Overcoming environmental constraints to the conduct of passive surveillance in a remote area

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Abstract

Routine disease investigation and sample submission by veterinarians are important components of an early detection and passive surveillance system for diseases with overt clinical signs. Remote areas are typified by low human and animal population densities with large properties running large numbers of stock. Routine disease investigations are often neglected due to the lower availability and relatively high cost of veterinary services and the difficulty of performing a complete clinical examination in the field. On most beef cattle enterprises in north Queensland these difficulties can be overcome. Animals are visually inspected by owners and managers during the routine inspection of watering points in the drier months. Should a clinical problem be noticed, euthanasia and examination post-mortem by a veterinarian is an effective field diagnostic technique. In addition, sale animals undergo a visual inspection at abattoirs and live export depots by veterinarians, and at saleyards and clearing dips by biosecurity inspectors. Overall numbers of animals transiting these facilities can be obtained by reference to the National Livestock Identification System database. Properties or areas with low levels of husbandry and/or turn-off can be identified and targeted for additional on-ground surveillance.

Introduction

A surveillance system aims to demonstrate the absence of disease, or if present, determine its occurrence and distribution (O.I.E., 2005). It should also detect the presence of an exotic or emerging disease as early as possible. For countries such as Australia, that trade in livestock and their products, it is economically important to demonstrate freedom from the diseases likely to hamper trade.

An important component of a surveillance system is passive surveillance. Here the uses of the information generated do not initiate the sequence of events that lead to a diagnosis (Cameron, 1999). Instead, it is left to an owner or manager to notice a sick animal and then to contact a veterinarian or another person with animal health knowledge. If a veterinarian visits the farm and examines the animal, samples can be submitted to a laboratory. If a significant diagnosis is made, a report is then forwarded to the relevant veterinary authority. A compulsory reporting system exists for specific notifiable diseases in the various Australian states as in most countries. Each step in the sequence of events is dependent on the previous occurring so the initial steps such as the noticing of a sick animal and the contacting of an available veterinarian are the most important. They are also the most influenced by the environment and are factors often assumed to limit our ability to conduct passive surveillance in a remote area. In this paper, these environmental constraints are examined using beef cattle production in the north Queensland shires of Etheridge, Croydon, Carpentaria and Burke as an example. The shires are outlined in Fig.1 (APS, 2006).

Background

The four shires stretch west from the Atherton Tablelands to the Northern Territory border. The main centres of population from east to west are Georgetown (Etheridge), Croydon (Croydon), Normanton and Karumba (Carpentaria) and Burketown and Doomadgee (Burke). Apart from a fishing industry centred on the gulf coastal community of Karumba, the sole agricultural industry is

the raising of beef cattle. Shire areas, population and the number of people employed in agriculture forestry and fisheries are given in Table 1 (ABS 2001).

Table 1 Population density

	Area (km^2)	Population	Number employed in agriculture*	Persons per 1000 km^2	Employed in agriculture* per 1000 km^2
Etheridge	39,309	998	242	25	6.2
Croydon	29,581	279	41	9	1.4
Carpentaria	68,335	3,708	214**	54	3.1**
Burke	41,990	1,634	99	39	2.4

* Includes owners and managers

** Does not include residents with a Karumba postcode

Climate

The four shires have a predominantly summer rainfall with most rain falling from late December to March as shown in Table 2 (Bureau of Meteorology, 2004).

Table 2 Mean Rainfall (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Georgetown	221	213	125	29	9	10	6	4	7	17	50	128	**819**
Croydon	216	178	115	23	8	8	3	3	6	14	44	113	**730**
Normanton	259	249	158	31	8	9	3	2	3	11	44	144	**920**
Burketown	213	196	154	21	6	6	2	1	2	12.9	38	118	**771**

Cattle husbandry

Properties in the area are large but have low stocking rates as illustrated in Table 3 (APS, 2006)

Table 3 Cattle density

	No. of cattle	No. farms >150 cattle	Av. no. cattle per farm	Average farm size (km^2)	Cattle per km^2	Persons employed per 1000 cattle
Etheridge	294,000	96	3,060	410	7.5	0.82
Croydon	176,300	42	4,200	700	5.9	0.23
Carpentaria	430,600	41	10,500	1,700	6.3	0.49
Burke	212,300	22	9,650	1,900	5.0	0.47

With the exception of a few properties in the north of the Burke shire, properties have both boundary and internal fencing allowing segregation of different sexes and age groups.

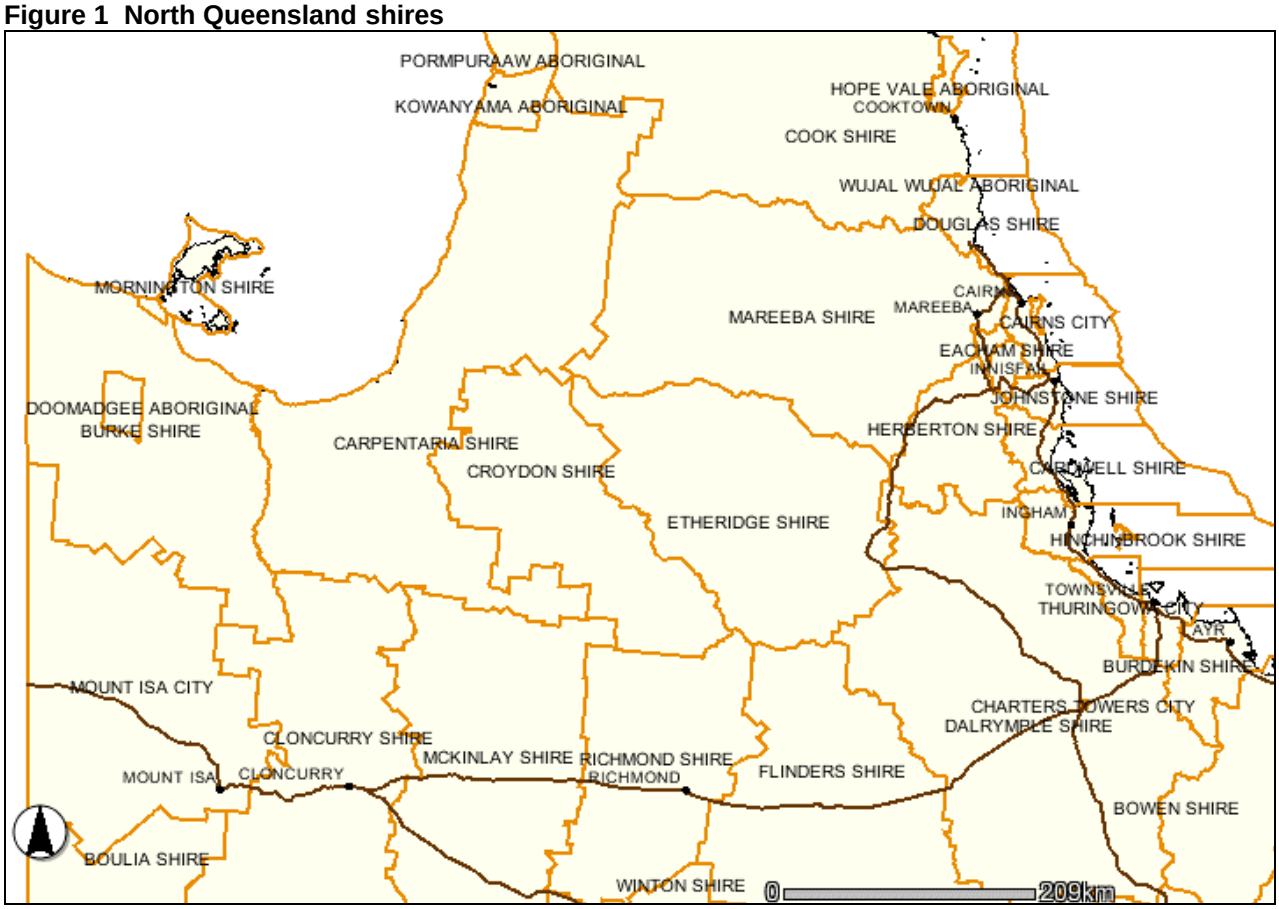
Mating occurs all year around with calving naturally concentrated in the wetter months. Routinely, there are two mustering rounds for breeder cattle each year, the first stretching from March to June and the second from June to August or September. The majority of properties run a breeder operation with stores turned off for grass fattening or to feedlot or live export. Cull cows are usually sold direct to slaughter.

There are permanent water holes along the major river systems but stock are mostly watered via troughs that are gravity fed from tanks or earthen tanks (turkey nests) that are filled by pumping from bores or dams.

Significant areas of Burke and Carpentaria shires have areas of treeless plains, the rest is open forest. Native grasses predominate but buffel grass (*Cenchrus ciliaris*) and uruochloa (*Urochloa panicoides*) are established along water courses. Indian couch (*Bothriochloa pertusa*) is established in areas of Etheridge shire. The stylo legumes, "seca" and "verano", are sown together and are established on about 50 000 hectares in Etheridge and Croydon shires (K.A.Shaw pers com)

Protein levels in pastures steadily decline throughout the drier months and the feeding non-protein nitrogen supplements is common. Virtually the entire area is phosphorous deficient and supplements are usually fed in the wetter months.

Figure 1 North Queensland shires



Opportunities to observe cattle on property

In the drier months from April to November cattle tend to congregate around watering points, arriving between 8:30am and 9:00am and leaving after 4:00pm with the total period spent at water decreasing in cooler weather (Yeates et al, 1974). They mostly graze at night.

Since watering points, especially troughs, are checked two or three times per week there is ample opportunity to observe cattle. Due to constant exposure, cattle become accustomed to vehicles and will allow them to approach within a few metres. Consequently, in the drier months, over three quarters of the animals in even very large herds receive a cursory examination two or three times per week. Dead animals are noticed immediately and towed away. If there is any indication of ill health, animals can be examined more closely by a person driving around and through the mob.

The other main opportunity to observe cattle occurs during mustering, yarding and working cattle in the yards. On larger properties, cattle are first mustered into a holding paddock. This can take up to

ten days depending on conditions and the quantity of forage in the holding paddocks. The widespread use of helicopters has lessened the mustering time of even large paddocks to less than four days. Since cattle often have to walk several kilometres to holding paddocks any individuals that can't keep up with the main group are noticed. The holding paddocks, and the cattle in them, are monitored closely until yarding for fear of the cattle escaping. Cattle can then be observed during yarding and for the next two or three days while in the yards. They are given another check when they are steadied out of the yards, and in the case of breeders, held until calves find their mothers. The percentage of cattle mustered and yarded from a paddock varies considerably but probably ranges from 70% to 95%.

During the wetter months the opportunity to observe cattle is significantly reduced with cattle dispersing and grazing in small groups. Also, many station roads become too wet to use. However, because of low stocking rates, the opportunity for direct transmission of disease to occur is also reduced. The ability to work cattle is lessened and, as a result, meatworks and saleyards close down over the summer period. In recent years the live export trade has continued throughout the year with forward planning needed to source cattle in the wetter months.

Basic records are kept and data obtained from counts of animals mustered, branded and culled each year. From this can be derived branding and weaning percentages and mortality rates.

Availability of animal health professionals

No veterinarians are resident in the any of the four shires. The area is serviced by practices in Charters Towers, the Atherton Tablelands, Cloncurry and Mt Isa. Veterinarians from the Charters Towers practice fly regularly into the area to perform pregnancy testing, speying and treatment of cattle prior to live export. The Mt Isa practice also provides these services to properties in the western shires.

Two biosecurity inspectors employed by the Department of Primary Industries and Fisheries are stationed at Georgetown and Normanton. They work with a government veterinary officer based on the Atherton Tablelands. There is a veterinary diagnostic pathology laboratory in Townsville that is a part of a network of government owned laboratories with NATA accreditation. The Department also employs extension officers based on the Atherton Tablelands, Cloncurry and Mt Isa. They provide advice on nutrition, economics and pasture management.

Opportunities to clinically examine animals on property

The ability to examine animals will depend on where and when animals are noticed sick. As with routine observations, there are two basic situations. One is during mustering, yarding and working cattle. If animals are noticed sick in the yards they can be simply drafted off and restrained in a crush. Due to high travel and operating costs this is where private veterinarians are most likely to examine them.

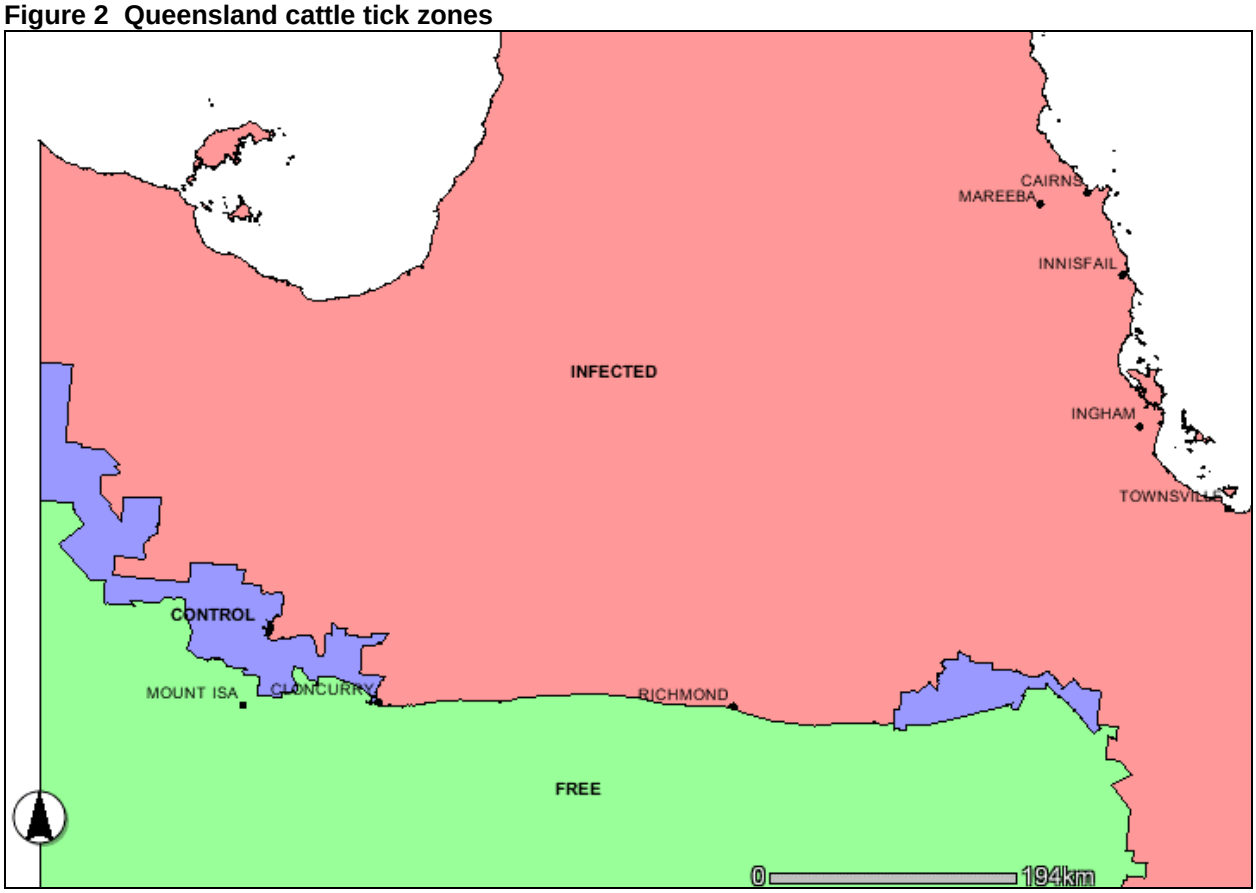
The other situation arises during monitoring of watering points. Mustering is expensive, time consuming, and if unplanned, likely to disrupt tight operational schedules. Consequently, it is more convenient to examine sick animals in the paddock. Since several animals need to be noticed ill to warrant an investigation, animals present at various stages of illness. Recently deceased animals can be examined post mortem, while downers are convenient to examine clinically. If necessary, help is usually available to capture and restrain animals still on their feet. All live animals can be examined post mortem following euthanasia either via an intravenous injection or by shooting.

Ability to observe and examine animals off property

Cattle can be observed at various aggregation points on leaving the property. For younger store cattle, this will include clearing dips along the northern boundary of the Queensland tick free area, as shown in figure 2, where cattle are inspected for cattle ticks (*Boophilus microplus*) and dipped en-route to southern destinations or for live export out of Darwin (APS, 2006). The main saleyards for the area are at Mareeba, Charters Towers, and Cloncurry. Live export depots are located at Karumba, Innisfail, Charters Towers and Townsville. There is a large feedlot at Mareeba. Fat cattle can be sent to export abattoirs at Innisfail and Townsville as well as further south. Hence, store cattle from this area often pass through several aggregation points. For example, they may go to saleyards, then to a clearing dip and then to a southern feedlot prior to slaughter or to a live export depot.

Biosecurity inspectors are present at saleyards and check all stock for compliance with regulations such as the National Livestock Identification Scheme. They also dip cattle at clearing dips although this role has passed to private contractors at some centres. Private veterinarians treat and inspect stock destined for live export while government veterinarians perform a final preloading inspection. All cattle slaughtered at export abattoirs undergo an ante-mortem inspection by a government veterinarian prior to slaughter. All of the above aggregation points have facilities to clinically examine sick animals and to carry out autopsies.

Figure 2 Queensland cattle tick zones



Discussion

Examination and treatment of single animals by veterinarians is not the norm in this area unless a veterinarian is on the property for another reason. However, the scale of operation of most enterprises renders investigation of significant disease outbreaks cost effective. The fact that private veterinarians derive most of their income from production-related activities such as pregnancy testing, speying and live export work does not mean that significant disease occurrences are not noticed or not investigated. It is more the case they do not occur. Infectious diseases that cause significant production losses such as pleuropneumonia, tuberculosis and brucellosis have been eradicated. Endemic vector borne diseases such as ephemeral fever, tick fever and anaplasmosis do not cause clinical illness if animals are first infected when young and herd immunity remains high. Widespread vaccination for botulism prevents losses from this disease. Although the total number of animal health professionals working in the area is low the ratio of professionals to graziers is comparable to more closely settled areas.

The weak link in the existing surveillance system lies with properties that have poor infrastructure in the way of fences, roads and watering points. Here the poor quality of soils and pastures do not allow adequate returns on capital invested. If owners or mangers actually live on these properties, they have less opportunity to monitor the health of cattle on a day to day basis. Also, fewer cattle are marketed so passage through aggregation points is less. Random surveys often do not include these cattle due to the difficulty in establishing the population denominators and in collecting samples. Thankfully, they make up only a small proportion of properties and the cattle on them comprise a small proportion of the total cattle population.

Assessing the effectiveness of a passive surveillance system presents difficulties and is ultimately reliant on expert opinion (OIE, 2005). A new method that utilises scenario trees and probability modelling enables the calculation of surveillance system sensitivities from multiple complex data sources (Martin et al). Although originally developed to demonstrate freedom from disease in intensive industries, it can be adapted to more remote areas and industries. Factors that affect the probability of infection and, ultimately, detection of disease can be incorporated into the model as can the differential risk of infection. Although the effectiveness of clinical on-farm surveillance may be difficult to quantify, especially on properties with poor infrastructure, accurate numbers of animals entering aggregation points can be obtained from the NLIS database. Depending on the level of sensitivity required, properties or areas that do not have adequate surveillance can be identified with the model. These properties can then be targeted for increased monitoring.

Conclusion

The size and remoteness of cattle properties do not necessarily lessen the probability of disease detection. It is important to consider the advantages of conducting surveillance in a remote area and to identify opportunities to better analyse the systems already in place.

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References

Agricultural Property Systems, 2006. Queensland Department of Primary Industries and Fisheries database.

Australian Bureau of Statistics, 2001. 2001 Census - Basic Community Profile by Location Name (local government areas), http://www.abs.gov.au

Bureau of Meteorology, 2004. Climate Averages for Australian Sites, http://www.bom.gov.au

Cameron, A.R., 1999, Survey Toolbox – A Practical Guide and Software Package for Active Surveillance of Livestock Diseases in Developing Countries. Australian Centre for International Agricultural Research, http://www.aciar.gov.au

Martin, P.A.J., Cameron, A.R., and Greiner, M. In preparation.

OIE, 2005. Terrestrial Animal Health Code. World Organization for Animal Health (Office International des Epizooties). Paris,France.

Yeates, N.T.M. & Schmidt, P.J., 1974. Beef cattle Production. Butterworth, London.