is a clear success. The six primary objectives and five end of project desires were also well supported. This project showed that given the current state of the art in RFID reader technology it is possible to collect traceability data in a fully automatic fashion at little to no burden to operators, for small costs. The synthesis of movement data out of this automatically collected sightings data is a task that can be readily achieved and depending on the setting, fully automated.

6.1 Recommendations

This project has supported the assessment of the utility of sightings data in the synthesis of movement records. While there is great potential to improve the national livestock traceability system through the use of ghost readers and sightings data, the authors of this report feel that undertaking activities in the following 4 themes could help drive adoption and formalize the CCIAs goal of a industry sustained, continuously improving traceability system for Canada.

1. Continue to refine and extend the sightings data submission framework to support a broad network of ghost reader equipment.
2. Support the development of policy and guidance on the use of sightings data in the synthesis of individual animal movement records.
3. Support the development of a set of metrics for the quantitative assessment of national traceability system efficacy.
4. Extend the testing of ghost reader equipment to settings outside of cow-calf and feedlot, and to a national scale.