

RESEARCH PAPERS AND REPORTS IN ANIMAL HEALTH ECONOMICS

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Working Paper No. 26

**Collecting Animal Health Data for Cattle
Properties in Extensive Grazing Systems**

by

Gavin Ramsay

November 1996



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'The overall goal of this project is to develop and evaluate the necessary tools to provide decision-makers with reliable animal health information which is placed in context and analysed appropriately in both Thailand and Australia. This goal will be achieved by improving laboratory diagnostic procedures; undertaking research to obtain cost-effective population referenced data; integrating data sets using modern information management technology, namely a Geographical Information System (GIS); and providing a framework for the economic evaluation of the impact of animal diseases and their control.

A number of important diseases will be targeted in the project to test the systems being developed. In Thailand, the focus will be on smallholder livestock systems. In Australia, research will be directed at the northern beef industry as animal health information for this sector of livestock production is presently scarce.'

For more information on *Research Papers and Reports Animal Health Economics* write to Professor Clem Tisdell (c.tisdell@economics.uq.edu.au) or Dr Steve Harrison, (s.harrison@uq.edu.au) Department of Economics, University of Queensland, Brisbane, Australia, 4072.

COLLECTING ANIMAL HEALTH DATA FOR CATTLE PROPERTIES IN EXTENSIVE GRAZING SYSTEMS

ABSTRACT

This chapter reviews the methods that have been used for the collection of animal health data then specifically examines three methods of data collection being used in the animal health information system by the Queensland Department of Primary Industries (QDPI). One method of passive data collection, namely laboratory submissions, and two active methods are considered. The laboratory database examined is maintained as part of the QDPI laboratory services. The active data have been collected as part of the system of Structured Animal Health Surveillance (SAHS) that is being set up in Queensland (Baldock, 1995) and the two methods considered are the collection of serum specimens from animals on-farm and the collection of serum specimens at an abattoir. The strengths and weaknesses of each method of data collection are examined in this chapter. In the case of laboratory data their use in estimating disease occurrence is examined. In the case of serological testing the usefulness in determining age specific seroprevalence of the two methods for the collection of specimens is compared.

Keywords: animal health, animal health data collection, Queensland Department of Primary Industries, QDPI,

JEL Codes: Q160

COLLECTING ANIMAL HEALTH DATA FOR CATTLE PROPERTIES IN EXTENSIVE GRAZING SYSTEMS

1. Introduction

Many methods are available for the collection of animal health data. In intensive production systems, health and production data can be collected for each individual animal in the herd and recorded in a computer database enabling analysis of the herd's health and production status. This is, however, not practical where animals are grazed extensively. Alternatively, data can be collected from a sample which simplifies data collection and reduces the cost of collection.

This chapter reviews the methods that have been used for the collection of animal health data then specifically examines three methods of data collection being used in the animal health information system by the Queensland Department of Primary Industries (QDPI). One method of passive data collection, namely laboratory submissions, and two active methods are considered. The laboratory database examined is maintained as part of the QDPI laboratory services. The active data have been collected as part of the system of Structured Animal Health Surveillance (SAHS) that is being set up in Queensland (Baldock, 1995) and the two methods considered are the collection of serum specimens from animals on-farm and the collection of serum specimens at an abattoir. The strengths and weaknesses of each method of data collection are examined in this chapter. In the case of laboratory data their use in estimating disease occurrence is examined. In the case of serological testing the usefulness in determining age specific seroprevalence of the two methods for the collection of specimens is compared.

2. Sources and Quality of Animal Health Data

Animal health data can be collected from a number of sources, including reports of disease from individual farmers, government officials, private veterinarians and as a result of specimens submitted from sick or dead animals to a diagnostic laboratory (Ogundipe et al., 1991). In all cases this method of data collection requires that clinical disease is detected and reported. These methods of data collection are often referred to as passive methods and the data collected as passive data. Passive data will only provide accurate indications of the level

of disease in the population if most cases of disease are reported, and appropriate records of the number of animals affected and the severity of disease are kept. Laboratory records have often been used as a source of animal health data. Each diagnosis is confirmed by the laboratory and the data are often stored in computerised databases hence they are relatively easily extracted and analysed (King, 1985).

Passively collected data has several weaknesses the most important of which are: the reliance on the recognition of disease by the livestock producer, and the lack of accurate data on the number of animals affected by, and the number at risk of becoming, diseased. In the first case disease reports from livestock producers are not always reliable because disease diagnosis is often not a simple task and in many cases it is not possible for the livestock producer to determine the cause of sickness or death in his animals. Particular problems occur where animals are grazed under extensive conditions. This is because under extensive grazing conditions it is difficult for the livestock producer to detect sick animals, especially if a small number of animals are affected by a disease or the clinical signs of the disease are mild. In some cases the producer may not notice that animals have died until the herd is mustered. The problem of detecting diseased and dead stock is accentuated if animals are not accessible due to adverse conditions, such as seasonal flooding. Therefore, questioning the owner may not provide an accurate assessment of the disease status of a herd or property.

Reliance on passively collected data can result in under-reporting of disease incidence as was found in Nigeria by Ogundipe et al. (1991). Systems which rely on laboratory results may be biased (Bender et al., 1994, Peauroi et al., 1991) and lead to incorrect conclusions being made on the occurrence of livestock disease.

Animal health data may be actively sought, for example, by a private veterinarian regularly visiting a property to examine animals and collect diagnostic specimens and animal health records, as often occurs in a herd health program. This type of data collection is suitable for small or intensive properties where it is relatively simple for the farmer or his veterinarian to collect disease and production data for individual animals or groups of animals.

Where data that are representative of a region, state or nation are required, different techniques must be applied to ensure the collection of representative data. The deficiencies of passive data collection methods have been recognised in the USA and the National Animal Health Monitoring Scheme (NAHMS) has been developed which combined active and

passive methods of data collection.

The collection of specimens at the time of slaughter is another method of active data collection. This approach has been especially used in pigs to determine the prevalence of important chronic diseases on farms (Christensen et al., 1994; Willeberg et al., 1984) and in cattle to examine the occurrence of fascioliasis in beef cattle (Baldock and Arthur, 1985) and bovine hydatidosis in Baldock et al. (1985) as well as for surveillance for a number of other diseases.

Active surveillance can involve the collection of serum specimens from a sample of animals. This technique is effective in that many diseases leave measurable markers, in the form of antibodies which reflect the host response to disease and can be detected by laboratory tests. In the case of some diseases antibodies remain at detectable levels for the lifetime of the animal following a single infection, while for other diseases the level of antibodies declines over time to the point where the antibodies can no longer be detected. If an animal is reinfected a boost is given to the antibody level and the decline is arrested. Serological tests are able to detect if an animal was infected in the past, but cannot be used to determine the time at which an animal became infected nor how severely it was affected. In addition, detection is limited to diseases for which a serological test is available. If detectable antibody titres are short lived, the disease frequency may be underestimated.

It is important to note that active and passive surveillance are not mutually exclusive and disease data collection may involve a number of methods including both active and passive methods as is being carried out in Queensland in Structured Animal Health Surveillance.

3. The Laboratory-on-line Information System

In 1987 the Queensland Department of Primary Industries introduced an on-line computerised laboratory database known as the Laboratory On-line Information System (LOIS). LOIS was introduced to the Central Queensland laboratory at Rockhampton at the end of 1989. Before the introduction of LOIS, specimen and diagnostic details were recorded in an off-line batch system (Elder, 1976). Livestock producers, private veterinary practitioners and veterinary staff from the QDPI submit specimens from cases of disease to the QDPI diagnostic laboratories. LOIS records data on types of specimens submitted, property of origin, and diagnosis made as well as epidemiological data including species, age,

breed, sex, type, number in the group, number affected and number that have died.

In this study data from Central Queensland have been extracted from the LOIS database for the period January 1990 to January 1995 for diagnoses of bovine ephemeral fever and *B. bovis* infection. Placed in an Access data base and examined for the monthly occurrence of disease, age, breed and sex of affected animals and the usefulness of the epidemiological data in determining the severity of disease outbreaks.

3.1 Data in the LOIS database from cases of bovine ephemeral fever

A total of 65 cases of bovine ephemeral fever are recorded in the database for Central Queensland for the years 1990-94. Almost all of these were diagnosed in animals three years old or less. The frequency distribution of cases by age is presented in Figure 1. In 15 cases the age was not stated in the database. Almost all cases of bovine ephemeral fever were recorded in animals less than four years old with few cases in older animals. Five cases were recorded in animals less than one year old with a peak of 18 cases in animals three years old.

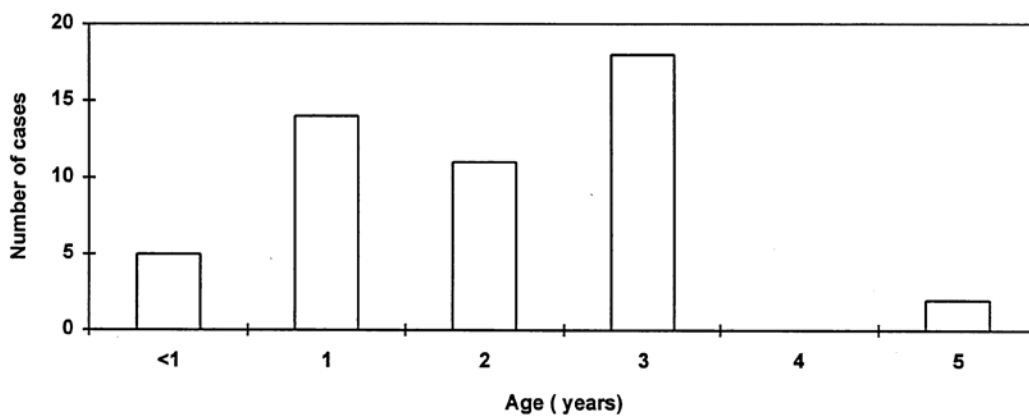


Figure 1: Number of cases of bovine ephemeral fever by age, Central Queensland, 1990-94

Bovine ephemeral fever was diagnosed in all months of the year with the number of diagnoses peaking in November (Figure 2). However, there has been considerable variation between years in both the number of cases diagnosed (Figure 3) and the seasonal distribution of those cases. The increase in the number of cases from 1991 may have been due to a change in the method of diagnosing bovine ephemeral fever rather than due to an increase in the number of cases. Prior to January 1991 bovine ephemeral fever had been confirmed by the

use of serological tests. This required the collection of a serum specimen at the time the animal was sick and a second specimen after the animal had recovered, an inconvenient procedure. After January 1991 virus isolation was introduced which requires a single specimen of blood, collected when the animal is sick, which simplified specimen collection (Pierce, 1996).

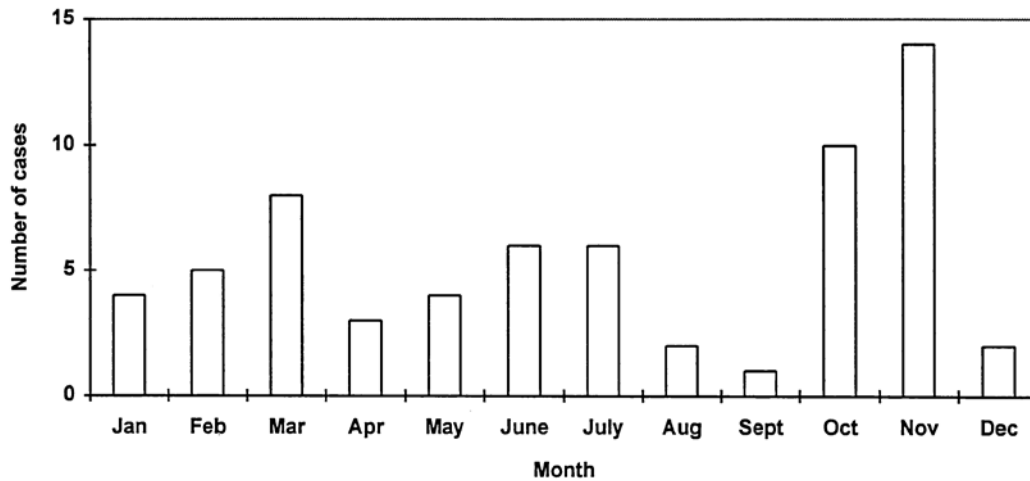


Figure 2: Number of cases of bovine ephemeral fever by month, Central Queensland, 1990-94

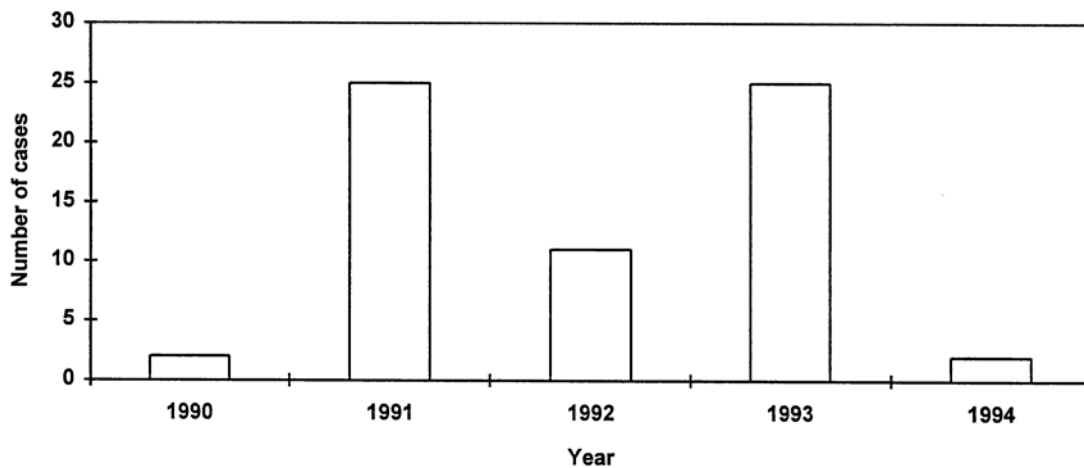


Figure 3: Number of cases of bovine ephemeral fever by year, Central Queensland, 1990-94

3.2 Data in LOIS database from cases of *Babesia bovis*

A total of 152 cases of *B. bovis* infection were diagnosed. Most of these cases were in animals aged three years or less with a peak at two years old (Figure 4). Age was not recorded in the database for 31 cases.

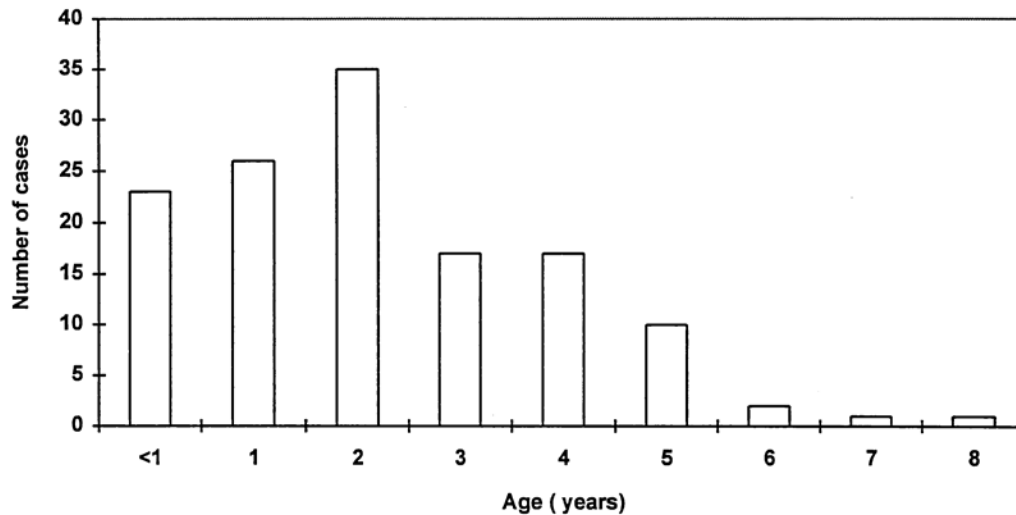


Figure 4: Number of cases of *B. bovis* by age, Central Queensland, 1990-94

Cases of disease were diagnosed in each month of the year with the number of cases in November being slightly higher than each of the other months (Figure 5). There was variation between years in the number of cases diagnosed (Figure 6).

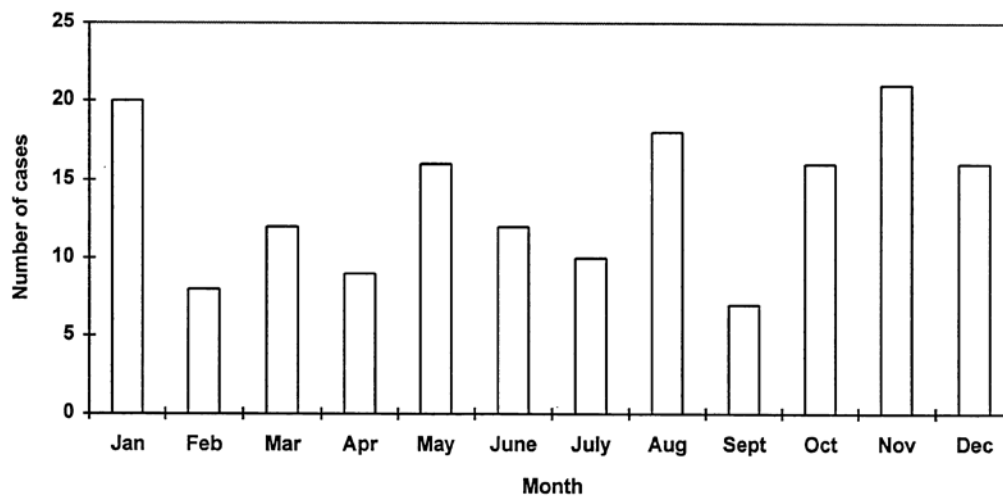


Figure 5: Number of cases of *B. bovis*, by month, Central Queensland, 1990-94

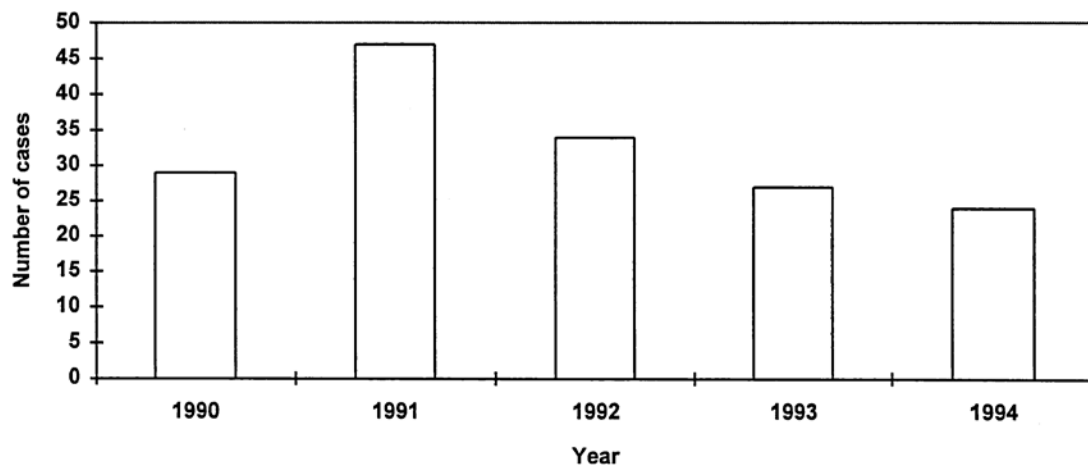


Figure 6: Number of cases of *B. bovis* by year, Central Queensland, 1990-94

3.3 Epidemiological data in the LOIS database

The need for data about the extent of each outbreak of disease was recognised when LOIS was designed and data to indicate the size and severity of the disease outbreak was included on the submission form and stored in the epidemiology section of LOIS.

The epidemiology data collected in LOIS consist of:

- total number of animals in the herd and number at risk of contracting the disease,
- the number showing clinical signs of the disease,
- number dead from the disease, and
- date of onset of the disease.

Because age is important epidemiological information, age is also considered to be an important part of the epidemiological data in LOIS and is also examined in this section.

Table 1: Number of complete records for bovine ephemeral fever and *B. bovis* in the LOIS database

Disease	Age of affected animals	Total number in herd	Number at risk	Number sick or dead	Date of onset	All sections completed
BEF(65)	50 (77%)	36 (55%)	37 (57%)	54 (83%)	38 (58%)	15 (25%)
<i>B.bovis</i> (152)	121(80%)	73 (48%)	103 (68%)	117 (77%)	87 (57%)	46 (30%)

In many cases recorded in LOIS the epidemiological data are not complete. In Table 1 the numbers reported in the column “all completed” are the numbers of records in which each and every field of the epidemiology section of LOIS is complete. That is data on age of animals, total number in the herd, number at risk, number sick or dead, and the date of onset are present in the database for a record for that record to be complete. When complete these fields provide the data necessary for the calculation of age specific disease rates. In the case of the column “Number sick or dead” in Table 1 if a number is recorded in either field (number sick, or number dead), the data are regarded as complete. This is because in both the number sick and the number dead it is not possible to differentiate between cases where the data have not been provided and cases where no animals are sick, or no animals are dead, because in both cases the database records the number zero. It was therefore decided that if both columns read zero then the data are incomplete but, if an entry is present in either column then the data are regarded as being complete. This will tend to overestimate the number of complete records.

The epidemiological data were incomplete in most cases which limited the usefulness of these data. For example, it is not possible to calculate age-specific disease rates from the number of cases of disease that have occurred without knowing the number of animals at risk of contracting the disease, the age of the animals affected and the duration of the outbreak. In addition, with only 15 completed records for bovine ephemeral fever over a period of five years the ability to extrapolate these data to the region as a whole is limited. While the number of complete records for *B. bovis* is much larger, at 46 it is again too small for interpretation on the severity of disease outbreaks due to *B. bovis*.

No checks on the reliability of the data given on the submission form are made at the time of entry into LOIS and the true situation has on occasions been found to be different from that reported on the submission form (Bock, 1996).

3.4 Interpretation of LOIS data

Care must be taken in interpreting the data in LOIS as it does not provide an indication of the number of animals affected by a disease but rather provides a count of the number of cases of disease that have had specimens submitted to the laboratory. A case may vary in the number of animals that are affected by the disease, the age of the animals affected and the severity of the disease.

It is also important to note specimens are only submitted from a proportion of cases of the disease. Therefore, the cases in the laboratory database may not be representative of the cases of disease that occur in the farm animal population in Central Queensland. The few specimens submitted to the laboratory for the diseases being examined limit the use of these data to determine seasonal trends or the ages of animals most affected by the disease. The major use of these data is to confirm that a disease has occurred in the region however, the data cannot be used to state that a disease does not occur in a region.

Several reasons can be suggested for the small number of specimens submitted for laboratory diagnosis in Central Queensland. It is possible that disease is rare in cattle grazed in Central Queensland. However, it is also possible that disease occurs more commonly than these data suggest and that specimens are not submitted from a large proportion of cases. Specimens from animals showing signs of disease or dead animals may not be submitted for laboratory examination because:

- clinical disease is rarely seen by producers,
- clinical diagnoses are usually made by cattle producers or their veterinary surgeons and laboratory diagnosis is not regarded as necessary,
- the collection of specimens requires that the animal is restrained which may require mustering, an additional expense and a source of stress to the animal, and
- many diseases cannot be treated even when a diagnosis has been made, therefore producers do not perceive that collecting specimens and having a diagnosis confirmed will be of use to them.

It is difficult to know why the epidemiological data are incomplete; however, several factors

could have played a role, including:

- the definition of the categories was unclear, making it difficult for those submitting the specimens to fill out the form,
- data needed to complete the form were not available or not collected, and
- the submitter of the specimens did not believe the data to be of significance. This is possible as the data held in the LOIS database are difficult to access and are not regularly summarised and reported to those submitting specimens.

It is important to note that the epidemiology data in LOIS relate only to cases of disease that occurred up to the time specimens were taken and submitted to the laboratory. In many cases the disease outbreak may continue with additional cases of clinical disease and more deaths occurring after specimens have been collected.

4. The Collection of Serological Samples From Cattle Properties

A system of on-farm sampling is being trialed as part of SAHS by the QDPI. The method being used for sample selection and specimen collection in Central Queensland is outlined in this section.

In 1994, 60 herds were selected at random from herds in Central Queensland having 50 or more breeding females. Blood samples were obtained from only 46 of the herds because drought restricted the ability of some producers to muster cattle. From each of these herds 30 blood samples were collected, 15 from young animals that were about one year old, and another 15 from animals older than three years.

The sample size of 30 animals per herd was chosen on the basis of detecting a disease where at least 5% of herds are affected by the disease and in those herds at least 10% of animals are affected (Baldock, 1994). The division of this into two sub-samples within the herd leads to some difficulties because the sample size is small if one wishes to determine age specific seroprevalence.

Age was estimated and recorded for all of the animals in 32 of the herds sampled. The vaccination status for 44 of the 46 herds was also recorded. The vaccination status of the herd is important because vaccination against the diseases being tested for would interfere with the tests being carried out.

4.1 Seroprevalence results from on-farm sampling

The results of serological tests for bovine ephemeral fever and *B. bovis* in yearling animals are examined in this section. The results from the older animals are not examined because a mixture of ages were generally sampled on each property making the results of limited use in calculating age-specific seroprevalence.

While serum specimens were collected from 46 properties in 1994, serology for *B. bovis* was carried out on samples from 31 properties only. This was because vaccination was carried out on 15 properties. In the case of *B. bovis* the specimens collected from 15 young animals only were tested because the sensitivity of the tests used decreases as animals age (Bock, 1996).

Most herds sampled in 1994 exhibited a low seroprevalence for bovine ephemeral fever in yearling animals. None of the herds sampled had a seroprevalence of greater than 50% (Figure 7). The herd seroprevalence for *B. bovis* varied more with a range of seroprevalences present (Figure 8).

The high proportion of properties where the seroprevalence was low for both diseases could have been due to the drought conditions that prevailed in Central Queensland at the time of sampling. Both diseases are transmitted by arthropod vectors and the size of vector populations would have been reduced by these conditions. Collection of specimens from the same properties over a period of years and under a variety of conditions would enable the effect of climatic conditions on the rate of seroconversion to be examined.

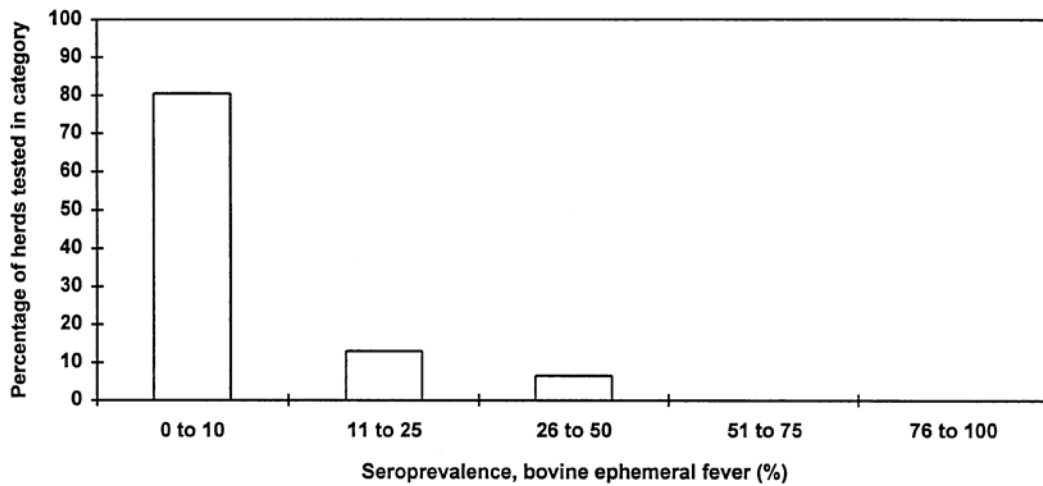


Figure 7: Seroprevalence of bovine ephemeral fever in yearling animals sampled in structured animal health surveillance (1994) indicating the percentage of herds sampled in each category of seroprevalence

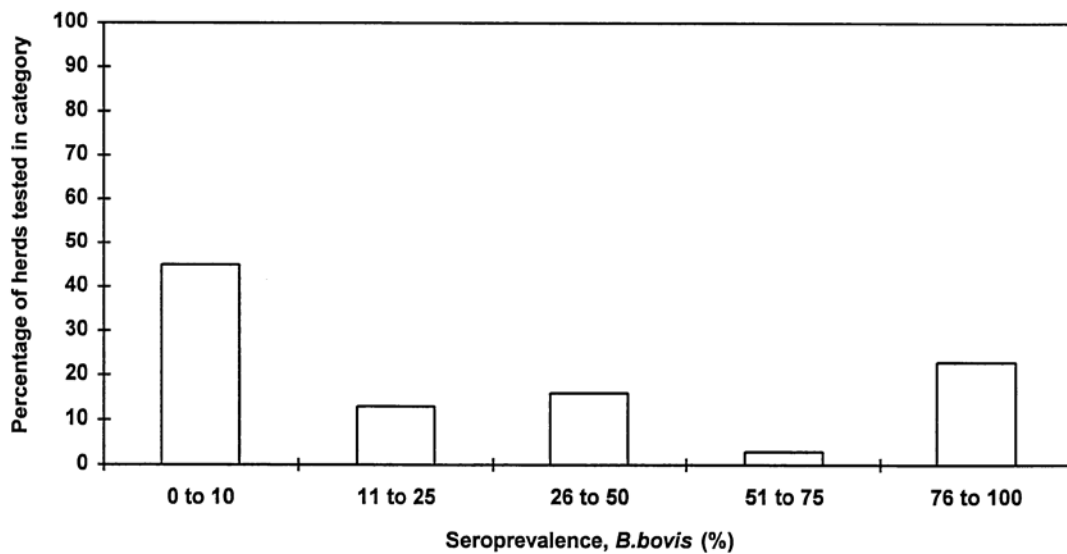


Figure 8: Seroprevalence of *B. bovis* in yearling animals sampled in structured animal health surveillance (1994) showing the percentage of herds sampled in each category of seroprevalence

4.2 Estimating the cost of on-farm sampling

A method to determine the cost of on-farm sampling and analysis of specimens is developed in this section. This method is used in a subsequent paper to determine the value of the collection of additional information on animal health to a producer considering the implementation of a disease control program.

The costs associated with on-farm sampling can be divided into several categories, these are: start-up costs, travel costs, cost of collecting the specimens, cost of laboratory testing of specimens, and mustering and handling costs. Each of these categories are examined in this section.

Start-up costs include the cost of determining the appropriate number of specimens to be collected and the age groups from which these specimens are to be collected and the cost of organising with the livestock producer a suitable date and time for the specimens to be collected. This was estimated to take half an hour per property (Black 1996).

Travelling costs were taken as those charged by the farm animal veterinary services operated by the Department of Farm Animal Medicine and Production at the University of Queensland and the rate is 80 cents per kilometre.

Collection costs are estimated as \$5 per specimen. This is calculated using the hourly rate charged by the farm animal veterinary services operated by the Department of Farm Animal Medicine and Production at the University of Queensland of \$80 per hour plus a cost of \$1 per sample for collection equipment. It is assumed that specimens could be collected at a rate of 30 specimens in one and a half hours (Black, 1996).

Mustering costs would be incurred only if animals were mustered specifically for the collection of specimens. If animals were already mustered there would be an extra labour cost for the additional time the animals were yarded. In most cases the additional labour cost would be small.

The cost of sampling (COS) can therefore be approximated using the function:

$$\text{COS} = s + k_n n + k_t n + k_d d + k_m$$

where s is the start-up cost

k_n is the collection cost per specimen

k_t is the cost of laboratory testing per specimen n is the number of specimens collected

k_k is the travel cost to the farm per kilometre

d is the number of kilometres travelled to collect the specimens and

k_m is the cost of mustering and handling the cattle for specimen collection

5. Abattoir Studies to Determine Age-specific Seroprevalence

Abattoir sampling is defined as the collection of specimens from animals at the time they are presented for slaughter at an abattoir. Abattoir sampling provides a relatively inexpensive and convenient method of specimen collection. The collection of serum specimens that are tested for disease antibodies and the use of findings from routine meat inspection are convenient ways in which information on the infectious disease status of a herd can be obtained. Abattoir sampling cannot be used to estimate the prevalence of all infectious diseases; however, it is useful for diseases which:

- leave measurable markers such as serum antibodies or specific chronic lesions,
- only rarely cause mortality,
- do not have extreme effects on productivity, and
- are not likely to select for or against an animal being sent to slaughter.

The abattoir population is a selected portion of the farm animal population and will be dominated by specific classes of animals, including:

- animals that have reached market weight and condition,
- animals culled due to reproductive failure,
- animals which have reached the end of their reproductive life, and
- animals not required for reproduction of the herd, such as surplus heifers.

The specific ages and weights of animals slaughtered and the proportions in different age categories will vary considerably between areas and will not be in the same proportions as those in the farm animal population. For this reason the abattoir population may not be

representative of the farm animal population.

A small pilot study carried out in Central Queensland by the author, in association with Dr Peter Black, is described in this section. The aims of this study are to determine the practical feasibility of collecting specimens at the abattoir and the usefulness of abattoir data in estimating the age specific seroprevalence for *B. bovis* and bovine ephemeral fever for individual farms.

5.1 Abattoir study procedure

In this study specimens were collected only from female cattle. This is because female cattle are rarely sold between farms and are, therefore, likely to have spent their entire life on the property from which they are consigned to the abattoir. Sampling from female cattle provides an indication of the disease status of their property of origin. Male cattle are more often traded between farms and are not included in this study as specimens collected from male cattle do not necessarily reflect the disease status of the property of consignment. Specimens from young animals were collected where possible as young cattle can be aged more accurately than older cattle.

All specimens were collected on a single day. As many specimens as possible were collected from cattle slaughtered from each of three properties. Each animal from which a specimen was collected was aged by its dentition.

5.2 Results from abattoir sampling

Most of the cattle slaughtered from the three properties were mature cows four or more years old. This poses problems in the calculation of age-specific seroprevalence as cattle that have a full set of permanent teeth cannot be accurately aged but are classed as four years old or older. No cattle younger than two years old were slaughtered from the properties being sampled. The distribution of the ages of the cattle sampled is shown in Figure 9.

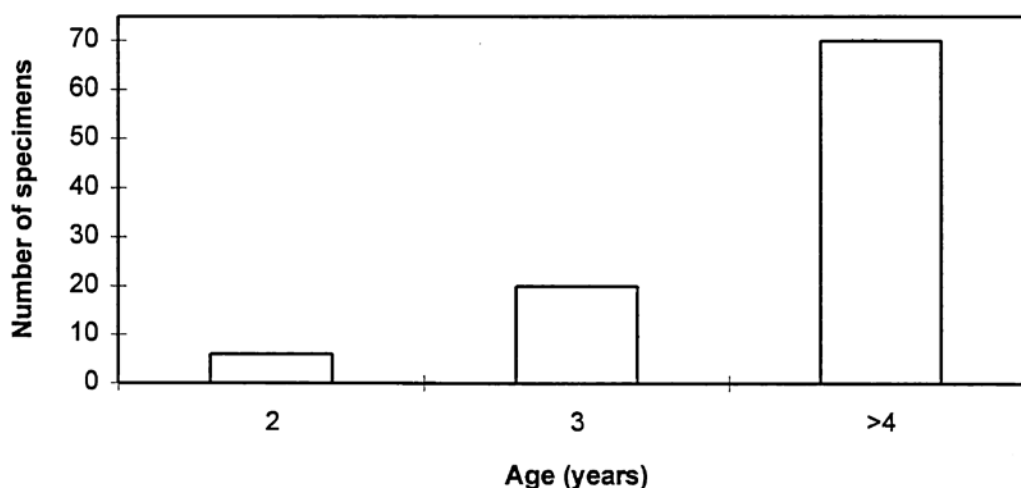


Figure 9: Age distribution of cattle from which specimens were collected at the abattoir

Close liaison was needed with the abattoir staff to ensure that the specimen collectors were aware of the property of origin of the cattle being slaughtered and when this changed. It was difficult to collect specimens from every animal slaughtered when the slaughter chain was restarting after breaks, because the chain moved more rapidly at these times. Two people were needed for abattoir sampling, one to collect the specimens and one to record details and to ensure that the specimens were being collected from the appropriate cattle. Neither task required a high level of skill.

The fact that the abattoir population consisted mainly of aged animals and the inability to age older animals accurately meant that abattoir sampling did not provide a satisfactory method for the collection of serum specimens to calculate age-specific seroprevalence.

6. Conclusion

Three methods of data collection have been examined in this paper, namely data from the QDPI laboratory database LOIS, data from on-farm serum sampling and data from serum specimens collected at an abattoir.

The data in the LOIS database have proved to be of limited use in determining the incidence of disease in the cattle population of Central Queensland. The data do not represent the farm

population closely, the collection of epidemiological data is not always carried out, and when it is carried out the reliability of those data are not known. The LOIS data are useful to state that a disease is present in an area, although they cannot be used to state that a disease or disease agent is absent.

Age specific seroprevalence could be estimated from serum specimens collected from cattle on the farm. This was because the specimens could be collected from cattle of known age. However, it was difficult to determine age specific seroprevalence from specimens collected at the abattoir. This was because the majority of cows slaughtered at the time the study was carried out were at least four years old and could not be aged accurately.

7. Acknowledgements

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