AUSTRALIAN VETERINARY EMERGENCY PLAN

AUSVETPLAN

Disease Strategy

Bluetongue

Version 3.2, 2013

AUSVETPLAN is a series of technical response plans that describe the proposed Australian approach to an emergency animal disease incident. The documents provide guidance based on sound analysis, linking policy, strategies, implementation, coordination and emergency-management plans.

Standing Council on Primary Industries

This disease strategy forms part of:

AUSVETPLAN Edition 3

This strategy will be reviewed regularly. Suggestions and recommendations for amendments should be forwarded to:

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DISEASE WATCH HOTLINE

1800 675 888

The Disease Watch Hotline is a toll-free telephone number that connects callers to the relevant state or territory officer to report concerns about any potential emergency disease situation. Anyone suspecting an emergency disease outbreak should use this number to get immediate advice and assistance.

Preface

This disease strategy for the control and eradication of bluetongue is an integral part of the **Australian Veterinary Emergency Plan**, or **AUSVETPLAN (Edition 3)**. AUSVETPLAN structures and functions are described in the AUSVETPLAN **Summary Document**. This bluetongue strategy provides information about the disease (Section 1); the relevant risk factors and their treatment, and the options for the management of a disease outbreak depending on the circumstances (Section 2); and the suggested starting policy and guidelines for agencies and organisations involved in a response to an outbreak (Sections 3 and 4). The key features of bluetongue are described in Appendix 1.

This manual has been produced in accordance with the procedures described in the AUSVETPLAN **Summary Document** and in consultation with Australian national, state and territory governments, and the relevant livestock industries.

Bluetongue is included on the World Organisation for Animal Health (OIE) list of notifiable diseases as a multiple species disease. This obliges OIE member countries that had been free from the disease to notify the OIE within 24 hours of confirming the presence of bluetongue. OIE-listed diseases are diseases with the potential for international spread, significant mortality or morbidity within the susceptible species, and/or potential for zoonotic spread to humans.[1]

The strategies in this document for the diagnosis and management of an outbreak of bluetongue are based on the recommendations in the OIE *Terrestrial Animal Health Code*[2] and the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals*.[3]

In Australia, bluetongue is included as a Category 3 emergency animal disease in the *Government and Livestock Industry Cost Sharing Deed in Respect of Emergency Animal Disease Responses* (EAD Response Agreement).[4]

An emergency response to bluetongue is required when clinical disease caused by bluetongue virus (BTV) is detected in ruminants or when requested by the Consultative Committee on Emergency Animal Diseases. In the absence of clinical disease, when evidence of a circulating strain of a pathogenic BTV is detected through the National Arbovirus Monitoring Program (NAMP) or other monitoring, and/or when serological or other evidence of viral spread is detected in areas where competent vectors are not known to occur, an investigation will be

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[1] These criteria are described in more detail in Chapter 1.2 of the OIE *Terrestrial Animal Health Code* (www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.1.2.htm).

[2] www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.8.3.htm

[3] www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.01.03_BLUETONGUE.pdf

[4] Information about the EAD Response Agreement can be found at www.animalhealthaustralia.com.au/programs/emergency-animal-disease-preparedness/ead-response-agreement

undertaken in accordance with NAMP guidelines. Circulation of endemic strains of BTV is likely to continue within the recognised BTV zone.

In this manual, text placed in square brackets [xxx] indicates that that aspect of the manual remains contentious or is under development; such text is not part of the official manual. The issues will be worked on by experts and relevant text included at a future date.

Detailed instructions for the field implementation of AUSVETPLAN are contained in the disease strategies, operational procedures manuals, management manuals and wild animal manual. Industry-specific information is given in the relevant enterprise manuals. The full list of AUSVETPLAN manuals that may need to be accessed in an emergency is shown below.

AUSVETPLAN manuals[5]

Disease strategies

- Individual strategies for each of 35 diseases
- Bee diseases and pests
- Response policy briefs (for diseases not covered by individual manuals)

Operational procedures manuals

- Decontamination
- Destruction of animals
- Disposal
- Livestock welfare and management
- Public relations
- Valuation and compensation

Enterprise manuals

- Artificial breeding centres
- Feedlots
- Meat processing
- Saleyards and transport
- Poultry industry
- Pig industry
- Zoos

Management manuals

- Control centres management (Parts 1 and 2)
- Laboratory preparedness

Wild animal response strategy

Summary document

Nationally agreed standard operating procedures[6]

Nationally agreed standard operating procedures have been developed for use by jurisdictions during responses to emergency animal disease incidents and emergencies. These procedures underpin elements of AUSVETPLAN and describe in detail specific actions undertaken during a response to an incident.

Information on bluetongue is also available in the *Reference Guide for Animal Health Staff* (FAO and SPC, nd) and the 'Gray Book' (United States Animal Health Association 2008).

[5] The complete series of AUSVETPLAN documents is available on the internet at: www.animalhealthaustralia.com.au/programs/emergency-animal-disease-preparedness/ausvetplan

[6] www.animalhealthaustralia.com.au/programs/emergency-animal-disease-preparedness/nasops

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1 Nature of the disease

Bluetongue is an arthropod-borne viral (arboviral) disease of ruminants of variable clinical severity, characterised by inflammation of mucous membranes, widespread haemorrhages and oedema. Ten of the 26 internationally recognised serotypes of bluetongue virus (BTV) and several related viruses in the *Orbivirus* genus have been recorded in northern Australia, although some of these serotypes are detected infrequently. The highly pathogenic strains encountered in Africa, North America, Europe and parts of Asia are exotic to Australia.

1.1 Aetiology and pathogenicity

BTV belongs to the *Orbivirus* genus of the *Reoviridae* family. The genome consists of 10 segments of double-stranded RNA. So far, 26 serotypes are recognised (Maan et al 2012), of which 10 have been isolated in Australia, although some are detected infrequently. All 10 of these serotypes — BTV-1, BTV-2, BTV-3, BTV-7, BTV-9, BTV-15, BTV-16, BTV-20, BTV-21 and BTV-23 (L Melville, Northern Territory Department of Resources, pers comm) — demonstrate variable pathogenicity for sheep under experimental conditions (Johnson et al 1992). To date, all initial isolations of Australian BTV serotypes have been from insects, or from cattle with no evidence of clinical disease.

BTV strains vary considerably in their virulence for ruminant species. However, other factors also influence the severity of the disease, including the animal's breed and age, and exposure of animals to sunlight, walking on rough ground and stress.

The serotypes are differentiated by serum neutralisation tests, but there are cross-reactions between some serotypes. All BTVs share group antigens, which can be demonstrated by agar gel diffusion tests, fluorescent antibody tests and group-reactive enzyme-linked immunosorbent assays (ELISAs). Complement fixation tests have been used in the past. Although the serotypes are defined by their antigenic profiles in serological tests, polymerase chain reaction (PCR) tests are being developed to serotype viruses on the basis of their RNA sequences. There are also PCR tests that differentiate BTV from other orbiviruses.

Several other orbiviruses have been loosely termed 'bluetongue-related' viruses because of serological and other relationships to BTV. The only such viruses known to be pathogenic for livestock are some members of the epizootic haemorrhagic disease of deer serogroup and the Palyam serogroup of *Reoviridae*; members of both these serogroups have been isolated in Australia.

1.2 Susceptible species

All ruminants, including sheep, goats, cattle, buffalo, camelids, antelopes and deer, are susceptible to bluetongue infection. Of the domestic species, sheep are the most severely affected. Sickness is sometimes reported in goats, and severe disease and mortalities occur in white-tailed deer in the United States. Although infection of cattle is of great epidemiological significance, it is generally subclinical. However, in the BTV-8 outbreaks in the European Union since 2006, clinical signs have been

seen in cattle. In the endemic region of Australia, cattle and deer (farmed and feral) have bluetongue antibodies, but no disease has been observed.

Antibodies have been detected in wild carnivores in Africa, and cross-contamination between bluetongue and canine vaccines during vaccine manufacture has resulted in the death of some vaccinated dogs in the United States. Clinical disease has also been reported in domestic dogs, but the source of infection has not been confirmed. Oral ingestion of infected meat and infection by *Culicoides* midges have been proposed as possible sources (Oura and Harrak 2011). Infection with BTV-8 and subsequent death of two Eurasian lynx, which had been fed ruminant fetuses and stillborns in a Belgian zoo, was reported in 2008.

Known insect vectors are discussed in Section 1.6.4.

1.3 World distribution and occurrence in Australia

Bluetongue occurs as a clinical disease of small ruminants in most countries of Africa, the Middle East, the Indian subcontinent, China, the United States and Mexico. BTV is also present in Southeast Asia, northern Australia, Papua New Guinea and northern South America, normally without associated clinical disease.

The virus was thought to have originated in Africa, but in the past 50 years bluetongue has been increasingly recognised wherever substantial populations of ruminants occur in the tropics and subtropics. The initial detection of virus in countries outside Africa has sometimes occurred because of spectacular outbreaks of disease.

In recent years, incursions of BTV into animal and vector populations have occurred in southern Europe, with significant disease outbreaks. Significant northwards spread of the virus into areas previously free from bluetongue has occurred as a result of additional species of *Culicoides* midges (see Section 1.6.4) becoming established as vectors. These vectors can survive under extremely cold conditions and in indoor environments. Since 2006, BTV-8 has spread as far north as Norway and Sweden. In 2008, BTV-1 expanded northwards in Spain and France; BTV-6 was reported in Belgium, the Netherlands and Germany; and a single case of BTV-11 was reported from Belgium. The BTV-6 and BTV-11 detections in Europe were believed to originate from unauthorised use of modified live vaccines. The bluetongue situation in Europe will continue to evolve, with spread of the virus and identification of new vectors.

The World Organisation for Animal Health (OIE) *Terrestrial Animal Health Code* (the OIE Terrestrial Code) has been changed to reflect this spread; historically, the northern limit for BTV was given as 53 degrees and the southern limit as 34 degrees. Changes in the environment and ecology may result in further changes in the distribution of bluetongue.

When bluetongue moves into a new area, it has a history of infecting new vector species; this gives rise to some concern for Australia. In Europe, vector competence is increased by higher environmental temperatures.

BTV and several related genera of orbiviruses are present in northern Australia. The virus was first isolated in Australia from a pool of *Culicoides* midges trapped near Darwin in 1975. The virus serotype was identified as BTV-20. Since then,

viruses belonging to a further nine serotypes — BTV-1, BTV-2, BTV-3, BTV-7, BTV-9, BTV-15, BTV-16, BTV-21 and BTV-23 — have been isolated from the blood of healthy sentinel cattle, mostly in the Top End of the Northern Territory (Daniels et al 2009).

Serological evidence of bluetongue infection in Australia has been found in sheep, cattle, buffalo, goats and deer. Experimental infections with all 10 serotypes found in Australia have produced variable pathogenicity in sheep. There has been no evidence of any clinical disease associated with bluetongue infection in any livestock species in the field in Australia, apart from one clinical case in a sentinel sheep flock on a research station near Darwin in 1989 and a small outbreak in a noncommercial sheep flock near Darwin in 2001. The Northern Territory has regulated the import of susceptible species into the known bluetongue zone.

Serological evidence for serotypes BTV-1 and BTV-21 has been found throughout the Australian bluetongue zone, although there is variable annual seroconversion in sentinel cattle. BTV-2, BTV-3, BTV-7, BTV-9, BTV-15, BTV-16, BTV-20 and BTV-23 have been isolated only in the Top End of the Northern Territory. There has been variable serological evidence for some of these serotypes in northern areas of Western Australia and far north Queensland. BTV-2 has also been detected in eastern Queensland.

For current information on the overall distribution of bluetongue serotypes, refer to the National Arbovirus Monitoring Program bluetongue zone map.[7]

The ecology of BTV in Australia is well documented. The observed serotypes and strains are distributed differently: some persist in endemic areas, some apparently die out after variable periods of transmission in the Northern Territory Top End, and some are apparently introduced from time to time into the Northern Territory Top End from sources in Southeast Asia. To date, BTV-1, BTV-2 and BTV-21 are the only serotypes that have been observed to spread beyond foci in the Northern Territory and the northern Kimberley. BTV-1 and BTV-21 extend throughout the endemically infected areas of Queensland, New South Wales and Western Australia, as well as being found in the more northern areas, and BTV-2 has been detected in eastern Queensland. Strains of the other serotypes, as well as viruses arising through reassortment of genes between longstanding strains and newly introduced strains, have not been isolated outside the Top End of the Northern Territory.

The factors limiting the distribution of serotypes and strains in Australia are still under investigation, but are believed to be associated with vector preferences for the *Culicoides* species that share this distribution. Serotypes that have not yet reached Australia have been isolated in Southeast Asia, and it is possible that additional serotypes will be recovered in northern Australia, as occurred with BTV-7 in 2007 and BTV-2 in 2008.

To date, there has been no case of clinical disease in Australian commercial agriculture, presumably because the necessary mix of biological and

[7] www.animalhealthaustralia.com.au/programs/disease-surveillance/national-arbovirus-monitoring-program

epidemiological variables has not occurred. Should that mix happen, disease will occur either insidiously or as a dramatic outbreak. Depending on epidemiological circumstances, an initial outbreak might end naturally or might require human intervention for its control. Once bluetongue disease has manifested clinically, clinical cases may become a regular feature unless control measures are in place, as with other endemic arboviral diseases.

1.4 Diagnostic criteria

1.4.1 Case definition

For the purposes of this manual:

- bluetongue is defined as clinical signs of bluetongue in a ruminant accompanied by a confirmed laboratory diagnosis (for the first case), or clinical signs in a susceptible ruminant after an outbreak has been confirmed
- positive serology in the absence of clinical signs does not constitute a definition of a case.

Confirmation of BTV infection requires definitive laboratory-based diagnostic tests performed at an accredited laboratory using a validated test, such as competitive ELISA (c-ELISA), PCR, virus neutralisation or virus isolation. BTV must be serotyped by virus neutralisation or another suitable typing method.

Bluetongue cases are suspected when there are clinical signs consistent with BTV infection (see Table 1.1). These cases have a high index of suspicion. Cases where there are no clinical signs consistent with bluetongue — for example, in apparently healthy ruminants sampled as part of survey studies — have a low index of suspicion. Positive serology does not constitute a diagnosis, but is evidence of possible exposure.

Table 1.1 Case definition of bluetongue and terms used

Term	Meaning	Laboratory testing	Comment
Confirmed presence of BTV infection	Laboratory-confirmed diagnosis in a ruminant demonstrating clinical signs consistent with bluetongue diagnosis	Exotic BTV confirmed by virus isolation or virus neutralisation type-specific tests	Case definition; definitive diagnosis based on confirmation of presence of exotic BTV
Presumptive diagnosis of bluetongue	History and/or clinical signs consistent with bluetongue and a positive nonspecific BTV test (competitive ELISA). Not confirmed by virus isolation or virus neutralisation type-specific tests	Nonspecific BTV test positive, but not confirmed by virus isolation or virus neutralisation type-specific tests	High index of suspicion, but not definitive diagnosis, as BTV serotype-specific testing has not occurred
Possible bluetongue	History and/or clinical signs consistent with bluetongue but no laboratory testing performed	No testing done	High index of suspicion and cannot exclude bluetongue

1.4.2 Clinical signs

Sheep

Bluetongue is primarily a disease of sheep. However, where sheep have positive BTV serology, care must be taken to avoid confusing clinical bluetongue and diseases with similar clinical signs (see Section 1.4.5; Saegerman et al 2008).

The clinical signs in sheep can be very variable, ranging from acute to mild. The acute signs begin with fever, which may last about a week. The incubation period, generally 4–8 days, is possibly influenced by the dose of virus received. Within 24–36 hours of the onset of fever, the lining of the mouth and nose both become hyperaemic. This is accompanied by excessive salivation and a clear nasal discharge. Over the next few days, the discharge becomes thick with mucus and pus, and may be bloodstained. It eventually dries to form a crust around the nostrils.

In acute cases, the lips and tongue become very swollen, and oedema may extend over the face to include the ears and intermandibular space. The hyperaemia becomes more intense, and tiny, flat, red or purple (petechial) haemorrhages appear on the mouth, nose and conjunctival linings. The clinical feature that gives the disease its name, a deeply cyanotic (blue) tongue, occurs in only a small percentage of cases.

Necrotic lesions (ulcers) develop on the gums, cheeks and tongue 5–8 days after the onset of fever. These heal slowly under a membrane of pus and serum (diphtheritic membrane). Breathing becomes difficult. Profuse bloody diarrhoea occurs in some cases. Regurgitation may also occur and lead to inhalation pneumonia.

Foot lesions, on one to four feet, may appear towards the end of the fever period. There is acute reddening and petechial haemorrhages on the coronary band at the top of the hoof. Affected sheep stand with arched backs and are reluctant to move.

There is rapid weight loss, weakness and a drop in milk production due to loss of appetite and specific muscular necrosis. Spasmodic twisting of the head and neck to one side (torticollis) is sometimes a late sign.

The mortality rate is variable; in highly susceptible sheep, it can be up to 70%. Deaths may occur up to 5 weeks after the onset of clinical signs. Convalescence in surviving sheep is prolonged. Breaks occur in wool, adding to production losses.

Infection of pregnant ewes with laboratory-modified, attenuated virus (see Section 1.5.3) can lead to abortions, mummified fetuses, or the birth of stillborn or weak lambs, which may have congenital defects.

In Australia, clinical signs in sheep experimentally infected with four serotypes of BTV varied from inapparent through to a range of the signs described above (Uren and St George 1985). Depression, lameness, unwillingness or inability to stand, pneumonia and laboured breathing were observed. Lameness was caused by severe inflammation of the corona at the top of the hoof, which was sensitive to touch. Facial and submandibular oedema was present in more severe cases, but there were no deaths. In other experimental studies in Australia, up to 40% of sheep died. The strain of virus and the breed of sheep will have an important effect on the clinical expression of bluetongue disease. A number of other factors are also known to influence the severity of the clinical disease, including the animal's age, exposure of animals to sunlight, walking on rough ground and stress.

Goats

Goats are less commonly, and less severely, affected than sheep. The pathogenesis is similar, and the clinical signs are milder to inapparent. Bluetongue disease has not been recorded in goats in Australia or Southeast Asia.

Cattle

Although cattle and buffalo are considered to be the principal vertebrate hosts of BTV, clinical disease is not generally observed in these species. Mild clinical signs — characterised by fever, sometimes associated with reproductive failure — may occasionally be seen. In Europe, BTV-8 in cattle has caused clinical disease; this has included ulcers of the nasal and oral mucosa (resulting in nasal discharge and salivation), fever, conjunctivitis, apathy, teat lesions and udder oedema, lameness and coronitis, reduced milk production and occasionally death (Saegerman et al 2008).

Deer

Severe disease and mortalities occur in white-tailed deer in the United States, where the pathogenesis and clinical signs are indistinguishable from those of the closely related epizootic haemorrhagic disease virus.

Both farmed and feral deer in the endemic region of Australia have BTV antibodies, but no disease has been observed.

Camelids

Camelids may be infected with BTV, but clinical disease has only been recorded in South American camelids (Henrich et al 2007, Meyer et al 2009, Ortega et al 2010).

1.4.3 Pathology

Gross lesions

In sheep, the basic pathological process is endothelial damage, leading to vascular permeability. Haemorrhages, 2–15 mm in diameter, in the tunica media at the base of the pulmonary artery are regarded as being very characteristic of bluetongue. The most prominent gross lesions in the gastrointestinal tract are found in and around the mouth. There is oedema and hyperaemia in the mucosa, which is occasionally cyanotic. Petechial or ecchymotic haemorrhages may also be present. Ulcers, which may be covered by grey necrotic material, are found on the lips, dental pad, tongue and cheeks. Hyperaemia of the rumen pillars and reticular folds is common.

The lymph nodes and spleen are moderately enlarged and haemorrhagic. Pale areas of necrosis are scattered through the skeletal and cardiac musculature. There is inflammation of the upper respiratory tract, causing excessive mucus secretion (catarrhal inflammation) and oedema of the lungs.

Microscopic lesions (histopathology)

Histologically, there is damage to the endothelium of small blood vessels. This results in vascular occlusion and clotting. In epithelial tissues, it leads to lack of oxygen and sloughing of the epithelium.

Experimental Australian cases exhibited haemorrhages, inflammatory mononuclear cell infiltrations and necrosis of the heart muscle (myocardium).

1.4.4 Laboratory tests

Specimens required

For the diagnosis of bluetongue, it is essential that the most appropriate specimens are carefully collected and properly transported. The following specimens are required:

- Three 10-mL vacutainer samples (plain, ethylenediaminetetraacetic acid [EDTA] and heparin-treated) of blood from the jugular vein of each of up to six sheep with high temperatures (over 40.5 °C). Highest concentrations of virus in the blood usually occur during the early stage of the fever. Viraemia persists after the temperature subsides, but at a lower level. Separate needles should be used for blood collection from each animal to avoid cross-contamination of samples or cross-infection of animals. The samples with anticoagulant should be well rotated to ensure adequate mixing. The lithium heparin sample is specifically for virus isolation in the embryonated chicken egg culture system. EDTA is the preferred anticoagulant for subsequent PCR testing (see Table 1.2 for details).
- Sera from 10–15 convalescent sheep. If there are no convalescent sheep, sera should be collected from in-contact sheep.
- Sera from in-contact cattle, ideally yearlings, and from other ruminants.
- Spleen and lymph nodes from all postmortem cases.
- Cardiac and skeletal muscle (especially if abnormal) in formal saline.
- *Culicoides* sp. from vector trapping.

Transport of specimens

Specimens should initially be sent to the state or territory diagnostic laboratory. At the jurisdictional laboratory, samples may be screened for BTV as part of the Laboratories for Emergency Animal Disease Diagnosis and Response (LEADDR) network, and testing will also be undertaken for endemic diseases. In the event of a positive result, samples must be sent to the CSIRO Australian Animal Health Laboratory (CSIRO-AAHL), Geelong, for testing for BTV, after the necessary clearance has been obtained from the chief veterinary officer (CVO) of the state or territory of the disease outbreak and after the CVO of Victoria has been informed about the transport of the specimens to Geelong. Until confirmatory testing has been undertaken, at or through CSIRO-AAHL, the outcome of the investigation should be considered as 'unconfirmed'. However, appropriate actions in response to the initial laboratory finding (as deemed by the CVO of the affected jurisdiction) may be taken in the field.

Specimens should be submitted on wet ice. **If ice blocks are used, extreme care should be taken to ensure that specimens do not contact the blocks. Direct contact with ice might cause freezing, which inactivates the virus.** Whole blood should be held at 4 °C for transmission experiments with wild virus.

A full history and identification of samples are necessary. Duplicate samples, for differential diagnosis of endemic disease, should be collected and retained by the state or territory diagnostic laboratory. For further information, see the **Laboratory Preparedness Manual**.

Laboratory diagnosis

Rapid testing to exclude bluetongue or index case diagnosis will be undertaken at CSIRO-AAHL. Results of both real-time PCR testing and BTV group-reactive c-ELISA for serology can be available within about 6 hours of receipt of specimens. Virus isolation and serotyping may take 2–3 weeks using conventional methods, but molecular techniques may give an early indication of serotype within 48 hours. Serotyping of c-ELISA reactors may take up to a week.

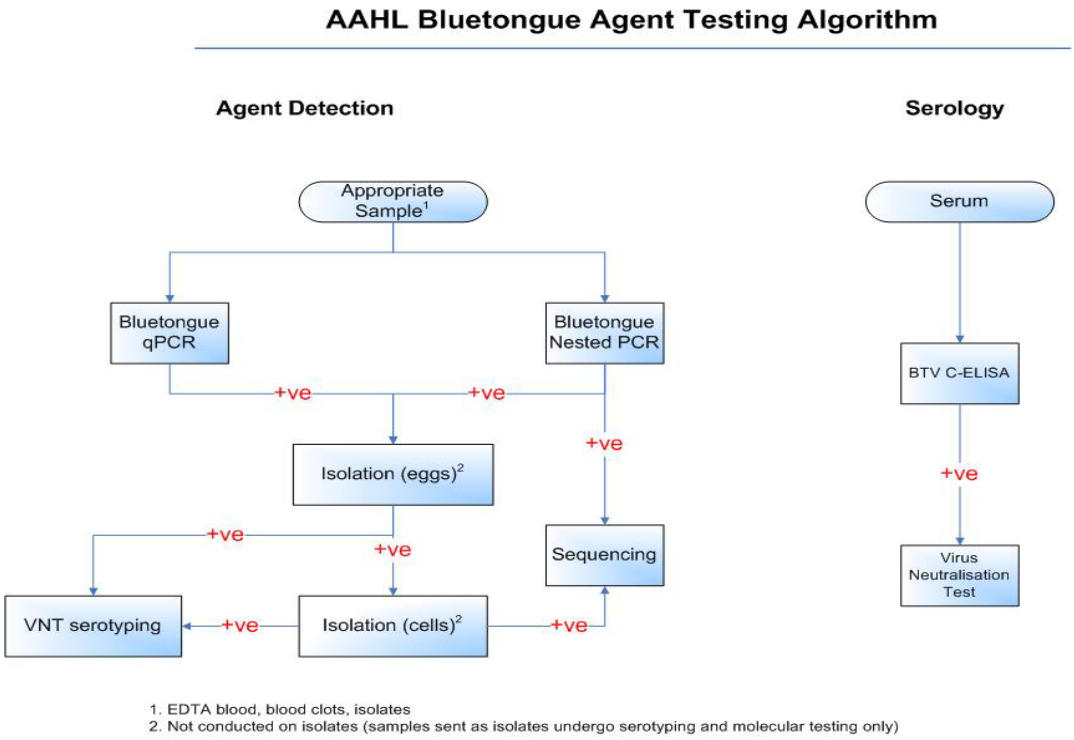
Diagnostic tests currently available at CSIRO-AAHL are shown in Table 1.2. The testing method used by CSIRO-AAHL is shown in Figure 1.1.

Table 1.2 Laboratory tests currently available at CSIRO-AAHL for diagnosis of bluetongue

Test	Specimen required	Test detects	Time taken to obtain result
Agent detection			
Real-time PCR	Fresh tissue, whole EDTA blood	Viral RNA	4–5 hours
Agent characterisation			
Virus isolation and identification	Whole lithium heparin blood	Virus	2–3 weeks
Serotyping	Virus isolate	Serotype	5 days
PCR and sequencing	Virus isolate, whole EDTA blood or tissues	Virus genotype	2 days
Pathogenicity testing in sheep	Virus isolate	Likely virulence	2 weeks
Serology			
Competitive ELISA	Serum	Bluetongue virus group antibody	4 hours
Virus neutralisation	Serum	Serotype-specific antibody	5 days

EDTA = ethylenediaminetetraacetic acid; ELISA = enzyme-linked immunosorbent assay; PCR = polymerase chain reaction

Source: Information provided by CSIRO-AAHL, 2009 (refer to CSIRO-AAHL for most up-to-date information).



BTV = bluetongue virus; c-ELISA = competitive enzyme-linked immunosorbent assay; EDTA = ethylenediaminetetraacetic acid; PCR = polymerase chain reaction; VNT = virus neutralisation test

Figure 1.1 The current approach to diagnostic testing for bluetongue used at CSIRO-AAHL

Interpretation of diagnostic tests is based on characteristics of the viruses. Bluetongue viruses have group antigens that allow their differentiation from other

orbiviruses, and 26 serotype-specific antigens that determine the serotype. Group antigens are detected by current ELISA tests; the c-ELISA detects antibodies to any of the BTVs, while the antigen detection ELISA detects any BTV. However, the antigen-detection ELISA is of insufficient sensitivity to use as a primary diagnostic tool: its use is restricted to identification of BTV in cultured material.

Serotyping of a BTV isolate is done using type-specific antisera, and antibodies to the individual serotypes are detected in the virus neutralisation test (VNT) using virus of that serotype as antigen. If an animal has been infected with only one serotype, interpretation of the test result is usually clear. If an animal has been infected with two or more serotypes, heterotypic antibody production makes interpretation of VNT serology more difficult; interpretation must be attempted on a case-by-case basis by people with sound knowledge of the limitations of the test. The detection of antibodies to a BTV serotype in a group of animals does not necessarily confirm their infection with that serotype. The strength of indication of such infection will depend on analysis of a range of test results.

Genotyping of BTV by sequence analysis can indicate the likely geographical origin of a particular isolate, and hence whether it is likely to be an exotic incursion or new to an area.

Molecular markers for viral virulence, such as those identified for Newcastle disease and avian influenza, have not been identified for BTV.

A PCR test for the detection of virus in insect vectors has been developed (Melville et al 2008). The test is sensitive enough to detect one infected insect in a pool of 50 insects obtained from light traps near sentinel cattle. This test is extremely useful in screening and assessing the level of virus activity and the relative importance of potential insect vectors, as it allows large populations of *Culicoides* to be screened at one time. For detection of virus in pools of sorted and identified *Culicoides*, as many suitable stages of the insect as possible (both parous and gravid) should be collected in alcohol for submission to the laboratory.

1.4.5 Differential diagnosis

The following sheep diseases and causes should be considered in a differential diagnosis of bluetongue (Saegerman et al 2008):

- scabby mouth (contagious pustular dermatitis)
- acute photosensitisation
- lameness due to footrot, foot abscess and other foot conditions
- acute haemonchosis (with depression and submandibular oedema)
- facial eczema
- pneumonia
- plant poisoning
- salmonellosis
- sheep pox
- foot-and-mouth disease
- peste des petits ruminants.

The following cattle diseases and causes should be considered in a differential diagnosis of bluetongue (Saegerman et al 2008):

- foot-and-mouth disease
- vesicular stomatitis
- bovine papular stomatitis
- pestivirus (bovine viral diarrhoea, bovine mucosal disease)
- infectious bovine rhinotracheitis
- malignant catarrhal fever
- Rift Valley fever
- foot conditions
- plant poisonings
- photosensitisation.

1.4.6 Treatment of infected animals

No effective treatment is available.

1.5 Resistance and immunity

1.5.1 Innate and passive immunity

All species of ruminants appear to be susceptible to infection with BTV, although, in most cases, the infection does not result in disease. The variability in expression of disease depends on both the virulence of the viral strain and differences in host susceptibility. The genetic basis of susceptibility and resistance is unknown.

Sheep indigenous to tropical countries in Africa, the Middle East, Asia and the Americas can be infected with BTV, but do not usually exhibit disease.

The lambs of susceptible breeds have been shown to be protected by colostral immunoglobulins when challenged several days after birth (Jeggo et al 1984). This protection is temporary and serotype specific, may be partial (depending on the amount of colostral immunoglobulin G transferred) and appears to have little use as a disease-control mechanism.

1.5.2 Active immunity

After an animal is infected via the saliva of a biting midge, BTV multiplies in the regional lymph node and then spreads in the blood. This systemic multiplication and spread allow ample opportunity for humoral and cell-mediated immune responses to develop.

Systemic antibody is first detected around 1–2 weeks after infection. Humoral immunity is considered to be lifelong and the most important protective mechanism against reinfection. After a single infection, group and type-specific antibodies can be detected. Neutralising antibodies are usually monotypic, although cross-reactions have been noted between serotypes BTV-3 and BTV-16, BTV-6 and BTV-21, BTV-4 and BTV-20, and BTV-5 and BTV-9. Consecutive

infections with a second and especially a third serotype normally give rise to a comparatively short-lived, broad-reacting neutralising antibody response.

Virus can persist in the body's circulation in the presence of homologous neutralising antibody as a result of the intimate association of the virus particles with the membranes of circulating erythrocytes and the consequent inaccessibility of the virus to immune mechanisms.

The natural role of cell-mediated immunity is uncertain. Cellular immune responses have been demonstrated experimentally. They have been shown to be broadly reactive but short lived.

1.5.3 Vaccination

Vaccines can be used to protect susceptible sheep against disease or, theoretically, to produce a barrier to transmission of BTV via the herd immunity of resistant animals. The possible approaches to vaccination are to target sheep only, sheep and cattle, or cattle only. Vaccination will reduce the number of animals that become viraemic following infection. In this respect, vaccination of cattle may be a more effective control measure than vaccination of sheep, as viraemic cattle are more common than viraemic sheep and are more often the source of BTV. In some European situations, cattle are vaccinated to allow their movement from infected to noninfected areas.

Two types of vaccines can be considered: inactivated (killed) and attenuated (live). Recombinant virus vaccines are still experimental. Details of vaccines currently available can be found in Tweddle (2009).

Inactivated vaccines

Inactivated vaccines are preferred for bluetongue vaccination in Europe, where emergency licensing has made them rapidly available. Inactivated vaccines against BTV-1, BTV-2, BTV-4, BTV-8 and BTV-9 were used in 2008–09. This included use of BTV-2, BTV-4 and BTV-9 vaccines in Italy (where a live attenuated vaccine against BTV-1 was also used); use of BTV-1 and BTV-8 vaccines in France; use of BTV-1, BTV-4 and BTV-8 vaccines in Spain; and use of a BTV-1 vaccine in Portugal. An inactivated BTV-8 vaccine was used in many countries across Europe, including the United Kingdom. Bivalent inactivated vaccines (against BTV-2 and BTV-4, and BTV-1 and BTV-8) are also available in Europe. Clinical disease due to BTV-8 rapidly declined after vaccination using these inactivated vaccines.

Generally, two doses of inactivated vaccines are required to achieve the efficacy claimed by the manufacturer (not necessarily full protection), and these doses are followed by an annual vaccination. Use of these inactivated products in Europe is being analysed, and appropriate recommendations are being developed.

Attenuated (live) vaccines

Serospecific attenuated vaccines are used to prevent disease in southern Africa, the United States, Israel and Italy. They produce vaccine virus viraemia.

Attenuated vaccines have the following potential disadvantages:

- There is a risk of recombination of the vaccine strain with field virus, which could give rise to a new, highly virulent strain.

- They may revert to virulence.
- They can be transmitted by insects.
- Attenuated BTV can cross the placenta, and pregnant ruminants vaccinated with attenuated vaccines may suffer reproductive failure or produce offspring with congenital abnormalities. (Field virus does not cross the placenta, except for BTV-8 in cattle.)
- Attenuated vaccine virus is likely to be excreted in the semen of vaccinated males during and soon after the viraemic period. (Field virus is rarely excreted in semen.)
- Attenuated vaccines must be made from the serotype(s) responsible for the outbreak of clinical disease.

Management of the vaccination program can avoid most of these potential problems. The virus titre of vaccinated animals at the height of viraemia is normally lower than the level required for transmission of the virus by blood-sucking insects. Animals can be vaccinated in late winter and early spring, well before the bluetongue season (summer) so that co-circulation of vaccine and wild virus is highly unlikely. The major demonstrated problem of attenuated vaccines is teratogenic effects arising from vaccinating pregnant ewes, but this is easily managed by timing vaccinations to avoid periods of pregnancy.

Attenuated vaccine seeds have been prepared for all Australian serotypes of BTV and are held at CSIRO-AAHL. Any vaccination policy should give careful consideration to the potential disadvantages of attenuated vaccines.

Recombinant and subunit vaccines

Recombinant vaccines are in an advanced stage of development in the European Union (due to the occurrence of BTV-8), but none have been licensed to date. These vaccines are not addressed in the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals*.

Recombinant and subunit vaccines potentially overcome some of the problems of attenuated vaccines. However, subunit proteins of one serotype will not give complete long-term protection against all serotypes. By careful choice of components, a broad-spectrum vaccine could be developed.

DIVA strategy

Currently, no tests are available for differentiating infected from vaccinated animals (DIVA) if the available attenuated or inactivated vaccines are used.

1.6 Epidemiology

Bluetongue is not a contagious (communicable) disease — that is, it is not spread directly from animal to animal. It is also not a zoonotic disease — that is, it is not spread from animals to humans. It is biologically transmitted by *Culicoides* midges, but only a limited number of *Culicoides* species are efficient vectors (see Section 1.6.4). Cattle are the main amplifying hosts and are probably also important maintenance hosts. The competent *Culicoides* vector species feed more abundantly on cattle.

The incidence and geographical distribution of bluetongue infections in Australia are determined largely by the distribution of insect vectors, and this can vary from year to year, depending on climatic conditions. Infection in sheep is preceded by widespread infection of cattle and an increase in vector density. Very few sheep-to-sheep transmissions (via vectors) are believed to occur in Australia.

Serotypes that have occasionally infected sheep in Queensland and New South Wales (BTV-1 and BTV-21) do not appear to be very pathogenic. For an outbreak of disease to occur, these serotypes would need to acquire virulence. A more likely scenario is the movement of more pathogenic serotypes (BTV-2, BTV-3, BTV-15, BTV-16 or BTV-23) from the Northern Territory to sheep production areas. The National Arbovirus Monitoring Program (NAMP) would be expected to detect this movement out of the Northern Territory, leading to increased surveillance to carefully track any movement of these more pathogenic serotypes into sheep areas.

1.6.1 Incubation period

The incubation period in susceptible animals is generally 5–20 days, and is possibly influenced by the dose of virus received. Because clinical disease in sheep usually follows amplification of virus in cattle and spread from cattle to sheep, disease might not be observed until 1–2 months after pathogenic virus has entered an area.

The OIE Terrestrial Code gives an infective period of 60 days for all ruminants.

1.6.2 Persistence of agent

General properties

BTV does not survive outside the vector species or susceptible hosts.

Environment

BTV does not persist in the environment. However, insect vectors can be carried over long distances by wind (see Sections 1.6.4, 1.6.5 and 1.7).

Live animals

The duration of viraemia depends on several factors, including the strain of the virus, the longevity of the mammalian host's cells with which the virus is associated, and the sensitivity of the system used to detect the virus.[8] Although virus may be detected in the blood of cattle in the experimental situation for several months (and in sheep for several weeks), infected animals can only transmit virus to a competent biting vector for several weeks after the initial infection. Persistence under field conditions in live animals is reported to be 50 days in cattle and 20 days in sheep. For the purpose of international trade, the OIE Terrestrial Code recognises a maximum period of viraemia of 60 days.

[8] In the older literature, there are reports of long-term carrier states in cattle and sheep. However, most of this work was undertaken before researchers recognised the significance of multiple reinfection of animals with different BTV serotypes.

Recent evidence from Europe of transplacental infection in cattle and sheep with BTV-8 may extend the period of infectivity (De Clercq et al 2008, Darpel et al 2009, van der Sluijs et al 2011, Zanella et al 2011). Previously, transplacental infection had only been seen with laboratory-attenuated viruses. Transplacental infection in cattle has been associated with the spread of infection to new areas.

Animal products and byproducts

BTV does not persist in animal carcases or animal products, such as meat and wool.

Equipment and personnel

BTV does not persist on equipment or personnel.

Vectors

BTV is biologically transmitted by *Culicoides* midges, but only a limited number of *Culicoides* species are efficient vectors (see Section 1.6.4). The competent *Culicoides* vector species feed more abundantly on cattle.

1.6.3 Modes of transmission

Live animals

The virus is not transmitted by direct contact or indirect means between animals in the absence of insect vectors. Animals can be infected experimentally by inoculation with infected blood. Therefore, iatrogenic transmission by needle transfer is considered possible but unlikely.

Transmission of BTV-8 by calving cows to other cows (which were moved into the calving box) in the absence of vectors was reported in Ireland in 2007. A possible mechanism is the ingestion of the placenta from infected cows.

Animal products and byproducts

Animal carcases and products, such as meat and wool, play no role in the epidemiology of bluetongue. On rare occasions, carnivores have been exposed to virus by eating infected meat.

Equipment and personnel

Equipment and personnel are not involved in transmission.

Transplacental

For at least BTV-8, there is field and experimental evidence that transplacental transmission occurs (Darpel et al 2009, van der Sluijs et al 2011, Zanella et al 2011).

Semen and embryos

Rarely, virus may be excreted in the semen when males are viraemic. Excretion is more likely if there is inflammation of the genital tract, if the animal is aged or if the virus has been laboratory adapted — for example, infection with live vaccines (see Section 1.5.3) or experimental infection. Contaminated semen may infect

recipient females, but this will not initiate a cycle of transmission unless competent insect vectors are abundant.

For cattle embryos derived in vivo, bluetongue has been listed as a Category 1 disease by the International Embryo Transfer Society (IETS). Category 1 diseases or pathogenic agents are those for which sufficient evidence has accrued to show that the risk of transmission is negligible provided that the embryos are properly handled between collection and transfer according to the IETS Manual.[9]

For sheep embryos derived in vivo, bluetongue has been listed as a Category 2 disease. Category 2 diseases are those for which substantial evidence has accrued to show that the risk of transmission is negligible provided that the embryos are properly handled between collection and transfer according to the IETS Manual, but for which additional transfers are required to verify existing data.

For goat embryos derived in vivo, bluetongue has been listed as a Category 4 disease, indicating that studies are in progress but no conclusions are yet possible.

These categories are based on information published before 1998 — that is, before the outbreak of BTV-8 in cattle in Europe. The OIE Terrestrial Code notes that, when authorising import or transit of in vivo–derived bovine embryos and oocytes collected, processed and stored in conformity with the code provisions, veterinary authorities should not require any BTV-related conditions, regardless of the BTV status of the ruminant population of the exporting country or zone, except for BTV-8 (under study).

Liquid nitrogen tanks used to store and transport genetic material may preserve fungal spores and yeast, bacteria and viruses for extended periods of time. Experimental studies have shown that cross-contamination of germ plasm can occur if it is stored in unsealed vials in contaminated tanks. Consideration should be given to disinfection — before movement or subsequent use — of liquid nitrogen tanks used to store and transport genetic material that is infected or potentially infected.

1.6.4 Vectors

BTV is transmitted by female midges of the *Culicoides* genus. For a midge to be a vector of BTV, it must be exposed to infection by feeding on a viraemic host. The virus must then infect the midge and be excreted by it when it subsequently feeds. Bluetongue is maintained by a cycle alternating between cattle and midges; a single bovine remains infectively viraemic for a maximum of about 50 days, and a midge survives for 10–90 days. The infection is thus maintained in limited areas where midges are active year-round and will 'escape' from time to time into surrounding areas when climatic conditions and animal movements permit.

Vectors are infected for life. When susceptible midges bite viraemic hosts (normally cattle), sufficient virus may be imbibed to infect the insect. The virus crosses the gut of the insect and then, after an intrinsic incubation period of 1–2 weeks, is excreted in the saliva of competent midges when they feed (1–2 times

[9] *Manual of the International Embryo Transfer Society*, 4th edition (2010)

per week). Virus replication in the vector is temperature dependent; replication is optimal at 30 °C and ceases below 15 °C. Work at the Pirbright Laboratory in the United Kingdom has indicated that a single bite from a single infected midge is sufficient to infect an immunologically naive animal (Baylis et al 2008).

Virus transmission may occur at any time of the year in the tropics, but is most active after seasonal rainy periods. In temperate climates, the favoured transmission season is the second half of summer and autumn; transmission stops suddenly with the onset of frosts.

Usually, adult *Culicoides* actively move no more than a few hundred metres from the site where they emerged from their pupae. They are dispersed passively by warm, humid winds blowing at a low altitude at speeds of less than 40 km/h (Saegerman et al 2008).

The risk of an outbreak depends on vector competence (ability of the vector to support replication of the virus and then to transmit it to a suitable host), vector capacity (range of the vector, vector abundance, host preference, vector survival) and the availability of susceptible hosts.

Overwintering

There is no reported evidence of transovarial viral transmission of BTV. For the virus to persist over winter, it must therefore survive either in infected hosts or in *Culicoides* that survive over winter. *Culicoides* can survive for up to 3 months, so they could survive through the winter in a suitable environment. Evidence from the outbreak of BTV-8 in Europe in 2007 indicates that the vector(s) can overwinter, or at least remain active, in small populations in microclimates such as those found in animal barns. However, there has been no evidence of persistent, active transmission under such conditions.

Animals can remain viraemic for up to 60 days. In Europe, cows that were seropositive and PCR negative to BTV-8 produced PCR-positive and seropositive calves. Furthermore, when PCR-negative and seronegative heifers were exposed to virus-positive placentas and to infected calves from these cows, the heifers became PCR positive, and virus was isolated from them. The mechanism of infection is yet to be determined, but oral infection has been suggested (Darpel et al, no date).

Transmission of field strains of BTV-8 from dam to progeny in ruminants in northern Europe has been demonstrated both in the field and in experimental studies. However, the role of vertical infection of fetal or neonatal ruminants in the overwintering of the virus is yet to be determined (EFSA Panel on Animal Health and Welfare 2008).

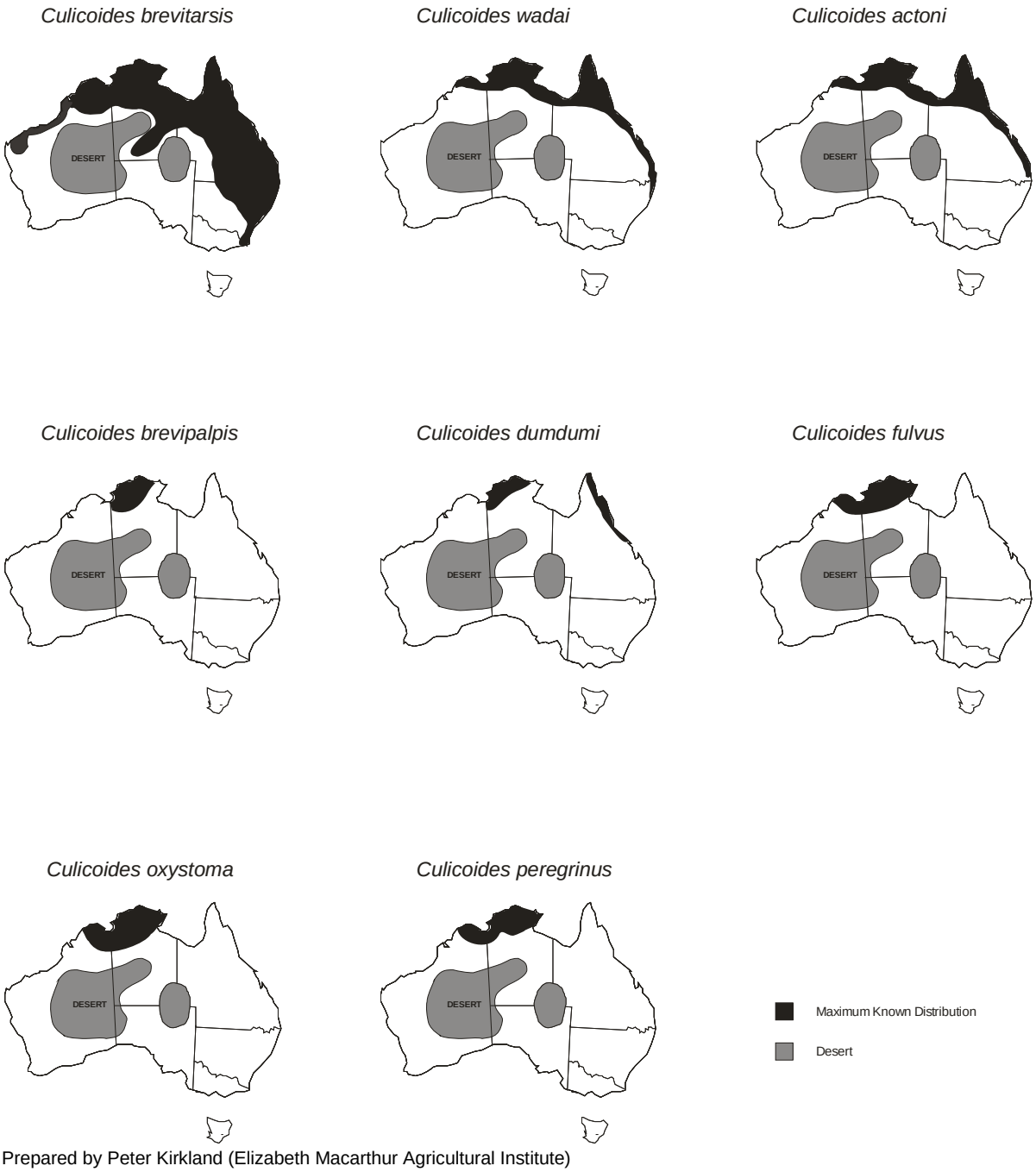
In conclusion, BTV could remain in an area in which vectors are not active.

Potential vectors in Australia

Of the approximately 250 *Culicoides* species in Australia, only eight have been shown to be capable of infection by BTV: *C. brevitarsis*, *C. actoni, C. oxystoma* (Standfast et al 1985), *C. wadai*, *C. fulvus*, *C. peregrinus* (Standfast et al 1979), *C. dumdumi* (Bellis and Dyce 2005) and *C. brevipalpis* (unpublished, but cited in Standfast et al 1985). *C. peregrinus*, *C. oxystoma* and *C. brevipalpis* have not yet met all the required criteria for recognition as vectors.

C. brevitarsis is the most widespread of these species. *C. brevitarsis* lays its eggs in 2–5-day-old cattle dung, 3–4 days after a blood meal. Adults emerge after 10–14 days in summer. There is no evidence to suggest that BTV is transmitted transovarially by Australian vectors, so adult females can only become infected with BTV after feeding on a viraemic host. Following an incubation period of 1–2 weeks in the vector, virus may be transmitted to susceptible hosts at subsequent feeds.

The maximum reported ranges of known vectors for BTV in Australia are shown in Figure 1.2.



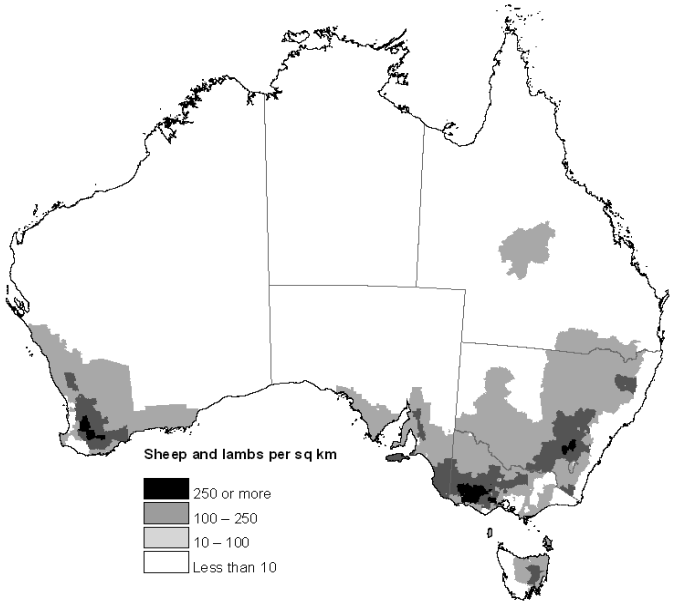
Prepared by Peter Kirkland (Elizabeth Macarthur Agricultural Institute)

Figure 1.2 Maximum reported range of known bluetongue vectors

The current known distribution of BTV in Australia can be obtained from NAMP reports.[10] The bluetongue zone map is based on OIE vector-monitoring guidelines and defines areas in which no viral activity has been detected for at least the past 2 years. NAMP regularly updates the map in response to new monitoring information, and the map is subject to change without notice.

In the absence of a major change in the distribution of northern vector species, only *C. brevitarsis* and *C. wadai* are likely to be of concern for bluetongue disease in sheep because of their occurrence in sheep-grazing areas (Figure 1.3). *C. brevitarsis* is closely associated with cattle. It not only has a strong host preference for cattle (and horses), but also lays its eggs, after feeding, in cattle dung.

C. wadai is abundant in coastal northern and eastern Australia, and may have the potential to expand into commercial sheep-producing areas (Figure 1.3).

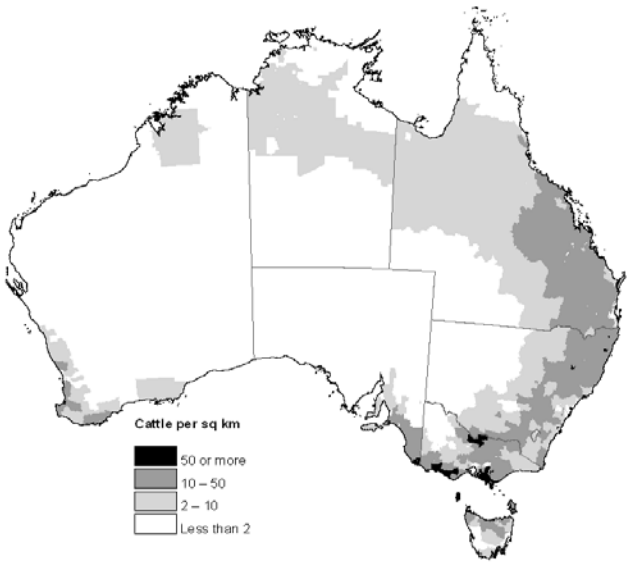


Prepared by Greg Hood (Bureau of Rural Sciences), 2010

Figure 1.3 Commercial sheep-raising areas, 2010

Commercial cattle-raising areas in Australia are shown in Figure 1.4.

[10] www.animalhealthaustralia.com.au/programs/disease-surveillance/national-arbovirus-monitoring-program



Prepared by Greg Hood (Bureau of Rural Sciences), 2010

Figure 1.4 Commercial cattle-raising areas, 2010

C. marksi and *C. victoriae* are present in large numbers in the sheep-raising areas of southern Australia and feed on sheep. If they were capable of transmitting BTV, this would be of great significance. However, there is strong epidemiological evidence that neither species transmits the virus, and experimental evidence that both are refractory to infection with the strains tested (Standfast et al 1979). Cattle have been found to be seropositive for BTV only within the range of *C. brevitarsis*, *C. wadai*, *C. actoni*, *C. fulvus and C. dumdumi*.

The detection of a number of exotic species in northern Australia (*C. semicercum* on Mer [Murray] Island in February 2008; *C. orientalis* on Boigu Island in March 2009; *C. flavipunctatus* and *C. palpifer* at the Douglas Daly Research Farm in the Northern Territory in May 2009 and *C. flavipunctatus* on Saibai Island in November 2010) indicates that new species of *Culicoides* enter Australia from northern neighbouring countries from time to time. The ability of these species to act as vectors of bluetongue is not known. In Europe, previously unidentified vectors have been responsible for the spread of BTV-8.

Two species of potential concern in islands to the near north of Australia are *C. orientalis* and *C. nudipalpis*. These are of the subgenus *Avaritia*, which includes the proven Australian vector species. *C. orientalis* is widely distributed in Indonesia, while *C. nudipalpis* has been collected in eastern Indonesia. Their vector status has not been specifically tested (Daniels et al 1995).

1.6.5 Factors influencing spread

BTV could be introduced to new regions by the movement of infected animals, but will survive in a new region only if competent vectors and sufficient susceptible hosts are present.

Natural spread of infected insect vectors from endemic areas during favourable seasons, or possibly by the long-distance carriage of infected vectors in wind

currents, is possible (see Section 1.7). Temperature and wind direction are relevant factors in the dispersal of *Culicoides*.

Temperature

The insects breed and are more active in warmer temperatures; adults are killed by frosts, but larvae can survive in dung for up to 2 months at low temperatures. Some Palaearctic species may survive over winter in animal barns. Evidence from Europe indicates that vector competence is increased by higher environmental temperature.

Models can predict the probability of vector survival over winter (Purse et al 2004). Using recent historical temperature data, the overwinter survival rate of *C. brevitarsis* in New South Wales is 50% at Port Macquarie and 0% at Goulburn, Tamworth and Mudgee. If temperatures were to rise 2 °C, the respective figures would be 100%, 0.1%, 0.1% and 0%.

Wind

Active dispersal of adult *Culicoides* is reported to be limited to a few hundred metres from the site where they emerged. However, passive dispersal by warm, humid winds blowing at low altitudes (<2000 m) can carry insects over distances greater than several hundred kilometres (Sellers 1980). This form of dispersal is believed to be responsible for the introduction of new serotypes to the Top End of the Northern Territory (Melville et al 1997).

The effect of wind speed on spread of insect vectors is uncertain; lower wind speeds encourage local spread, as the insects will not fly in higher winds (>8 km/h), but strong winds could cause rapid movement of insect vectors over greater distances.

In 2007, BTV-8 spread from Belgium or France to East Anglia in the United Kingdom. This is believed to have been the result of movement of infected vectors by wind.

1.7 Manner and risk of introduction to Australia

Although some strains of BTV already exist in Australia (see Section 1.3), exotic strains could be introduced by movement of viraemic ruminants, inoculation of infected imported biological products into ruminants, use of attenuated vaccines or wind dispersal of infected vectors. Australian quarantine procedures should prevent legal introduction by the first three means, but are defenceless against the last.

It is generally accepted that windborne spread of BTV-infected vectors occurred across the Mediterranean. The most plausible route of entry of BTV to Australia is via infected midges blown on the annual northwest monsoons from Indonesia to the Top End of the Northern Territory.

The irregular detection of a total of 10 BTV serotypes in the Top End and ongoing detections of viruses of Southeast Asian genotype suggest that there have been multiple entries of BTV into Australia. Research in Southeast Asia has identified

one additional serotype (BTV-12) that is exotic to Australia, so there is a risk of further genotypes entering northern Australia.

The natural history of bluetongue in Australia will probably continue to evolve. Serotypes that have been confined to northern Western Australia and the Northern Territory may spread, vector distributions may change as climate allows, and potential vectors and viruses from Southeast Asia may enter Australia. The contracting sheep populations in Queensland and Western Australia and their replacement with cattle may affect the distribution of vectors and the potential for occurrence of disease.

1.8 Social and economic effects

The economic costs of bluetongue to affected rural communities would depend on many factors, including the virulence of the virus serotype involved in the outbreak. Costs would arise from control measures, production losses due to the effects of the disease and effects on markets.

Production losses would result from deaths, reduced quantity and quality of wool, and decreased efficiency of prime lamb production. Sheep losses are expected to be sporadic in areas occasionally populated by vectors. Losses due to disease in cattle are likely to be rare.

A decrease in exports of live animals and ruminant products is likely — this would particularly apply to sheep and sheep products, at least in the short term, until the outbreak situation is well defined and detailed information can be provided to trading partners. Sheep are more likely to be clinically affected by an outbreak, with significant effects on the sheep industry; however, trade impacts could also affect the goat and cattle industries. Regaining export markets will require the targeting of advice to particular countries. The spread of BTV-8 in Europe via previously unknown vectors and the changes adopted by the OIE in 2011 will complicate trade discussions. According to these changes (OIE Terrestrial Code, Article 8.3.3), a country or a zone may be considered free from BTV when bluetongue is notifiable in the whole country and either:

- a surveillance program in accordance with Articles 8.3.16 to 8.3.21 has demonstrated no evidence of BTV in the country or zone during the past 2 years; or
- an ongoing surveillance program has demonstrated no evidence of *Culicoides* in the country or zone.

Quarantine and movement controls will reduce market-access options, and the costs of exports might increase due to costs of testing and isolating animals in vector-free areas before their export or movement into free areas (OIE Terrestrial Code, Article 8.3.8).

Domestic consumption of sheepmeat could be affected if the effects of the disease and the absence of public health implications are not properly explained to the Australian public.

Reduced demand in both the export and domestic markets could result in reduced value of livestock. Movement restrictions and testing would be additional costs for the domestic and international markets.

If investigations suggest that the disease is likely to be ongoing or seasonal, producers will incur additional costs for altered husbandry methods, insecticide use and vaccination.

A loss of markets would have an important impact on the Australian economy.

1.9 Criteria for proof of freedom

As proof of national freedom from BTV is not possible, Australia should continue to promote the concept of regional freedom from clinical disease. Regional freedom may only be claimed after appropriate surveillance is undertaken, based on sound epidemiological principles and in accordance with Articles 8.3.16 to 8.3.21 of the OIE Terrestrial Code. The monitoring undertaken by NAMP will help to fulfil this objective.

See Appendix 2 for further details on proof of freedom, and Appendix 3 for details of vector monitoring and control.

2 Principles of control and eradication

2.1 Critical factors assessed in formulating a response policy

2.1.1 Features of the disease

- Bluetongue is a disease of ruminants, including feral ruminants.
- Bluetongue virus (BTV) does not affect humans.
- Introduction of BTV to Australia appears most likely to occur from long-distance travel of vectors on wind currents. To date, serotypes detected in Australia reflect those present in countries to the north of Australia.
- Laboratory tests are available in Australia that will detect BTV within 24 hours of receipt of samples.
- Serotyping of BTV isolations takes 1–3 weeks.
- BTV can cause a range of clinical signs, from mild to acute. The first disease outbreak may not be recognised quickly unless it is acute and explosive.
- The incubation period is generally 5–20 days.
- The World Organisation for Animal Health (OIE) Terrestial Code gives a maximum infective (viraemic) period of 60 days for ruminants. There may be some overlap between the incubation and infective periods.
- Certain serotypes of BTV have been identified in parts of Australia, predominantly in cattle-rearing areas.
- These serotypes have not, to date, caused disease in cattle, goats or camelids in Australia.
- Bluetongue is not transmitted directly between animals; it is transmitted only via competent insect vectors. Analysis of data from the outbreak of BTV-8 in Europe indicates that transplacental infection or transfer at calving in the absence of vectors is possible in cattle.
- Vectors competent to transmit the virus are present in Australia. Known Australian vectors have a preference for feeding on cattle, not sheep.
- Vector monitoring is important to determine the species involved and their distribution, but facilities available for vector trapping and identification in Australia are limited.
- Facilities in Australia for the identification of virus from pooled samples are limited.
- The distribution of the most effective known vectors is limited to northern Australia by climatic factors.
- The expansion of BTV-8 in Europe has demonstrated an ability for BTV to use new *Culicoides* vectors that have not previously been associated with BTV spread when expanding into new areas.

- Cattle have an important epidemiological role as primary and amplifying hosts, and as ongoing sources of infection for vectors. Cattle may remain infective for *Culicoides* vectors for approximately 50 days after infection (the OIE figure is 60 days).
- A carrier status in animals is not known. Serotype-specific antibodies are believed to persist for the life of the animal following infection.
- *Culicoides* vectors remain infected and infective for life (10–90 days). Transovarial infection does not occur. Subsequent generations of vectors can only be infected by feeding on a viraemic host during the infective period (the OIE uses 60 days).
- BTV does not survive outside the host or vector for long, and products (meat, wool, etc) and fomites are not a risk for transferring infection. Rarely, BTV may be transmitted in semen.
- The disease is most likely to occur in late summer or early autumn, due to the buildup of virus numbers in cattle and increasing vector populations with warmer weather.
- The European expansion of BTV confirmed that BTV-8 causes clinical signs in cattle as well as in sheep. However, disease in cattle remains a rare observation, associated with the European BTV-8 strain and with BTV-24 in dairy cattle in Israel.

2.1.2 Features of susceptible populations

- Some of, or possibly all, the Australian serotypes of BTV could cause clinical disease in sheep and small ruminants, but they have not affected sheep-rearing areas to date, probably due to vector distribution and vector feeding preference for cattle.
- The most obvious clinical signs are expected to occur in sheep, varying from fulminating to subclinical.
- An outbreak of BTV in sheep often follows an amplification period in cattle.
- In Australia, most sheep infection will probably originate from cattle. Little spread by vectors between sheep is expected.
- Cattle are the main reservoir population.
- Incursions of BTV into animal populations may be periodic, associated with changes in vector distribution and sensitivity of the vector insects to frost, although some *Culicoides* species can tolerate a cooler environment.
- Stamping out of infected animals is not recognised as a useful strategy for BTV.
- Destruction of individual infected animals may be required for welfare reasons.
- Control of vectors, other than short-term control in a limited area, is not recognised as a viable strategy.
- Overseas, movement controls and vaccination form the core of control programs.
- A vaccine may need to be chosen after the serotype has been identified. The available vaccines will need to be carefully considered before a choice is made.

- Commercial inactivated BTV vaccines for BTV-1, BTV-3 and BTV-9 should be available from Europe. Based on experience in Europe with BTV-8, an inactivated vaccine for additional serotypes for emergency use might not be available in the first 2–3 years of an outbreak (Tweddle 2009).
- Widespread subclinical infection, particularly in cattle, is a feature of BTV. An epidemiological investigation to define the scope of the infection will be required.
- A BTV outbreak in a susceptible population would result in trade impacts, as well as impacts on affected producers and rural communities.
- Long-distance spread of BTV, after it becomes established in Australia, could occur through movement of infected animals and windborne movement of vectors. Establishment at any destination will require competent insect vectors and a susceptible population.

2.2 Options for control or eradication

Based on an assessment of the above factors, issues that are relevant to managing an outbreak of bluetongue in Australia include the following:

- An emergency response to BTV is required when clinical disease meeting the case definition is confirmed in ruminants.
- Under certain circumstances where the case definition is not satisfied, the Consultative Committee on Emergency Animal Diseases may request a follow-up epidemiological investigation.
- Endemic circulation of BTV is likely to continue within the recognised BTV zone.
- An investigation in accordance with National Arbovirus Monitoring Program (NAMP) guidelines is indicated when evidence of a circulating strain of a pathogenic BTV is detected through NAMP or other monitoring, or when serological or other evidence of viral spread is detected in areas in which known competent vectors are absent.
- A thorough epidemiological investigation to scope the extent of BTV infection will be needed to guide the response program. All environmental factors, including the presence of ruminants, stocking densities, movements of ruminants into and out of the district, presence of potential vectors and recent rain and wind patterns, should be recorded. Recent movements of livestock can be determined using the industry's National Livestock Identification System.
- It is probable that BTV would enter through northern Australia and that the first infections would be in cattle in northern Australia. The northern cattle herd may then act to amplify the BTV strain. The infection in cattle may not be detected until clinical disease occurs in either cattle or (most likely) sheep, or until it is detected by NAMP activities.
- Competent vectors are already present in Australia. The known vectors are generally limited to cattle populations, either through their preferential feeding on cattle or through their distribution (which relates to climatic influences).

- In Australia, a BTV outbreak in sheep is likely to originate from a cattle reservoir within flying distance of vector insects; wind speed and direction are also relevant.
- Identification of the serotype and its competent vectors, including any 'new' vectors for the Australian environment, will be needed to guide policy. It will take at least 1–3 weeks to identify the serotype and possibly longer to identify new vectors; hence, the early response should focus on epidemiological scoping and movement controls.
- Movement controls are needed only for live ruminants and possibly semen. Animals that die from, or are humanely destroyed due to, BTV infection no longer transmit virus.
- Stamping out is not an option for BTV, although modified stamping out of selected feral ruminant populations may be used as part of the overall response.
- Protection of susceptible populations through vaccination will be critical. Choice of the appropriate vaccine from those currently available will require knowledge of the serotype.
- Implementation of steps to minimise vector spread may be useful; however, control of the spread of BTV will rely mainly on movement controls and creating an immune population through vaccination.
- Registration of all ruminant holdings and knowledge of feral ruminant populations will be required to support any program.
- Infection may be present across a considerable area before BTV is detected. Good communication will be required for coordination across all producers and owners.

From the above issues, policy options that could contribute to the control of BTV are:

- an emergency response, involving immediate zoning through declaration of areas, to be implemented when clinical disease caused by BTV is detected in ruminants
- tracing and surveillance to identify the area of infection
- modification of zones following an epidemiological investigation
- movement controls on live ruminants and possibly semen within zones
- vaccination of susceptible animals
- modified stamping out to target selected feral ruminant populations within zones
- vector management procedures
- humane destruction of severely clinically affected animals
- industry awareness.

The policy to be implemented is described in Section 3.

3 Policy and rationale

Case definition

For the purposes of this manual:

- bluetongue is defined as clinical signs of bluetongue in a ruminant accompanied by a confirmed laboratory diagnosis (for the first case), or clinical signs in a susceptible ruminant after an outbreak has been confirmed
- positive serology in the absence of clinical signs does not constitute a definition of a case.

This manual will come into operation when the case definition is satisfied and the Consultative Committee on Emergency Animal Diseases (CCEAD) and the National EAD Management Group (NMG) recommend that action should be taken or a response is required.

3.1 Introduction

Bluetongue is not a contagious (communicable) disease — that is, it is not spread directly from animal to animal. It is spread by vectors and viraemic animals, and this will determine the most appropriate control measures to be implemented.

Summary of policy

Bluetongue is a World Organisation for Animal Health (OIE)-listed disease that has the potential for rapid spread with significant production losses, and is of major importance to the international trade in ruminant livestock (including sheep, goats, cattle and deer).

The policy with regard to an outbreak of clinical disease caused by bluetongue virus (BTV) is to minimise the economic impact and to eliminate clinical disease if circumstances permit. Eradication might be feasible if the disease is detected early in isolated animals and infected vectors are absent, if the disease occurs in a vector-free area, or if frosts are imminent in vector areas. If the disease occurs in areas with competent vectors early in the vector season, control will be difficult. Should bluetongue disease become established in an area, a long-term industry control program may be adopted.

During an initial response to an outbreak of clinical disease, a combination of strategies (not listed in priority order) will be used to limit or control the disease, including:

- **an *immediate assessment* of the epidemiological situation, including vector monitoring and serosurveillance of susceptible animals to determine the zone of active transmission**
- ***quarantine and movement controls* over ruminant livestock in declared areas**

- ***treatment and husbandry procedures*** **to control vector attack on ruminants, minimise health and production effects, and provide animal welfare relief in declared areas**
- ***tracing and surveillance*** **to determine the source and extent of infection, and to provide proof of freedom from the disease**
- ***zoning*** **to define infected and disease-free areas**
- ***vaccination*** **to create buffer zones to protect noninfected susceptible animals, to protect against clinical disease and to facilitate livestock movement; vaccination would be a key component of any control program**
- **possible measures to *reduce vector attacks* on animals**
- ***an awareness campaign*** **to encourage cooperation from the industry and the community and, where necessary, to assure consumers of product safety.**

There is no justification for a stamping-out policy, but some animals may need to be destroyed for welfare reasons.

Bluetongue disease is a Category 3 disease under the *Government and Industry Cost Sharing Deed in Respect of Emergency Animal Disease Responses* (EADRA). Category 3 diseases are those for which costs will be shared 50% by governments and 50% by industry.

The chief veterinary officer (CVO) in the state or territory in which the outbreak occurs will be responsible for developing an EAD Response Plan for the particular outbreak.

The CCEAD, convened for the incident, assesses the response plan drawn up by the CVO for technical soundness and consistency with AUSVETPLAN, and endorses or seeks modifications to it. The CCEAD may also ask unaffected jurisdictions to develop response plans to address activities in the jurisdictions that will be cost shared. Overall operational management of the incident rests with the CVO of the affected jurisdiction, with oversight by the CCEAD.

The NMG, also convened for the specific incident, decides on whether cost-sharing will be invoked (following advice from the CCEAD) and manages the national policy and resourcing needs.

For further details, refer to the **Summary Document**.

CVOs will implement disease control measures as agreed in the EAD Response Plan and in accordance with relevant legislation. They will make ongoing decisions on follow-up disease control measures in consultation with the CCEAD and the NMG, based on epidemiological information about the outbreak(s).

For information on the responsibilities of state or territory disease control headquarters and local disease control centres, see the **Control Centres Management Manual**.

3.2 Strategy for control and eradication

When a clinical outbreak of bluetongue occurs, the initial strategy will be to quarantine domestic ruminants on affected properties and implement movement controls while an epidemiological investigation is carried out. All environmental factors, including ruminant stocking densities, recent movements of ruminants onto and off the property, and recent rain and wind patterns, will be recorded.

The aim of the epidemiological investigation will be to gain an immediate understanding of:

- the extent of infection and disease
- the virulence of the virus
- whether the virus is a new or endemic serotype
- the potential vectors present and their density
- the competence of vectors
- whether the outbreak is the start of an epidemic or the tail end of what has largely been a subclinical event.

Tracing will also determine if other areas are at risk due to the movement of viraemic animals. Virus-free and/or vector-free areas will be identified as soon as possible. The investigation will be used to determine the appropriate control strategy for the outbreak — for example, the potential use of longer term movement controls or vaccine. **The availability and registration of a suitable vaccine need to be investigated at an early stage.**

The purpose of movement restrictions on potentially infected animals is to minimise the spread of virus to new areas where vectors may be present while the investigation is being conducted. The extent of these movement controls will depend on epidemiological predictions (see Section 4). For tracing and surveillance, two periods are relevant: incubation and infective. The incubation period lasts up to 20 days, and the infective (viraemic) period, as defined by the OIE, is 60 days. There may be an overlap between the incubation and infective periods. Virus may circulate in some species without clinical signs for longer periods (i.e. more than one cycle).

There is no justification for placing restrictions on the movements of animal products such as wool and meat.

Immediate liaison with industry and then the media is essential to inform them about the presence of the disease and the control measures that are proposed or recommended; the lack of risk to human health should be emphasised.

A decision on the control measures to be adopted will depend on all the factors discussed above. If no control measures are appropriate or feasible, it could be technically valid and most cost-effective to allow the outbreak to run its natural course and restrict control measures to limiting the movement of viraemic animals to other areas. In an endemic area, it may be appropriate to simply monitor the disease, determine the vectors involved and undertake extension activities; this, combined with movement controls, was the approach used in Europe in 2006–07. This would especially be the case if the outbreak occurred towards the end of the arbovirus season in a temperate area.

Should clinical bluetongue be detected in Australia, it would be important to determine whether it was in a group of animals that had recently been moved from another area (where further investigations would then be focused), or whether an endemic focus was developing in an area previously free from the virus.

3.2.1 Stamping out

A stamping-out policy would not be justifiable for bluetongue because the disease is not spread by direct or indirect contact between animals, and it would be impossible to eliminate the insect vector. In some cases, it might be necessary to slaughter infected animals showing severe (i.e. life-threatening) clinical signs for animal welfare reasons; in practice, this will be a relatively small percentage of the affected population. Slaughter for trade purposes may be advocated, but should be strongly opposed.

3.2.2 Quarantine and movement controls

Movement controls are best implemented through the establishment of declared areas (transmission areas, restricted areas and control areas) and an outside area, and linking appropriate movement controls to each area. As a general principle, the aim of movement controls is to reduce the spread of disease by preventing the movement of infected animals and infected vectors, while allowing animal movements — such as movement of immune animals — that pose a minimal risk.

Movement controls are required only for susceptible animals and reproductive material, and associated vehicles that could transfer infected vectors. Movement controls will focus on facilitating the movement of vaccinated immune animals and naturally immune animals while restricting the movement of infected and nonimmune (susceptible) animals. These controls will be complemented by vector treatment of animals and livestock transport vehicles (ensuring that withholding periods and export slaughter intervals are complied with) and risk-based decision making to determine when nonimmune animals can move. The initial premises on which animals that meet the case definition are detected will be subjected to quarantine and movement controls and will be officially declared an infected premises (IP).

Early in the outbreak, it is critical to identify all dangerous contact premises (DCPs). DCPs include premises that have received animals from an IP before the appearance of first clinical signs and until quarantine was imposed on the IP, and all premises sharing a common boundary with IPs. DCPs should initially be subject to movement controls.

The results of the epidemiological investigation will determine whether continuing quarantine and movement controls are warranted. It is important to be aware of possible trade concerns about the movement of animals from the vicinity of the outbreak area to free areas, even if such movements carry negligible disease risk. Any movement restrictions placed on live animals may be influenced more by trade considerations than by disease risk. Affected jurisdictions may wish to act conservatively until the epidemiological investigation is complete and the full extent of the disease risk and trade risk is known. Critical factors are virus serotype and pathogenicity, vector competence and ecology, host species distribution and recent movement, and climate. There is no risk of disease transmission in animal products (such as meat, milk and wool), and these may be moved without restriction.

See Section 4 for further details on declared areas and on quarantine and movement controls.

Zoning and compartmentalisation

Zoning is an important strategy that will be implemented to re-establish the confidence of trading partners, minimise restrictions over the movement of susceptible animals within Australia and minimise disruptions to the export trade in live animals. The zones will be determined from the epidemiological investigation and information available from the National Arbovirus Monitoring Program (NAMP). Under the OIE Terrestrial Code, a zone may be considered free from bluetongue when a surveillance program, in accordance with Articles 8.3.16 to 8.3.21, has demonstrated no evidence of BTV in the zone during the past 2 years, or no evidence of *Culicoides* species likely to be competent vectors in the zone. This needs to be considered when zones are developed.

3.2.3 Tracing and surveillance

Clinical bluetongue could result from the movement of infected vectors into sheep-raising areas. Disease could also occur as a result of the movement of susceptible sheep into the northern endemic region, or the movement of viraemic cattle from an endemic region to a location where there is an abundance of competent vectors that can carry the virus to sheep. Disease could also result from the entry into northern Australia of a virus pathogenic for cattle.

Tracing will be used to determine the movements of ruminants onto and off IPs before the first signs of clinical disease and up to the introduction of quarantine and movement controls. The National Livestock Identification System would be used for cattle tracing and to assist, where available, with the tracing of other ruminants. Tracing of products, people and things would be of no benefit.

A surveillance and monitoring program for virus and competent vectors in affected or threatened areas will be initiated immediately when disease is detected. The survey will attempt to determine the extent of the virus and vectors, the serotype involved and its virulence. The survey will also help to define the limits of the bluetongue-free area. If vaccination is used, it will be necessary to distinguish between natural infections and vaccination responses, by the permanent identification of vaccinates.

The epidemiological investigation should include:

- examination of the time and location of the outbreak, and the location of the susceptible population
- recording of recent movements of ruminants onto and off IPs
- identification of the species of vectors and the virus serotypes present
- collection of meteorological data
- a serum survey of affected animals and contacts.

The size of the TA may be very large (100 km radius), depending on meteorological and other factors assessed by epidemiologists. Priority should be given to the area surrounding the affected property or properties. A modified

NAMP will be used to continually monitor the limits of areas containing the virus and vectors, and free areas.[11]

See Appendix 2 for further details on surveillance.

3.2.4 Vaccination

Importation of BTV vaccines is subject to the issuing of import permit(s) from DAFF Biosecurity, part of the Australian Government Department of Agriculture, Fisheries and Forestry. Supply and use of the vaccine in Australia will require an emergency permit and consent to import from the Australian Pesticides and Veterinary Medicines Authority. Importation, distribution, use and disposal of a vaccine that is a genetically modified organism must also be licensed by the Office of the Gene Technology Regulator or permitted under an Emergency Dealing Determination by the minister responsible for gene technology. Vaccination will be approved by the NMG based on the recommendation of the CCEAD.

Vaccination would form a major strategy of any control program.

It is unlikely that sufficient vaccine will be available during the first disease outbreak to protect susceptible animals. The first outbreak would probably be in the autumn, after one or more favourable seasons have led to the buildup of vectors. If vaccine is not available, the control strategy in the first year will aim at containing spread and reducing transmission by all practical means other than vaccination, even though all of these methods have limitations.

Sufficient vaccine (inactivated or subunit) should become available to immunise at-risk populations if epidemiological investigations indicate that there is likely to be a prolonged period of infection or that recurrent outbreaks are likely.

Vaccines are not currently available in Australia, and the most suitable type of vaccine for use in Australia is continually being investigated as vaccine research progresses. Attenuated (live) vaccines have been used overseas but would not be used in Australia because of their shortcomings (see Section 1.5.3) and the risk of introducing foreign genes into Australia's BTV gene pool. Further investigations may show that this type of vaccine is useful in a prolonged outbreak or continuing seasonal clinical disease, in the absence of suitable effective alternatives. If there is no alternative to the use of an attenuated vaccine, care must be taken to ensure that pregnant animals are not vaccinated and that vaccination is not undertaken when vector activity could be expected during the subsequent infective period (60 days).

Currently, the only vaccines supported for use in Australia are inactivated vaccines. Noninfectious subunit vaccines would be acceptable on epidemiological grounds if they were efficacious, but such vaccines are yet to be developed. If a decision to vaccinate is made, a supply of inactivated vaccines of the relevant serotype will have to be negotiated. Commercial vaccines are available for a number of serotypes but, for certain serotypes not currently covered, acquisition of adequate quantities of appropriate vaccine may take at least 2 years (Tweddle

[11] See www.animalhealthaustralia.com.au/programs/disease-surveillance/national-arbovirus-monitoring-program

2009). However, in some cases this period may be shortened if suitable expertise is available.

DIVA strategy

Currently, no tests are available for differentiating infected from vaccinated animals (DIVA) if the available attenuated or inactivated vaccines are used. Vaccinates would require permanent identification to allow them to be differentiated from infected animals.

See Section 1.5.3 for further details on vaccination.

3.2.5 Treatment of infected animals

There is no effective treatment for infected animals. In some cases, it may be necessary to alleviate the effects of the disease for welfare purposes. Anti-inflammatory medications and treatment against secondary infections may be required. Animals should not be moved unless necessary, and should be provided with shade, soft food and water.

If only a few animals are infected and vectors are present, it would be advisable to treat the animals with insecticide and insect repellent to reduce further spread of the virus by vectors. Local transmission of BTV can be suppressed for up to 6 weeks by treating cattle with ivermectin. Eradication of vectors is not practicable.

Valuable sheep may be protected by housing them in vector-proof housing.

Destruction of affected animals is not justified on disease control grounds. However, in some cases, it might be necessary to slaughter infected animals showing severe (i.e. life-threatening) clinical signs for animal welfare reasons; in practice, this will be a relatively small percentage of the affected population (see the **Destruction of Animals Manual**).

3.2.6 Treatment of animal products and byproducts

BTV does not survive in the environment, or in animal products or byproducts (such as meat, milk and wool), and does not persist on fomites. However, it can be found in semen from viraemic bulls; therefore, semen should not be collected from bulls during this infective phase. Collection and movement of bovine and ovine embryos derived in vivo is considered to be safe.

3.2.7 Disposal of animal products and byproducts

Since the virus does not survive in the environment or in animal products and byproducts, there is no need to destroy such products. There is no known risk to human health.

3.2.8 Decontamination

Because BTV does not survive outside the vector or living host or on fomites, decontamination procedures are not warranted.

3.2.9 Wild animal control

Wild animal control is not relevant to the control of bluetongue. Deer, camelids, buffalo and goats are generally unimportant in the spread of disease because known Australian vectors have a host preference for cattle, and the level and duration of viraemia are greater in cattle than in these other species. The role of wild animals will need to be re-assessed if new vectors are identified during an outbreak.

3.2.10 Vector control

Eradication of vectors across the whole of a declared area is not considered possible under Australian grazing conditions.

Eradication of vectors in small, carefully selected and well-controlled areas is an option that could be included in the overall strategy.

Vector-suppression strategies (see Appendix 3) to reduce vector numbers or to prevent vector–animal interaction can be applied to animals, vehicles and other fomites, and areas.

Vector monitoring should form part of a control strategy. This includes monitoring for the presence of known or suspected vectors, and monitoring the effectiveness of vector eradication or control programs. Some of these techniques may also provide an indication of vector density.

For further details of vector monitoring, suppression and control, see Appendix 3.

3.2.11 Public awareness and media

Close liaison with industry, the media and the public will be needed to ensure that all are fully informed about the ecology of bluetongue, the effects of the disease and their role in the disease control measures that are proposed. Public confidence in the safety of products must be maintained so that demand is not affected.

Affected industries need to be made aware of the potential impacts of the disease and the clinical signs that susceptible animals may display. Livestock owners should be encouraged to inspect their animals regularly and promptly report any suspicious findings to their local departmental animal health officer. This activity is an important part of the monitoring program.

Industry and the media must be informed that prevailing circumstances will determine the most appropriate control measures. Promotion of the rationale for control policies for an arboviral disease such as bluetongue will be very important because other disease control policy has focused on diseases such as tuberculosis, brucellosis and foot-and-mouth disease, for which stamping out can play a major role.

Important information to convey to the livestock industry includes the facts that stamping out is not appropriate for bluetongue control, and that vectors and movement of infected animals play a pivotal role in the distribution of bluetongue disease (and in some cases will lead to a preference to let the disease 'run its course').

3.2.12 Public health implications

Humans are not affected by BTV.

3.3 Funding and compensation

An outbreak of bluetongue disease is classified as a Category 3 EAD under the EAD Response Agreement between the governments of Australia and the livestock industries.

Category 3 diseases are EADs that have the potential to cause significant (but generally moderate) national socioeconomic consequences through international trade losses, market disruptions involving two or more states, and severe production losses to affected industries, but have minimal or no effect on human health or the environment. For this category, the costs will be shared 50% by governments and 50% by the relevant industries (refer to the EAD Response Agreement for details).[12] Information on the cost-sharing arrangements can be found in the **Summary Document** and in the **Valuation and Compensation Manual**.

3.4 Recovery

It is important in any response to an EAD that consideration is given to the need for simultaneous recovery activities that will be addressed by other agencies. It is important that the response agencies have effective communications with agencies leading the recovery activities.

3.5 Strategy if the disease becomes established

If bluetongue infection causes recurring serious disease in sheep or cattle areas, an industry control program using vaccination may need to be introduced. Effective vaccines, supported for use in Australia, are still to be developed. The costs associated with insecticide treatment would be high, and such treatment is likely to be ineffective unless it is adopted over large areas by a majority of producers.

[12] Information about the EAD Response Agreement can be found at www.animalhealthaustralia.com.au/programs/emergency-animal-disease-preparedness/ead-response-agreement

4 Recommended quarantine and movement controls

4.1 Guidelines for classifying declared areas

4.1.1 Premises classifications

The status of individual premises will be declared after an epidemiological assessment has been completed.

For the purposes of this manual, 'high-risk premises' are infected premises, dangerous contact premises, dangerous contact processing facilities, suspect premises and trace premises.

Infected premises (IP)

A premises classified as an IP by the chief veterinary officer (CVO) (or their delegate) is a defined area (which may be all or part of a property):

- in which bluetongue disease meeting the case definition exists; or
- in which viraemic ruminants are detected; or
- that the chief veterinary officer decides should be declared an IP.

Dangerous contact premises (DCP)

Premises classified as DCPs are those that:

- contain ruminants that are not showing clinical signs of bluetongue but, following a risk assessment, are considered to have a high likelihood of containing infected animals or a high likelihood of containing infected vectors that present an unacceptable risk to the control program
- are within a zone where competent vectors are known or suspected to be present
- share a common boundary with IPs.

DCPs would include premises containing ruminants that have recently been introduced from an IP (before the appearance of first clinical signs and until quarantine was imposed on the IP) and are likely to be infected.

Since a DCP presents an unacceptable risk to the response if the risk is not addressed, such premises are a high priority for investigation and action. An investigation of a DCP may produce the following outcomes:

- If the presence of a bluetongue virus (BTV)-infected animal or contaminated animal products, wastes or things is confirmed, the premises would be designated as an IP.
- If their presence is not confirmed but the likelihood is considered to remain high, the premises would continue to be designated as a DCP until completion of control measures enable it to be cleared (or resolved). If it is located in the

restricted area (RA), it would be designated as an at-risk premises (ARP). If it is located in the control area (CA), it would be designated as a premises of relevance (POR).

- If it is considered unlikely that a BTV-infected animal or contaminated animal products, wastes or things are present, the premises would receive the qualifier assessed negative (AN). It would become a resolved premises (RP) initially and, if it is located in the RA, be designated as an ARP. If it is located in the CA, it would be designated as a POR.

Dangerous contact processing facility (DCPF)

A DCPF is an abattoir, knackery or milk processing plant (or other such facility) to which, based on a risk assessment, it appears highly likely that BTV-infected animals, or contaminated animal products, wastes or things have been introduced.

This designation provides authorities with legal powers over such premises to facilitate product tracking, and serves as a communication tool for reporting nationally and internationally on progress in the response.

If, over the course of the response, it is considered unlikely that a BTV-infected animal or contaminated animal products, wastes or things is/are present, the premises would receive the qualifier DCPF-AN. It would become an RP initially, and, if it is located in the RA, be designated as an ARP. If it is located in the CA, it would be designated as a POR.

Suspect premises (SP)

SP is a temporary classification of a premises that contains BTV-susceptible animal(s) not known to have been exposed to the disease agent but showing clinical signs that require investigation(s).

Every effort should be made to resolve the status of an SP as soon as possible. For most diseases, the RA should contain as many SPs as practical. The investigation may produce the following outcomes:

- If the case definition is confirmed, the premises would be designated as an IP.
- If the case definition is not confirmed but suspicion remains, the premises would continue to be designated as an SP.
- If the case definition is ruled out, the premises would be assessed as negative and receive the qualifier SP-AN. If it is located in the RA, it would then be designated as an ARP. If it is located in the CA, it would be designated as a POR.

Trace premises (TP)

TP is a temporary classification of a premises that contains BTV-susceptible animal(s) that tracing indicates may have been exposed to an infected animal(s), or contaminated animal products, wastes or things, and that requires investigation(s).

Every effort should be made to resolve the status of a TP as soon as possible. The investigation may produce the following outcomes:

- If the case definition is met, the premises would be designated as an IP.

- If it appears highly likely, as a result of an epidemiological assessment of the risk, that the disease is present in the specific epidemiological situation, that the TP contains an infected animal(s) or contaminated animal products, wastes or things, it would be designated as a DCP.
- If the trace proves to be negative, the premises would receive the qualifier TP-AN. However, if it is located in the RA, it would then be designated as an ARP. If it is located in the CA, it would be designated as a POR.

At-risk premises (ARP)

An ARP is a premises in an RA that contains a live susceptible animal(s) but is not considered at the time of designation to be an IP, DCP, DCPF, SP or TP.

The animal(s) on such premise(s) are subject to procedures such as heightened surveillance and movement restrictions. This designation provides authorities with power over such premises, facilitates tracking and serves as a communication tool for reporting nationally and internationally on progress in the response.

Premises of relevance (POR)

A POR is a premises in a CA that contains a live susceptible animal(s) but is considered at the time of designation not to be an SP, TP or DCPF. The animal(s) on such a premises are subject to procedures applicable in the CA, such as heightened surveillance and movement restrictions.

Resolved premises (RP)

An RP is and an IP, DCP or DCPF that has completed the required control measures and is subject to the procedures and restrictions appropriate to the area in which it is located.

An RP will become an ARP if it is within the RA and a POR if it is within the CA.

Unknown status premises (UP)

A UP is a premises that has been identified as having an unknown animal status.

Zero susceptible stock premises (ZP)

A ZP is a premises that contains no BTV-susceptible animals.

Qualifying categories

The following qualifying categories may be added to a property status.

Assessed negative premises

Assessed negative is a qualifier that may be applied to premises previously defined as DCP, DCPF, SP, TP or ARP that have been cleared of suspicion at the time of designation. The animals on such premises are subject to the procedures (such as heightened surveillance) and movement restrictions appropriate to the declared area (RA, TA or CA) in which the premises is located. For DCPFs, increased biosecurity measures must be maintained.

This designation is a description to document progress in the response and in the proof-of-freedom phase. As a qualifier, it is not to be used at the same level as the other premises classifications.

Vaccinated premises

The vaccination status of a population of animals or premises might be important when considering movement controls. For the purposes of AUSVETPLAN, the following guidance should be followed.

To be referred to as a vaccinated population, the population must have been vaccinated in accordance with:

- the Australian Pesticides and Veterinary Medicines Authority (APVMA) registered label particulars, or
- APVMA-approved permit instructions relating to an approved emergency animal disease response plan for off-label use, or use of an unregistered immunobiological product(s), or
- instructions of the relevant CVO.

Vaccination programs during emergency responses are not always completed by the time a response is lifted. Thus there may be populations of animals present in the proof-of-freedom phase that are only partially vaccinated and will need to be accounted for, particularly if serology is used for proof of freedom.

Any premises that has had vaccine used would appear as a vaccinated premises.

Any vaccination program should be able to record the number of doses administered and their timing, if records are required of fully vaccinated premises. However, the key requirement in an emergency animal disease response where vaccine is used will be to identify fully or partially vaccinated animals so that they can be disposed of or tested in the proof-of-freedom phase.

In cattle, the National Livestock Identification System (NLIS) can record animals vaccinated, but for other species this information still relies on mob identification — hence the importance of premises status qualifiers.

4.1.2 Declared areas

In the declaration of areas, the following factors should be taken into account:

- industries involved
- environmental features
- vector range
- movement patterns of susceptible species
- processing options (livestock and products)
- natural and artificial barriers and easily recognisable boundaries
- other geographic features such as road networks and towns
- nature of the outbreak

- livestock species involved
- feral animal involvement.

Transmission area (TA)

Vector-borne diseases differ from non–vector-borne infectious diseases in that vectors cannot be contained by boundary fences. The TA is thus less concerned with property boundaries or definitions and more with including all infected vectors in the area surrounding known areas of infection. It will be declared around known sources of infection as evidenced by disease, seroconversion or trapping of infected vectors, and any other confirmation of active disease transmission.

A TA will include all IPs and, where possible, all DCPs, SPs and TPs. In the presence of competent vectors, a TA of not less than 50-km radius should be declared. The TA does not need to be circular but can have an irregular perimeter, provided that the boundary is initially an appropriate distance from the nearest IP, DCP, SP or TP. This distance will depend on the information gained about vector numbers and competence, prevailing winds, and the number and distribution of infected animals. In the absence of competent vectors, the TA may be reduced in size.

Restricted area (RA)

The RA will be a larger declared area around the TAs. The boundary of the RA does not have to be circular or parallel to that of the TA but should be at least 100 km from the boundary of the TA; it may be influenced by World Organisation for Animal Health (OIE) guidelines. The RA can include areas of known competent vector distribution. In general, surveillance and movement controls will be less intense than in the TA, and animals may be permitted to move under permit from and within the area.

The boundary of the RA will be adjusted as confidence about the extent of the outbreak increases. It will take into account the OIE *Terrestrial Animal Health Code* chapters on BTV, and zoning and compartmentalisation (Chapter 4.3).[13]

Control area (CA)

A CA is a disease-free buffer between the RA and the outside area (OA) (see below). It will have specific movement controls and surveillance strategies applied within it to maintain the disease free status and prevent spread of the disease into the OA.

An additional purpose of the CA is to control movement of susceptible livestock for as long as is necessary to complete trace-back and epidemiological studies, to identify risk factors and forward and backward risk(s).

The CA will be a larger declared area around the RA(s) — initially, possibly as large as the state or territory in which the outbreak occurs — where restrictions

[13] www.oie.int/international-standard-setting/terrestrial-code/access-online

will reduce the risk of disease spreading from the RA(s). It may be defined according to geography, climate and the distribution of feral animals. The boundary will be adjusted as confidence about the extent of the outbreak increases.

The OIE *Terrestrial Animal Health Code* standards on BTV, and zoning and compartmentalisation (Chapter 4.3)[14] give guidance on specific activities. RAs and CAs are declared for the purposes of disease control, and zones may be used for trade and business continuity purposes. RAs and CAs declared for the purposes of disease control may not be the same as OIE zones for trade. For the latter, consideration will need to be given to the Terrestrial Code guidelines.

In general, surveillance and movement controls will be less intense in the CA than in the RA, and BTV-susceptible animals and their products may be permitted to move under permit within and from the area.

Outside area (OA)

The OA is not a declared area but is used to describe the rest of Australia outside the declared areas. The OA will be subject to surveillance. As it is highly desirable to maintain the OA as 'disease free', the movement of animals and commodities from the RA and CA into the OA will be restricted.

Possible declared areas during a bluetongue outbreak are summarised in Table 4.1.

Table 4.1 Summary of possible declared areas

Area	Characteristics
Transmission	50-km radius from infected premises, dangerous contact premises, trace premises and suspect premises
Restricted	100 km from transmission area
Control	Buffer zone between restricted area and the rest of Australia
Outside	The rest of Australia outside the control area

Purpose of area declarations

TAs, RAs, CAs and OAs are used for the overall management of the bluetongue outbreak, rather than primarily to reduce the incidence of cases. Virus-free zones will need to continue to be defined for trade purposes. The following factors must be taken into account for assessing a disease-free zone:

- number, density and distribution of cattle, sheep and other ruminants
- number, density, distribution and competence of vectors
- climate and prevailing weather factors
- geographical features
- virus activity, as demonstrated by seroconversions.

[14] www.oie.int/international-standard-setting/terrestrial-code/access-online

The continued classification of premises and areas will depend on the assessment of the epidemiological findings.

4.2 Guidelines for issuing permits

When assessing risk for the purposes of issuing a permit, the elements to consider may include:

- sources of risk
  - species of animal
  - type of product
  - presence or absence of virus on both the originating and destination premises
  - current vector activity
  - organisation and management issues (ie confidence in animal tracing and surveillance, biosecurity)
  - proposed use of the animals or product
  - proposed transport route
  - vaccination status of the animals
  - biosecurity of transport
  - biosecurity and monitoring at the destination
  - environment and natural events
  - community and human behaviour
  - risk of sabotage
  - regulations and standards
  - available resources for compliance and enforcement
- areas of impact
  - livestock health (health of affected species, including animal welfare)
  - human health (including occupational health and safety)
  - trade and economic impacts (including commercial and legal impacts)
  - environmental impacts
  - organisational capacity
  - political impacts
  - reputation and image
- proposed risk treatment measures
  - vaccination
  - processing of product
  - disinfection or other treatment of animals, vehicles and fomites
  - vector control

- security
- communication.

4.3 Types of permit

Permits are either general or special. They are legal documents that describe the animal(s), commodities or things to be moved, the origin and destination, and the conditions to be met for the movement. Either type of permit may include conditions. Once permit conditions have been agreed from an operational perspective, all permit conditions must be met for every permit. Both general and special permits may be in addition to documents required for routine movements between or within jurisdictions (eg health certificates, waybills, consignment notes, National Vendor Declarations).

4.3.1 General permit

General permits (GP) are used for lower risk movements, and create a record of each movement to which they apply. They are granted without the need for direct interaction between the person proposing to move the animal(s), commodity or thing and a government veterinarian or gazetted inspector of stock. The permit may be completed via a webpage or in an approved place (such as a government office or commercial premises). A printed version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. GPs may not be available until the relevant chief veterinary officer (CVO) gives approval for general movements, and this may not be available in the early stages of a response.

4.3.2 Special permit

Special permits (SpP) are issued by the relevant government veterinarian or gazetted inspector of stock. They are used for higher risk movements, and therefore require formal application and individual risk assessment. SpP describe the requirements for movement of an animal (or group of animals), commodity or thing, for which a specific assessment has been conducted by the relevant government veterinarian or gazetted inspector of stock. A printed version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements.

Emergency permit

An emergency permit is a special permit that specifies strict legal requirements for an otherwise high-risk movement of an animal, to enable emergency veterinary treatment to be delivered, to enable animals to be moved for animal welfare reasons, or to enable any other emergency movement under exceptional circumstances. These permits are issued on a case-by-case basis under the authorisation of the relevant CVO.

4.4 Recommended movement controls for bluetongue

For any movement of any item, steps should be taken to stop the mechanical movement of competent vectors with that item. Usually this would comprise use of knockdown or residual insecticidal treatments.

This precaution should be applied to both commodity groups that require a movement permit and those that are not subject to movement controls.

4.4.1 Commodity groups

Commodity groups for which **no movement controls apply** are:

- people
- nonruminant species
- animal products, including wool, meat, milk and animal wastes.

Commodity groups for which **movement controls apply** are:

- live ruminants (pregnant and nonpregnant)
- live ruminants for slaughter
- reproductive material from ruminants
- fomites that may transport infected vectors, such as vehicles used for livestock transport
- diagnostic specimens.

4.4.2 Control of vector movement

Infected vectors can be mechanically transferred in vehicles, containers and crates, and on animals. Treatment for vectors should be specified in movement controls.

The type of movement will determine whether disinfestation techniques or vector-suppression techniques are used (see Section 3.2.10 and Appendix 3 for more information).

The conditions outlined in the movement control matrixes (Section 4.4) will include a recommendation on whether disinfestation or vector control should be applied for each movement. Reference should be made to time of day and seasons when vectors are known to be active.

A communication strategy must be developed to inform affected communities of strategies to reduce the risk of spread of infected vectors, so that livestock owners can take appropriate steps.

4.4.3 Recommended movement controls for live ruminants not being sent to slaughter

Table 4.2 shows recommended movement controls for live ruminants not being sent to slaughter.

Table 4.2 Recommended movement controls for live ruminants not being sent to slaughter

From \ To	TA	RA	CA	OA
TA	Prohibited, except under SpP1	Prohibited, except under SpP1	Prohibited, except under SpP1	Prohibited
RA	Prohibited, except under SpP1	Prohibited, except under SpP1	Prohibited, except under SpP1	Prohibited, except under SpP1
CA	Prohibited, except under SpP2	Prohibited, except under SpP2	Prohibited, except under GPa	Prohibited, except under GPa
OA	Prohibited, except under SpP2	Prohibited, except under SpP2	No permit required	No permit required

CA = control area; GP = general permit; OA = outside area; RA = restricted area; SpP = special permit; TA = transmission area
Emergency permits can be approved if the permit conditions can be met.

Notes for Table 4.2

GPa conditions:

- No evidence of clinical disease in animals being moved.
- Animals were born on the property or resident on the property for the consecutive 60 days immediately before movement.
- All animals moving must be individually identified and specified on the permit for traceability and other purposes.
- The permit must accompany the livestock during movement, and the person responsible for the livestock must retain a copy of the permit, consistent with the legal requirements of the jurisdiction.
- Any animals that develop any clinical signs during the 60 days following movement must be reported to a government veterinary officer.
- Animals are not permitted to move again for 60 days (ie they must remain resident at destination for a minimum of 60 days).

SpP1 conditions:

- No evidence of clinical disease in animals being moved.
- Physical identification of animals (eg NLIS or other ear tag, brand), with appropriate accompanying movement documentation (eg National Vendor Declaration [NVD], waybill, Sheep Health Statement).
- Completed vaccination program plus 60 days from date of first vaccination, OR tested seropositive plus 60 days from date of test.
- Cattle are not pregnant, or were immune due to vaccination or natural infection before mating if BTV-8 is present.

- Vector control to stop adult competent vectors travelling with animals
  - animals treated to control vectors
  - livestock transport cleaned and treated for vectors
  - disinfestation or vector suppression must be appropriate for the proposed movement.
- Agreed transport route, with no spelling en route.
- Destination advised and agreed.
- The permit must accompany the livestock during movement, and the person responsible for the livestock must retain a copy of the permit, consistent with the legal requirements of the jurisdiction.
- Animals are not permitted to move again for a period of 60 days (ie they must remain resident at destination for a minimum of 60 days).
- Any animals that develop any clinical signs during the 60 days following movement must be reported to a government veterinary officer.

SpP2 conditions:

- No evidence of clinical disease in animals being moved.
- Animals fully vaccinated plus 14 days after last vaccination.
- Destination advised and agreed.
- The permit must accompany the livestock during movement, and the person responsible for the livestock must retain a copy of the permit, consistent with the legal requirements of the jurisdiction.

Conditions for emergency permit for movement to slaughter:

- Where emergency movements are required, these should be assessed on a case-by-case basis.
- The permit must accompany the livestock during movement, and the person responsible for the livestock must retain a copy of the permit, consistent with the legal requirements of the jurisdiction.

4.4.4 Recommended movement controls for live ruminants being sent to slaughter

Table 4.3 shows recommended movement controls for live ruminants that are being sent to slaughter.

Table 4.3 Recommended movement controls for live ruminants to slaughter

To / From	TA	RA	CA	OA
TA	Prohibited, except under SpP3	Prohibited, except under SpP3	Prohibited, except under SpP4	Emergency permit
RA	Prohibited, except under SpP3	Prohibited, except under SpP3	Prohibited, except under SpP4	Prohibited, except under SpP4
CA	Prohibited, except under GPb	Prohibited, except under GPb	No permit required	No permit required
OA	Prohibited, except under GPb	Prohibited, except under GPb	No permit required	No permit required

CA = control area; GP = general permit; OA = outside area; RA = restricted area; SpP = special permit; TA = transmission area
Emergency permits can be approved if the permit conditions can be met.

Notes for Table 4.3

GPb conditions:

- No evidence of clinical disease in animals being moved.
- Animals were born on the property or resident on the property for the consecutive 60 days immediately before movement.
- All animals moving must be individually identified and specified on the permit for traceability and other purposes.
- The permit must accompany the livestock during movement, and the person responsible for the livestock must retain a copy of the permit, consistent with the legal requirements of the jurisdiction.
- Animals consigned to an abattoir must be slaughtered as soon as possible.
- Any animals that develop any clinical signs during the 60 days following movement must be reported to a government veterinary officer.

SpP3 conditions:

- No evidence of clinical disease in animals being moved.
- Vector control to stop adult competent vectors travelling with animals
  - animals treated to control vectors, and withholding period or export slaughter interval completed before slaughter
  - livestock transport cleaned and treated for vectors.
- Movement directly to abattoir.
- Animals slaughtered as soon as possible.
- Physical identification of animals (eg NLIS or other ear tag, brand), with appropriate accompanying movement documentation (eg NVD, waybill, PigPass, Sheep Health Statement).

- The permit must accompany the livestock during movement, and the person responsible for the livestock must retain a copy of the permit, consistent with the legal requirements of the jurisdiction.

SpP4 conditions:

As per SpP3 plus:

- Animals fully vaccinated plus 14 days after last vaccination, OR tested seropositive plus 60 days after date of test.

Conditions for emergency permit for movement to slaughter:

- Where emergency movements are required, these should be assessed on a case-by-case basis.
- The permit must accompany the livestock during movement, and the person responsible for the livestock must retain a copy of the permit, consistent with the legal requirements of the jurisdiction.

4.4.5 Recommended movement controls for reproductive material

Table 4.4 shows recommended movement controls for ruminant reproductive material.

Table 4.4 Recommended movement controls for ruminant reproductive material

To / From	TA	RA	CA	OA
TA	Prohibited	Prohibited	Prohibited	Prohibited
RA	Prohibited, except under SpP5	Prohibited, except under SpP5	Prohibited, except under SpP5	Prohibited, except under SpP5
CA	Prohibited, except under GPc	Prohibited, except under GPc	Prohibited, except under GPc	Prohibited, except under GPc
OA	Prohibited, except under GPc	Prohibited, except under GPc	No permit required	No permit required

CA = control area; GP = general permit; OA = outside area; RA = restricted area; SpP = special permit; TA = transmission area

Notes for Table 4.4

GPc conditions:

- Reproductive material is collected in a way that meets industry standards and, for embryos, also satisfies IETS requirements.
- Reproductive material is collected and donors are tested in agreement with OIE requirements and, for embryos, IETS requirements.

SpP5 conditions:

- Reproductive material is collected in a way that meets industry standards and, for embryos, also satisfies International Embryo Transfer Society (IETS) requirements.
- Reproductive material is collected at licensed/accredited premises and, for embryos, premises consistent with IETS requirements.
- All donors are tested in agreement with World Organisation for Animal Health (OIE) requirements and, for embryos, IETS requirements.

4.4.6 Treatment of vehicles and containers

Table 4.5 shows recommended requirements for transport operators to clean and treat empty vehicles, containers, crates and so on. On presentation of decontaminated vehicles, operators can apply for a decontamination certificate from an inspector. (See Appendix 4 for further information on decontamination and disinfestations procedures.)

Table 4.5 Recommended treatment of vehicles and containers

To / From	TA	RA	CA	OA
TA	Clean and treat for vectors	Clean and treat for vectors	Clean and treat for vectors	Clean and treat for vectors
RA	Clean and treat for vectors	Clean and treat for vectors	Clean and treat for vectors	Clean and treat for vectors
CA	Not required	Not required	Not required	Not required
OA	Not required	Not required	Not required	Not required

Cleaning and treating for vectors involves cleaning of manure after each load, then treating with an appropriate insecticide that is effective against vectors. For details of appropriate insecticide treatments, refer to Appendix 4.

4.4.7 Transport of specimens

Specimens should be collected according to Section 1.4.4. They should be packed and transported according to International Air Transport Association guidelines.

4.4.8 Movement of nonruminant animals

Every effort must be taken to avoid transport of infected vectors with any movement of nonruminant animals.

Vehicles transporting nonruminants should meet the requirements for ruminant transport if they have had any contact with ruminants.

4.4.9 Movement of animals for emergency or animal welfare reasons

For emergency veterinary treatment of ruminants, the first preference is for veterinarians to visit the property.

Where a ruminant has to be transported for emergency veterinary treatment, the animal should be treated with an appropriate insecticide before movement. At the destination, an attempt should be made to control vectors.

Other emergency animal welfare reasons for movement — for example, lack of food or water, or overcrowding — should be assessed and have permits issued on a case-by-case basis.

4.5 Guidelines for reclassifying previously declared areas (TAs, RAs and CAs)

Maintaining restrictions on areas for long periods has important implications for resource management, animal welfare, business continuity and socioeconomic impacts on producers and regional communities.

A BTV epizootic may involve multiple foci of infection, with potentially several jurisdictions involved. Since disease may be controlled at different rates in different areas, there may be the opportunity to progressively lift restrictions on an area basis. This would involve reclassifying previously declared areas (TAs, RAs and CAs), with a staged approach to lifting of movement restrictions. This is a key step in the recovery process and will have positive community benefits.

The key principles for reclassifying a previously declared area are as follows:

- The area is epidemiologically distinct from other declared areas.
- All IPs, DCPs, TPs and SPs in the area have been resolved, including with the use of sentinel animals, where appropriate.
- All tracing and surveillance associated with BTV control has been completed satisfactorily, with no evidence or suspicion of infection in the area.
- If an approved surveillance program has confirmed no evidence of active disease transmission in any part or all of the TA during the previous 60 days (consistent with the OIE Terrestrial Code infective period for BTV), the restrictions on that part or all of the TA may be removed; however, the area would continue to be declared an RA.
- Vector monitoring indicates that vectors are not active.

Provided that all these conditions are satisfied, a state or territory can apply to the Consultative Committee on Emergency Animal Diseases (CCEAD) for a TA or RA, or part thereof, to be reclassified to 'resolved'. Jurisdictions should present documented evidence that all the above conditions have been met.

A resolved area will have a lower risk status, and the movement restrictions that would apply would be consistent with those applying within a CA.

Following a further period of surveillance and monitoring as determined by the CCEAD, and provided that the additional surveillance and monitoring find no evidence of infection, a jurisdiction could apply to the CCEAD for the resolved area to be reclassified as 'recovered'. This would result in the lifting of the remaining movement controls, and restocking of resolved premises would be allowed.

4.5.1 Approved surveillance programs for reclassifying previously infected areas

Epidemiological expertise should be used to design a surveillance program that will provide a high level of confidence that BTV infection is not present in the TA and RA. Such a surveillance program should be consistent with that envisaged for the final proof-of-freedom stage. As a general rule, it would be expected that a statistically valid sample of animals from herds within the RA, including the TA, must be sampled weekly until an appropriate period following the last confirmed case. Thereafter, the samples may be collected monthly for the next 12 months and quarterly for a further 2 years.

Appendix 1 Key features of bluetongue

Disease and cause

Bluetongue is an insect-borne disease, primarily of sheep, caused by a virus belonging to the family *Reoviridae*. The disease is not contagious and is only transmitted by certain midges of the *Culicoides* genus. Bluetongue is different from most other diseases covered by AUSVETPLAN — whereas the agents of most other exotic diseases are not known to occur in Australia, some types of bluetongue virus (BTV) are present in Australia, but are restricted to vector endemic areas. However, clinical bluetongue disease is not seen generally in the Australian ruminant population (see Section 1.3).

Species affected

Bluetongue is mainly a disease of sheep, but other species — including goats, cattle, buffalo, camelids, antelopes and deer — can be infected. Some serotypes of BTV have been reported as causing clinical disease in cattle in other countries. Antibodies (evidence of BTV infection) have been found in cattle, and in farmed and feral deer in many areas of Australia, but not in the major sheep-growing areas. Humans are not affected.

Distribution

Historically, BTV has been present throughout Africa and Asia. It moved to the Americas decades ago and, globally, its range has been increasing in recent years, most notably in Europe. The virus is present in most European Union member states, and has spread significantly northwards in Europe into areas that were previously free from BTV. In 2006, the BTV-8 serotype appeared in northern Europe beyond the range of known vector species. Importantly, new vector species have been implicated in this spread. With the widespread use of vaccination and movement controls, clinical disease has been brought under control.

The first detection of a strain of BTV in Australia was in trapped insects in 1975. Currently, at least two basic BTV ecological systems are recognised in Australia: a somewhat restricted but very active focus in the wet tropics of the north of the Northern Territory, where all known Australian serotypes have been isolated; and a broad zone of BTV distribution throughout the northern and eastern Australian pastoral areas, in which only 3 of the 10 recorded serotypes in Australia are found — BTV-1, BTV-2 and BTV-21. The southern distribution depends on climatic conditions, which influence vector distribution.

Key signs

In its clinical state, the disease is characterised by fever and signs attributable to vascular permeability, including widespread haemorrhages of the oral and nasal tissue, excessive salivation and nasal discharge. Erosions of the nasal and oral mucosa can result. In acute cases, the lips and tongue become swollen, and this swelling may extend below the lower jaw. Lameness due to coronitis (swelling and reddening of the cuticle above the hoofs) and emaciation (due to reduced feeding because of painful inflammation of the mouth) may also be seen. The blue tongue that gives the disease its name occurs in only a small number of cases.

Convalescence of surviving sheep is slow. High fever in sheep results in wool breaks, which add to production losses. Destruction of affected animals on humanitarian grounds, as occurred in Europe in 2006–07, can result in significant losses.

Spread

BTV generally cannot be transmitted between susceptible animals without insect vectors (*Culicoides* midges). However, in Europe, there has been apparent transmission of BTV-8 from infected cows to calves in utero, and from fetal membranes to other cows in the absence of vectors.

The incidence and geographical distribution of bluetongue depend on seasonal conditions, the presence of vectors and the availability of susceptible animals. Cattle are the main mammalian reservoirs and are very important in the epidemiology of the disease. The midges prefer warm, moist conditions and are in their greatest numbers and most active after rainfall. Long-distance spread of BTV is usually associated with dispersal of infected vectors, although movement of virus across national borders in infected livestock has been reported.

Persistence of the virus

BTV does not usually survive outside insect vectors or susceptible hosts. Animal carcases and products such as meat, milk and wool are not a method of spread. Survival of the virus in a particular area depends on whether the vectors can overwinter there, as transovarial transmission does not occur.

Control strategy

An emergency response to BTV is required when clinical disease caused by BTV is detected in ruminants or when requested by the Consultative Committee on Emergency Animal Diseases. In the absence of clinical disease, an investigation will be undertaken in accordance with National Arbovirus Monitoring Program (NAMP) guidelines when evidence of a circulating strain of a pathogenic BTV is detected through NAMP or other monitoring, and/or when serological or other evidence of viral spread is detected in areas in which known competent vectors are absent. Endemic circulation of BTV is likely to continue within the recognised BTV zone.

In a bluetongue outbreak, the strategy is to impose movement controls on affected and susceptible animals in the area of the outbreak while an initial epidemiological investigation is conducted. Treatments and husbandry procedures will be used to help control vectors, reduce transmission and protect susceptible animals. Tracing, surveillance and vector trapping will determine the extent of virus and vector distribution, and zoning will be used to define infected, control and disease-free areas. There is no justification for stamping out (slaughter of all infected or exposed animals), but some animals may need to be destroyed for welfare reasons.

In a response, a thorough epidemiological investigation will be a key element of the early stages.

Should bluetongue disease become established in an area, a long-term industry control program based on vaccination may be adopted.

It is not possible to eradicate the bluetongue vectors, but they are highly susceptible to frost.

The agreement between the Australian government and industry for sharing the costs of emergency animal disease control applies only to bluetongue disease.

Appendix 2 Procedures for surveillance and proof of freedom

A surveillance program for virus and vectors should be undertaken in affected and threatened areas in accordance with Articles 8.3.16 to 8.3.21 of the OIE Terrestrial Code. The purpose of surveillance is to detect virus and vector circulation in a country or zone, rather than to determine the status of an individual animal or herd. Surveillance deals not only with the occurrence of clinical signs caused by BTV, but also with evidence of infection with BTV in the absence of clinical signs and of vector activity.

The ability to distinguish between natural infections and vaccination responses is desirable when vaccination is used. This may or may not be possible, depending on the type of vaccine chosen for use in Australia.

A stamping-out policy is not applicable for bluetongue disease or vectors. Proof of national freedom from the disease would be impossible, but regional freedom may be demonstrable.

BTV is active in the northern part of Australia. However, there have been very few cases of clinical disease because the mix of biological and epidemiological variables required to cause the disease has occurred only very rarely. If this mix arose, disease would occur either insidiously or as a dramatic outbreak. Depending on epidemiological circumstances, an initial outbreak might end naturally or might require human intervention. Once bluetongue disease has occurred, it may become a regular feature, as is the case with other endemic arthropod-borne viral diseases. Some states, regions or districts may not have clinical cases.

An established surveillance system to monitor for the absence or presence of BTV is appropriate. Such a surveillance system has several uses:

- to monitor for the absence of the virus for the satisfaction of Australia's livestock trading partners
- to track the movement of the various serotypes of BTV for early warning of impending disease
- to understand the basic ecology of BTV and other arboviruses.

The National Arbovirus Monitoring Program has been implemented to fulfil this role.

Vector monitoring should be undertaken in conjunction with virus monitoring, as described in Article 8.3.19 of the OIE Terrestrial Code.[15]

[15] www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.8.3.htm

Appendix 3 Procedures for vector monitoring and control

Monitoring

Vector monitoring to identify the species of vector present and their distribution and relative abundance should be one of the first steps in a response to a vector-borne disease. PCR testing of trapped vectors may indicate whether they are carrying disease agents. Vector monitoring could also indicate the effectiveness of disinfestation and vector-control strategies.

At the national level, facilities for monitoring are limited, so the resources need to be deployed to achieve maximum effect. Advice must be taken from specialists in this area.

Collections should aim to provide information on:

- all the potential vectors present
- the vertebrate hosts of the potential vectors
- the relative abundance of the vector species
- the age structure of the vector populations.

Vector trapping can be supported by serological testing of livestock to check for antibody responses to BTV. Presence of antibody to BTV in resident livestock will indicate the presence of vectors in the area.

Siting of traps should be done with epidemiological input and in consultation with members of the National Arbovirus Monitoring Program (NAMP). Light traps are most commonly used to collect biting midges. These traps should be available from the New South Wales department of agriculture. Many local government medical authorities use carbon dioxide–baited light traps to collect mosquitoes, and these could be adapted for biting midges, if necessary. Some preliminary CSIRO trials have indicated that carbon dioxide and octenol are useful attractants for biting midges when used with light traps.

Two alternative methods of collecting that do not rely on artificial attractants are truck trapping and using animal bait — this includes direct aspiration of insects from hosts. A truck trap is most effective where evening and night temperatures are low enough to reduce insect activity before it is dark enough for light traps to become attractive. Direct aspiration of insects from hosts is also independent of ambient light levels and has the additional advantage of providing some indication of the species that are actually biting hosts in the area. The use of either truck traps or direct aspiration is necessary to monitor for *Culicoides actoni*, whose peak activity is before sunset (Bellis et al 2004).

Larval sampling is considerably more time consuming than adult sampling, and may not be as reliable an indicator of presence or prevalence as adult trapping. As well, the breeding site of some vector species is unknown.

Maps with appropriate detail will be required to plot the distribution of traps and stock.

The limiting factor in any monitoring program will be the availability of staff with taxonomic expertise to identify the collections. Confirmation of identifications can be made using PCR technology.

If collections are to be processed for virus isolation, insects will need to be collected live for immediate processing, or held in suitable storage, such as liquid nitrogen (Dyce et al 1972). Collections for population analysis and identification should be stored in 70% ethanol. PCR techniques are available to allow detection of virus in insects (Melville et al 2008), and identification of *Culicoides* species preserved in alcohol.

If bluetongue is diagnosed in an area where vectors of the virus are not known to occur, such as southern Australia, steps will be taken to verify that it is indeed a vector-free area by immediately deploying light traps and some form of animal-baited collection technique, such as direct aspiration from cattle. Regular serological monitoring of ruminants on neighbouring properties will also indicate if virus is circulating in the area. If vectors are not caught and ruminants do not have locally acquired antibody, the clinically affected animals must have been introduced while infected and cannot be a source of vector-transmitted virus for other animals.

Further information on vector monitoring can be found in Article 8.3.19 of the OIE Terrestrial Code.[16]

Control

The main aim of any vector control program must be to break the transmission cycle by rapidly reducing the numbers of all insects that can be infected by virus from vertebrate hosts. A range of methods of controlling midge populations have been developed, including treating larval breeding sites, removing larval breeding sites, treating adult resting sites, treating livestock with repellents, treating livestock with systemic insecticides, housing stock in insect-proof buildings and using attractants to lure adult midges away from livestock.

In Australia, south of the Tropic of Capricorn, the main potential vector of bluetongue is *Culicoides brevitarsis*, so this species is likely to be the major target of any control program. *C. brevitarsis* breeds in cow dung and feeds on cattle, often in large numbers.

Treating or removing larval breeding sites, and use of systemic insecticides

The direct treatment or removal of *C. brevitarsis* larval breeding sites (cattle dung pats) is impractical in most circumstances, but the use of a systemic insecticide in cattle in the area offers a means of reducing both larval and adult survival. For example, a laboratory trial has shown that a subcutaneous injection of a

[16] www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.8.3.htm

formulation of ivermectin will produce 99% mortality in *C. brevitarsis* feeding on treated cattle for up to 10 days after treatment (Standfast et al 1984). The larval stages in dung of treated animals will also be controlled for up to 4 weeks. In a field trial of subcutaneous ivermectin, the field population of *C. brevitarsis* was reduced to a point where there was a period of up to 6 weeks of low risk of virus transmission (Muller and Harris 1993).

The effect on *C. brevitarsis* of subcutaneous and oral formulations of ivermectin in sheep has also been tested. The effect of the subcutaneous treatment was gone by 16 days and that of the oral treatment by 4 days.

The subcutaneous formulation of ivermectin is not repellent and therefore will not protect animals from attack and subsequent infection (Muller and Harris 1993). A pour-on formulation of ivermectin is also available, but this has not yet been tested. Other systemic insecticides are also coming onto the market.

Because of the close association between cattle and *C. brevitarsis*, it is more effective to treat cattle, even when bluetongue disease is in sheep.

Some control measures, such as treatment of cattle with ivermectin, will be difficult to implement under extensive grazing conditions. A high adoption rate will be needed if such a measure is to be effective. The cost involved may exceed the economic return for producers who have not incurred direct financial loss as a result of the disease.

Treating adult resting sites

Murray (1987) and Bishop et al (1995) found that adult *C. brevitarsis* rest in ground herbage during the day. In most cases, it would be impractical or undesirable to treat these effectively.

Use of repellents

Bishop et al (2001), Doherty et al (2002) and Melville et al (2001) investigated the efficacy of insect repellents on midges attacking cattle in Australia and found that deltamethrin, fenvalerate and cypermethrin significantly reduced midge numbers on cattle. These chemicals are commonly registered for control of buffalo fly, so should easily be used in an outbreak situation.

Housing stock in insect-proof buildings

Although stabling has been shown to reduce vector attack overseas (Meiswinkel 2000), Melville et al (2005) found that housing livestock, including beneath roofs, did not discourage attack by Australian species.

Eradication of vectors

Disinfestation is the application of procedures intended to eliminate arthropods that may cause disease or are potential vectors of infectious agents of animal diseases.

Disinfestation is likely to be used to support the movement of animals, by removing the risk of infected vectors moving with animals and their associated fomites.

When assessing disinfestation techniques, consideration needs to be given to chemical withholding periods, the possibility of reinfestation, the frequency of application required to maintain disinfested status, environmental impact, and application of vector suppression techniques in the surrounding area.

A means for monitoring or checking the effectiveness of disinfestation might also be required in some situations.

Techniques include:

- control on individual animals (eg systemic ivermectin products, topical application of chemical for short-term knockdown, treatment of the immediate airspace around an animal with rapid knockdown sprays, insect-proof premises)
- vehicle and building control (eg insect proofing, treatment of airspace with rapid knockdown spray, application of residual chemicals).

For further information on disinfestation, refer to Appendix 4.

Vector suppression

Vector suppression, when feasible, is likely to be one of the immediate response actions on infected premises and in transmission areas. The aim is to reduce the risk of disease spread by infected vectors, by rapidly reducing vector numbers or by creating a barrier between the vector and the animal.

Vector suppression techniques include:

- herd/animal treatments — topical application of contact insecticide, topical application of insect repellents, systemic application of chemicals that are active against a phase of the insect's lifecycle (eg ivermectin controls adult *Culicoides* and also has an effect on larval development in cattle dung), insect traps placed at strategic points
- environmental treatments — spraying of areas with a knockdown spray or a residual spray, spraying of areas with a chemical lifecycle inhibitor, insect traps, insect baits
- fomite treatments — use of knockdown sprays and insect repellents, application of residual chemicals, insect traps, insect baits
- host manipulation — where cattle are the preferred vector host, the removal of cattle from sheep populations may assist vector control; alternatively, cattle may be introduced to sheep areas to attempt to draw vectors away from sheep and reduce clinical disease
- other measures, such as housing, to protect valuable animals.

Although barrier sprays of residual insecticides have been shown to effectively protect people in populated areas from midge attack (Standfast et al 2003), the ability of broadscale insecticide treatments to control adult biting midges in a rural area has never been tested, and such a treatment is unlikely to be used. However, should it be considered necessary to mount such an operation, the main types of insecticide application are:

- ultra-low-volume application from the ground
- ultra-low-volume application from the air

- thermal fogs or mists from the ground.

Ground-based ultra-low-volume application would be the most likely method. The insecticide used will be determined by consultation with appropriate environmental and food safety authorities, bearing in mind the products that are rapidly available in sufficient quantity and the residual impact they could have on livestock products destined for human consumption. Treatment will depend on prevailing weather, the terrain and machinery access.

Aerial application of insecticides is unlikely to be considered because of environmental concerns and the enormous cost and resource requirements of such a program.

When developing a vector suppression program, consideration needs to be given to chemical withholding periods,[17] the possibility of reinfestation, the frequency of application to maintain control, cost factors, environmental impact and monitoring for effectiveness of control. Epidemiological input will be required when determining the percentage of a population that is required to be treated for the strategy to be effective.

Ongoing implementation of movement controls will also need to be considered to ensure that the area is not reinfested during the program.

Appropriate protective clothing and equipment must be provided and their use made compulsory for staff involved in any insecticide applications. Staff must follow recommended safety guidelines, and adequate first-aid measures must be on hand.

For further information on vector suppression, refer to Appendix 4.

[17] www.apvma.gov.au/residues/ESI.shtml

Appendix 4 Principles of disinfestation

Disinfestation means the application of procedures intended to eliminate arthropods that may cause diseases or are potential vectors of infectious agents of animal diseases, including zoonoses.[18]

Disinfestation may be useful in the following situations during an EAD response in Australia:

- to support movement controls
- to suppress or eliminate vectors within a defined or declared area
- to assist disease control on a premises.

Supporting movement controls

The following techniques may be used, together with measures such as vector-free housing:

- individual animal treatment — for example, systemic application of ivermectin, topical application of a chemical to animals for quick and short-term knockdown, treatment or spraying of the immediate airspace around animals with an insecticide such as permethrin
- vehicle and equipment treatment — for example, pretreatment with a residual chemical (eg permethrin), use of rapid knockdown spray just before movement
- environmental control to reduce vector numbers in areas where stock, vehicles or equipment are held before movement — for example, use of residual sprays (with environmental agency approval) or light traps (as used by National Arbovirus Monitoring Program [NAMP]).

Vector suppression

The techniques used, or the application of these techniques, may depend on whether vector eradication or vector suppression in an area is required.

Another consideration is how long the area needs to be free (or nearly free) from vectors and whether this is feasible — removing vectors may create a 'vacuum' that is reinfested from surrounding areas.

For environmental control in an area, residual sprays, knockdown sprays, or compounds that inhibit growth or breeding may be useful, but use of these chemicals would need approval from the relevant environmental agency. Light traps (as used by NAMP) could be used to monitor progress.

For treatment of individual animals, all animals, or a percentage of animals (calculated from epidemiological information) would need to be treated. A long-

[18] Glossary, OIE Terrestial Code (www.oie.int/index.php?id=169&L=0&htmfile=glossaire.htm#sous-chapitre-2)

term control program would be required (eg through use of ivermectin or other long-acting compounds, or a program of regular spraying or dipping with a suitable chemical).

Movement controls would be required to prevent vectors moving into the area with livestock.

Vector suppression can be expensive compared with merely treating animals before movement. The benefits of such techniques therefore need to be assessed in relation to their costs, likely effectiveness, ease of application, legal authority and chemical availability before they are advocated.

Assisting disease control

Treatment of livestock with ivermectin and/or insect repellants may protect animals following vaccination until immunity develops.

Ivermectin will be effective in controlling midges for approximately 2 weeks after dosing. Since a viraemic animal may remain infective for up to 60 days, more than one dose of ivermectin may be needed if there is a risk of a viraemic animal being present.

Use of vector-proof housing may be considered for valuable animals.

Other issues to consider

Emergency use permits may be required if the chemical or compound is not specifically registered for use against *Culicoides* species (it may be registered for use against other insect species).

For pretreatment of vehicles, containers and transports with a residual insecticide, the Australian Quarantine and Inspection Service's *Guidelines for Disinsection of Aircraft* note that a residual covering is achieved using a 2% permethrin emulsion that is sprayed over the surface to wet stage (not run-off). Phenothrin is also mentioned as a chemical to use. [Pyrethroids could also be a possibility.]

For treatment of airspace, the *Guidelines for Disinsection of Aircraft* advise use of 2% permethrin in an aerosol sprayed into an airspace and left for 5 minutes before opening or further actions.

Further information

Veterinary Medicines Directorate: www.vmd.defra.gov.uk

Glossary

Agar gel diffusion precipitation test	A serological test designed to detect and measure the presence of antibody or antigen in a sample.
Animal byproducts	Products of animal origin that are not for consumption but are destined for industrial use (eg hides and skins, fur, wool, hair, feathers, hooves, bones, fertiliser).
Animal Health Committee	A committee whose members are the Australian and state and territory CVOs, the Director of the CSIRO Australian Animal Health Laboratory, and the Director of Environmental Biosecurity in the Australian Government Department of Sustainability, Environment, Water, Population and Communities. The committee provides advice to SCoPI on animal health matters, focusing on technical issues and regulatory policy (formerly called the Veterinary Committee). *See also* Standing Council on Primary Industries
Animal products	Meat, meat products and other products of animal origin (eg eggs, milk) for human consumption or for use in animal feedstuff.
Approved processing facility	An abattoir, knackery, milk processing plant or other such facility to which animals or animal products have been introduced from lower risk premises under a permit for processing to an approved standard. The facility maintains increased biosecurity standards (refer to the relevant enterprise manuals and the **Decontamination** and **Disposal** manuals).
Arbovirus	*Ar*thropod-*bo*rne *virus*. The virus replicates in an arthropod and is transmitted by bite to a vertebrate host in which it also replicates.
At-risk premises	A premises in a restricted area that contains a live susceptible animal(s) but is not considered at the time of designation to be an infected premises, dangerous contact premises, dangerous contact processing facility, suspect premises or trace premises. *See* Section 4.1 for further details
Australian Chief Veterinary Officer	The nominated senior veterinarian in the Australian Government Department of Agriculture, Fisheries and Forestry who manages international animal health commitments and the Australian Government's response to an animal disease outbreak. *See also* Chief veterinary officer (CVO)

AUSVETPLAN	*Aus*tralian *Vet*erinary Emergency *Plan*. A series of technical response plans that describe the proposed Australian approach to an emergency animal disease incident. The documents provide guidance based on sound analysis, linking policy, strategies, implementation, coordination and emergency-management plans.
Chief veterinary officer (CVO)	The senior veterinarian of the animal health authority in each jurisdiction (national, state or territory) who has responsibility for animal disease control in that jurisdiction. *See also* Australian Chief Veterinary Officer
Compensation	The sum of money paid by government to an owner for livestock or property that are destroyed for the purpose of eradication or prevention of the spread of an emergency animal disease, and livestock that have died of the emergency animal disease. *See also* Cost-sharing arrangements, Emergency Animal Disease Response Agreement
Complement fixation test	Assay for complement by its ability to cause lysis of red blood cells. Fixation of complement by combination of antibody and antigen reduces its ability to lyse red blood cells.
Consultative Committee on Emergency Animal Diseases (CCEAD)	The key technical coordinating body for animal health emergencies. Members are state and territory CVOs, representatives of CSIRO-AAHL and the relevant industries, and the Australian CVO as chair.
Contagious disease	An infectious disease that can be transmitted from one animal or person to another (also called a communicable disease). Contagious diseases are often spread through direct contact, contact with body fluids or contact with objects that an infected individual has contaminated (fomites). *See also* Infectious disease
Control area (CA)	A declared area in which the conditions applying are of lesser intensity than those in a restricted area (the limits of a control area and the conditions applying to it can be varied during an outbreak according to need). *See* Section 4.1 for further details
Corona	The band around the top of the hoof. Also called the coronary band.
Cost-sharing arrangements	Arrangements agreed between governments (national and states/territories) and livestock industries for sharing the costs of emergency animal disease responses. *See also* Compensation, Emergency Animal Disease Response Agreement
Cyanosis (adj. cyanotic)	Blueness of the skin and/or mucous membranes due to insufficient oxygenation of the blood.

Dangerous contact animal	A susceptible animal that has been designated as being exposed to other infected animals or potentially infectious products following tracing and epidemiological investigation.
Dangerous contact premises (DCP)	A premises, apart from an abattoir, knackery, milk processing plant or other such facility, that may or may not contain a susceptible animal(s) not showing clinical signs, but that, following a risk assessment, is considered highly likely to contain an infected animal(s) or contaminated animal products, wastes or things, which present an unacceptable risk to the response if the risk is not addressed and which therefore requires action to address the risk. *See* Section 4.1 for further details
Dangerous contact processing facility (DCPF)	An abattoir, knackery, milk processing plant or other such facility to which it appears highly likely that infected animals or contaminated animal products, wastes or things have been introduced and which therefore requires action to address the risk.
Declared area	A defined tract of land that is subjected to disease control restrictions under emergency animal disease legislation. Types of declared areas include *transmission area*, *restricted area, control area, infected premises, dangerous contact premises and suspect premises*. *See* Section 4.1 for further details
Decontamination	Includes all stages of cleaning and disinfection.
Depopulation	The removal of a host population from a particular area to control or prevent the spread of disease.
Destroy (animals)	To kill animals humanely.
Destruction	The killing of an animal using an approved method during a disease response.
Disease agent	A general term for a transmissible organism or other factor that causes an infectious disease.
Disease Watch Hotline	24-hour freecall service for reporting suspected incidences of exotic diseases — **1800 675 888**.
Disinfectant	A chemical used to destroy disease agents outside a living animal.
Disinfection	The application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of animal diseases, including zoonoses; applies to premises, vehicles and different objects that may have been directly or indirectly contaminated.

Disinfestation	The application of procedures intended to eliminate arthropods that may cause diseases or are potential vectors of infectious agents of animal diseases, including zoonoses.
Disposal	Sanitary removal of animal carcasses, animal products, materials and wastes by burial, burning or some other process so as to prevent the spread of disease.
Ecchymotic haemorrhage	Small, round spots or purplish discolouration caused by bleeding or bruising in the skin or mucous membrane.
Emergency animal disease	A disease that is (a) exotic to Australia or (b) a variant of an endemic disease or (c) a serious infectious disease of unknown or uncertain cause or (d) a severe outbreak of a known endemic disease, and that is considered to be of national significance with serious social or trade implications. *See also* Endemic animal disease, Exotic animal disease
Emergency Animal Disease Response Agreement	Agreement between the Australian and state/territory governments and livestock industries on the management of emergency animal disease responses. Provisions include participatory decision making, risk management, cost sharing, the use of appropriately trained personnel and existing standards such as AUSVETPLAN. *See also* Compensation, Cost-sharing arrangements
Endemic animal disease	A disease affecting animals (which may include humans) that is known to occur in Australia. *See also* Emergency animal disease, Exotic animal disease
Enterprise	*See* Risk enterprise
Enzyme-linked immunosorbent assay (ELISA)	A serological test designed to detect and measure the presence of antibody or antigen in a sample. The test uses an enzyme reaction with a substrate to produce a colour change when antigen–antibody binding occurs.
Epidemiological investigation	An investigation to identify and qualify the risk factors associated with the disease. *See also* Veterinary investigation
Exotic animal disease	A disease affecting animals (which may include humans) that does not normally occur in Australia. *See also* Emergency animal disease, Endemic animal disease
Exotic fauna/feral animals	*See* Wild animals
Export slaughter interval	The time that should elapse between administration of a veterinary chemical to animals and their slaughter for export.

Fluorescent antibody test	Use of a fluorescently tagged antibody to detect a specific antigen.
Fomites	Inanimate objects (eg boots, clothing, equipment, instruments, vehicles, crates, packaging) that can carry an infectious disease agent and may spread the disease through mechanical transmission.
General permit (GP)	A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which permission may be granted without the need for direct interaction between the person moving the animal(s), commodity or thing and a government veterinarian or inspector. The permit may be completed via a webpage or in an approved place (such as a government office or commercial premises). A printed version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. *See also* Special permit
Hyperaemia	An increase in the amount of blood in a tissue or organ due to dilation of the supplying arteries.
Immunoglobulin	Antibody proteins
– IgE	Immunoglobulin usually present at very low levels but increases in hypersensitivity (allergic) reactions.
– IgG	The main form of immunoglobulin produced in response to an antigen. It is mainly found in body fluids.
– IgM	High molecular weight immunoglobulin; IgM antibodies are the first to be synthesised and released in response to a primary antigenic stimulation.
In-contact animals	Animals that have had close contact with infected animals, such as noninfected animals in the same group as infected animals.
Incubation period	The period that elapses between the introduction of the pathogen into the animal and the first clinical signs of the disease.
Infected premises (IP)	A defined area (which may be all or part of a property) on which animals meeting the case definition are or were present, or the causative agent of the emergency animal disease exists, or there is a reasonable suspicion that either exists and which a chief veterinary officer or their delegate has declared to be an infected premises. *See* Section 4.1 for further details

Infectious disease	A disease that results from the presence and activity of one or more pathogenic microbial agents, including viruses, bacteria, fungi, protozoa, multicellular parasites and prions. Transmission of an infectious disease may occur through several pathways, including through contact with infected individuals (in the case of contagious diseases), by water, food or airborne inhalation, or through vector-borne spread. *See also* Contagious disease
Laminitis	Inflammation of the sensitive laminae of the hoof.
Local control centre (LCC)	An emergency operations centre responsible for the command and control of field operations in a defined area.
Modified stamping out	Any variation to *stamping out*.
Monitoring	Routine collection of data for assessing the health status of a population. *See also* Surveillance
Movement control	Restrictions placed on the movement of animals, people and other things to prevent the spread of disease.
Mummified fetus	Dry/shrivelled fetus due to the resorption of fluids from the placenta following death in the uterus.
National management group (NMG)	A group established to approve (or not approve) the invoking of cost sharing under the Emergency Animal Disease Response Agreement. NMG members are the Secretary of the Australian Government Department of Agriculture, Fisheries and Forestry as chair, the chief executive officers of the state and territory government parties, and the president (or analogous officer) of each of the relevant industry parties.
Native wildlife	*See* Wild animals
OIE Terrestrial Code	OIE *Terrestrial Animal Health Code.* Reviewed annually at the OIE meeting in May and published on the internet at www.oie.int/en/international-standard-setting/terrestrial-code/access-online.
OIE Terrestrial Manual	OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals.* Describes standards for laboratory diagnostic tests and the production and control of biological products (principally vaccines). The current edition is published on the internet at www.oie.int/en/international-standard-setting/terrestrial-manual/access-online.
Operational procedures	Detailed instructions for carrying out specific disease control activities, such as disposal, destruction, decontamination and valuation.

Outside area (OA)	The area of Australia outside the declared (control and restricted) areas.
Owner	Person responsible for a premises (includes an agent of the owner, such as a manager or other controlling officer).
Petechial haemorrhages	Tiny, flat, red or purple spots in the skin or mucous membrane caused by bleeding from small blood vessels.
Premises	A tract of land including its buildings, or a separate farm or facility that is maintained by a single set of services and personnel.
Premises of relevance (POR)	A premises in a control area that contains a live susceptible animal(s) but is considered at the time of designation not to be a suspect premises, trace premises or dangerous contact processing facility. The animal(s) on such a premises are subject to procedures applicable in the control area, such as heightened surveillance and movement restrictions. *See* Section 4.1 for further details
Prevalence	The proportion (or percentage) of animals in a particular population affected by a particular disease (or infection or positive antibody titre) at a given point in time.
Quarantine	Legal restrictions imposed on a place or a tract of land by the serving of a notice limiting access or egress of specified animals, persons or things.
Resolved premises (RP)	An infected premises, dangerous contact premises or dangerous contact processing facility that has completed the required control measures and is subject to the procedures and restrictions appropriate to the area in which it is located. *See* Section 4 for further details
Restricted area (RA)	A relatively small declared area (compared with a control area) around the transmission area that is subject to intense surveillance and movement controls. *See* Section 4.1 for further details
Risk enterprise	A defined livestock or related enterprise, which is potentially a major source of infection for many other premises. Includes intensive piggeries, feedlots, abattoirs, knackeries, saleyards, calf scales, milk factories, tanneries, skin sheds, game meat establishments, cold stores, artificial insemination centres, veterinary laboratories and hospitals, road and rail freight depots, showgrounds, field days, weighbridges, garbage depots.
Sensitivity	The proportion of truly positive units that are correctly identified as positive by a test. *See also* Specificity

Sentinel animal	Animal of known health status that is monitored to detect the presence of a specific disease agent.
Seroconversion	The appearance in the blood serum of antibodies (as determined by a serology test) following vaccination or natural exposure to a disease agent.
Serotype	A subgroup of microorganisms identified by the antigens carried (as determined by a serology test).
Serum neutralisation test	A serological test to detect and measure the presence of antibody in a sample. Antibody in the test serum is serially diluted to detect the highest dilution that neutralises a standard amount of antigen. The neutralising antibody titre is given as the reciprocal of this dilution.
Special permit (SpP)	A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which the person moving the animal(s), commodity or thing must obtain prior written permission from the relevant government veterinarian or inspector. A printed version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. *See also* General permit
Specificity	The proportion of truly negative units that are correctly identified as negative by a test. *See also* Sensitivity
Stamping out	The strategy of eliminating infection from premises through the destruction of animals in accordance with the particular AUSVETPLAN manual, and in a manner that permits appropriate disposal of carcasses and decontamination of the site.
Standing Council on Primary Industries (SCoPI)	The council of Australian national, state and territory and New Zealand ministers of agriculture that sets Australian and New Zealand agricultural policy (formerly the Primary Industries Ministerial Council). *See also* Animal Health Committee
State or territory control centre	The emergency operations centre that directs the disease control operations to be undertaken in that state or territory.
Surveillance	A systematic program of investigation designed to establish the presence, extent or absence of a disease, or of infection or contamination with the causative organism. It includes the examination of animals for clinical signs, antibodies or the causative organism.
Susceptible animals	Animals that can be infected with a particular disease.

Suspect animal	An animal that may have been exposed to an emergency disease such that its quarantine and intensive surveillance, but not pre-emptive slaughter, is warranted. *or* An animal not known to have been exposed to a disease agent but showing clinical signs requiring differential diagnosis.
Suspect premises (SP)	Temporary classification of a premises that contains a susceptible animal(s) not known to have been exposed to the disease agent but showing clinical signs that require investigation(s). *See* Section 4.1 for further details
Trace premises (TP)	Temporary classification of a premises that contains susceptible animal(s) that tracing indicates may have been exposed to an infected animal(s), or contaminated animal products, wastes or things, and that requires investigation. *See* Section 4.1 for further details
Tracing	The process of locating animals, persons or other items that may be implicated in the spread of disease, so that appropriate action can be taken.
Transmission area (TA)	A declared area that is used for vector-borne diseases, recognising that vectors are not confined by property boundaries. It includes infected premises and, where possible, dangerous contact premises, trace premises and suspect premises, and is subject to increased surveillance and movement controls. *See* Section 4.1 for further details
Unknown status premises (UP)	A premises that has been identified as having an unknown animal status. *See* Section 4.1 for further details
Vaccinated premises	A premises on which an approved vaccination program (as defined in the emergency animal disease response plan) has been completed. *See* Section 4 for further details
Vaccination	Inoculation of individuals with a vaccine to provide active immunity.

Vaccine	A substance used to stimulate immunity against one or several disease-causing agents to provide protection or to reduce the effects of the disease. A vaccine is prepared from the causative agent of a disease, its products, or a synthetic substitute, which is treated to act as an antigen without inducing the disease.
– attenuated	A vaccine prepared from infective or 'live' microbes that are less pathogenic but retain their ability to induce protective immunity.
– inactivated	A vaccine prepared from a virus that has been inactivated ('killed') by chemical or physical treatment.
– recombinant	A vaccine produced from viruses or bacteria that have been genetically engineered to contain only selected genes, including those causing the immunogenic effect.
– subunit	A vaccine consisting of a purified protective protein or epitope from a disease-causing agent, which is produced by recombinant DNA or synthetic peptide technology.
Vector	A living organism (frequently an arthropod) that transmits an infectious agent from one host to another. A *biological* vector is one in which the infectious agent must develop or multiply before becoming infective to a recipient host. A *mechanical* vector is one that transmits an infectious agent from one host to another but is not essential to the lifecycle of the agent.
Veterinary investigation	An investigation of the diagnosis, pathology and epidemiology of the disease. *See also* Epidemiological investigation
Viraemia	The presence of viruses in the bloodstream.
Wild animals	
– native wildlife	Animals that are indigenous to Australia and may be susceptible to emergency animal diseases (eg bats, dingoes, marsupials).
– feral animals	Domestic animals that have become wild (eg cats, horses, pigs).
– exotic fauna	Nondomestic animal species that are not indigenous to Australia (eg foxes).
Witholding period	The minimum period that must elapse between last administration or application of a veterinary chemical product (including treated feed) and the slaughter, collection, harvesting or use of the animal commodity for human consumption.
Zero susceptible stock premises (ZP)	A premises that contains no susceptible animals. *See* Section 4.1 for further details

Zoning	The process of defining, implementing and maintaining a disease-free or infected area in accordance with OIE guidelines, based on geopolitical and/or physical boundaries and surveillance, in order to facilitate disease control and/or trade.
Zoonosis	An infection or pathogen that can be naturally transmitted between animals and humans.

Abbreviations

AAHL	Australian Animal Health Laboratory
AUSVETPLAN	Australian Veterinary Emergency Plan
BTV	bluetongue virus
CA	control area
CCEAD	Consultative Committee on Emergency Animal Diseases
c-ELISA	competitive enzyme-linked immunosorbent assay
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVO	chief veterinary officer
DCP	dangerous contact premises
EAD	emergency animal disease
EADRA	*Government and Livestock Industry Cost Sharing Deed in Respect of Emergency Animal Disease Responses* (Emergency Animal Disease Response Agreement)
ELISA	enzyme-linked immunosorbent assay
IETS	International Embryo Transfer Society
IP	infected premises
NAMP	National Arbovirus Monitoring Program
NLIS	National Livestock Identification System
NMG	national management group
NVD	National Vendor Declaration
OA	outside area
OIE	World Organisation for Animal Health
PCR	polymerase chain reaction
RA	restricted area
SP	suspect premises
TA	transmission area

TP	trace premises
VNT	virus neutralisation test

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Video/training resources

On alert for bluetongue (video), AAHL 1991 (available from Product Integrity, Animal and Plant Health, Australian Government Department of Agriculture,

Fisheries and Forestry, Canberra; departments of agriculture; or CSIRO, AAHL, Private Bag 24, Geelong, Victoria 3220).

On alert for bluetongue (48 slides), available from Product Integrity, Animal and Plant Health, Australian Government Department of Agriculture, Fisheries and Forestry, Canberra.

See the **Summary Document** for a full list of training resources.