The change in likelihood of *Echinococcus multilocularis* (Alveolar Echinococcosis) introduction into the United Kingdom as a consequence of adopting harmonised Community rules for the non-commercial movements of pet animals

Qualitative Risk Assessment

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3 Summary

Alveolar Echinococcosis is a disease caused by the fox tapeworm, *Echinococcus multilocularis* and is one of the most important zoonotic diseases globally. It is geographically restricted to the northern hemisphere and although human infection may be considered rare in comparison to some other zoonotic diseases, there are an estimated 0.3 to 0.5 million cases per annum. Currently the UK has controls on pets entering the UK for treatment for tapeworms. The harmonised EU rules for the non-commercial movement of pets that come into force on the 1st January, 2012 are not currently intended to include a stipulation for tapeworm treatment. However a derogation is currently being jointly sought by the UK, Ireland, Malta, Sweden and Finland, accompanied by Norway, to achieve such a requirement to retain these countries’ *Echinococcus multilocularis* free status.

On the basis of scientific evidence presented in this risk assessment, and providing rules are followed with complete compliance, we consider that:

- In terms of pet movement between EU MSs and the UK, changing to harmonised EU rules without a specific derogation to permit the continued tapeworm treatment of travelling pets would *increase from negligible to low* the risk of introducing *Echinococcus*
multilocularis into the UK by a legal pet movement. This will not diminish as long as EU Member States with endemic Echinococcus multilocularis have no effective control programmes in place, and could rise if prevalence rises in these countries.

• Similarly, there would be an increase to a low risk that a change in the current UK rules to the proposed harmonised EU rules would result in the introduction of Echinococcus multilocularis by a legal pet movement from certain Listed Third countries to the UK (for a definition of a Listed Third Country please section 6.2 Definitions).

• In terms of pet movement between certain unlisted Third countries and the UK, changing to harmonised EU rules would lead to an increase from negligible to a low risk of Echinococcus multilocularis being introduced by a legal pet movement.

• Current pet movements to the UK suggest that the number of pets entering the UK from unlisted third Countries is far less than those from EU MSs or Listed Third countries (where disease prevalence is non-negligible). Unlisted Third Countries include many where this disease is not present; however several Listed Third Countries include those where disease is endemic. Therefore the increase in risk is more significant when concerned with EU MSs and Listed Third Countries. However the Unlisted Thirds do still include China and Turkey where this disease is a concern.

• The risk is not just about preventing disease in our pets and pet owners, but possibly more importantly, about preventing the disease becoming established in the UK. Should the disease be introduced into the UK we consider there would be a high risk of the disease becoming established in the fox and rodent population in time.

• Recent evidence from Sweden reports two foxes found (one with >500 worms) despite the 1-10 day treatment for travelling pets. This new evidence has therefore increased the risk levels for certain treatment regimes and reinforced the evidence that the most risk averse regime remains 24-48 hours.

4 Introduction

The European Union Regulation 998/2003 lays down the rules for movement controls for dogs, cats and ferrets into and between Member States. Some rabies-free EU Member States (including the UK) were granted temporary derogations from the current Regulation to allow them to continue to apply their previous national control policies which included additional risk mitigation measures and border checks in order to safeguard their distinct disease status.

The derogations were originally due to expire in 2008 but were subsequently extended to 30th June 2010 and have now been further extended until 31st December 2011.

Under EU law, whenever the current derogations expire, the affected Member States will have to come in line with the “harmonised” Community rules on pet movements. The presence of the tapeworm parasite, Echinococcus multilocularis, the causative agent of alveolar echinococcosis is of concern and interest to numerous UK stakeholders, which
means that the risk of relaxing the requirement for tapeworm treatment needs to be assessed.

5 Hazard identification

Echinococcus multilocularis is the causative agent of alveolar echinococcosis disease. It is a Taenid tapeworm, where the definitive (final) hosts are canids, such as red foxes or arctic foxes and the intermediate hosts are rodents (often the microtine or arvicolid rodents) such as the common or field vole, Microtus avestis.

Domestic cats and dogs can be infected by ingesting infected intermediate hosts, or by ingesting the eggs in infective faeces. If the pet in question ingests an infected rodent (containing cysts) the tapeworms develop into adults and after a suitable prepatent period, produce eggs. The pet shows no clinical signs but is able to transmit disease. However if the pet ingests eggs excreted by another infected pet or infected definitive host (wild canid, often a fox), it may develop infection caused by the metacestode life cycle stage. This can cause some clinical signs (often misdiagnosed) but is not a risk for onward transmission and is termed an aberrant host infection.

Humans become accidentally infected by ingesting eggs in the contaminated environment (contaminated by faeces of infected definitive hosts, either a pet or a wild canid). The disease has a poor prognosis in humans, who are considered dead end (intermediate or aberrant) hosts, as the tapeworm is unable to complete its life cycle. Instead highly pathogenic cysts form around the tapeworm segments, or protoscoleces. These lodge in the liver (most commonly), lung or other organs (including the brain) and are very difficult to treat either surgically or chemically.

The adult tapeworm in the carnivore definitive host is short lived (approximately 100 days) and time between ingestion of infected intermediate host and the development to adult stage in the final host is about 4-5 weeks.
Treatment in domestic cats and dogs is with a single dose of anthelmintic, such as praziquantel or epsiprantel, which should ideally be verified for official purposes by a veterinarian. The treatment however is only short lived, with a parasiticidal effect lasting 24 hours and animals may continue to shed eggs for several hours after treatment. It is recommended that treatment should be repeated every 28 days in areas where the disease is known to occur. Current worming guidance in the UK for tapeworms is dependent on the specific advice of the veterinary surgeon responsible for the care of a particular animal. We anticipate that the likely recommendation in the UK is currently a worming frequency of every three to six months to avoid re-infection by other tapeworms, where this is deemed to be a risk.

The UK PETS and the EC harmonised pet movement rules are designed to mitigate the specific levels of *Echinococcus multilocularis* infection risk depending on where a pet has come from. Table 1 outlines the current UK (PETS) and EU harmonised rules to mitigate the risk of an animal with a parasitic infection entering the UK and the EU and differences between them. In this Table the differences identified as areas for further consideration are clearly indicated by the suffix (2).

The concern for the UK is not only that a pet may become infected and pass on the infection to the pet owner, but also that the disease may be brought into the UK and become established in the wild red fox population.

**Table 1. Outline of the current UK rules and the EU harmonised rules**

<table>
<thead>
<tr>
<th>Measures</th>
<th>Current UK (PETS scheme)</th>
<th>EU harmonised</th>
<th>EU/Listed 3rd countries</th>
<th>Unlisted 3rd countries</th>
<th>EU/Listed 3rd countries</th>
<th>Unlisted 3rd countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent identification (Microchip)</td>
<td>Yes(1)</td>
<td>No(2)</td>
<td>Yes(1)</td>
<td>Yes(1)</td>
<td>Yes(1)</td>
<td>Yes(1)</td>
</tr>
<tr>
<td>Tick and Tapeworm treatment within 24 – 48 hours prior to start of journey</td>
<td>Yes(1)</td>
<td>No, but treatment is carried out once in quarantine(2)</td>
<td>No(2)</td>
<td>No(2)</td>
<td>No(2)</td>
<td></td>
</tr>
<tr>
<td>Quarantine with immediate treatment</td>
<td>Only for non-compliance. Can be released early once treatment complete if other requirements are fulfilled(2)</td>
<td>Yes – 6 months(2)</td>
<td>No(2)</td>
<td>No(2)</td>
<td>No(2)</td>
<td></td>
</tr>
</tbody>
</table>

*Legend: (1) – same requirement; (2) – different requirement*

For the purposes of this risk assessment, a potential **increase** in the risk of *Echinococcus multilocularis* introduction to the UK via travelling pets under harmonised EU rules is identified as the hazard for consideration.
6 Risk question

“How would the risk of *Echinococcus multilocularis* introduction to the UK via travelling pets change if the UK were to apply the current harmonised EU rules for the non-commercial movements of pet animals”? How would the risk change if the window for treatment was increased from 0-72 hours?

7 Risk assessment

7.1 Scope

7.1.1 Inclusion

This qualitative risk assessment covers:

- *Echinococcus multilocularis*, the pathogenic agent of Alveolar Echinococcosis
- The term “pets” is used to cover both dogs and cats. Cats are believed to have a lower zoonotic significance than dogs because of the slower development and reduced egg production of *Echinococcus multilocularis* when infecting this host species (Deplazes and others, 2004). However for convenience, dogs and cats are grouped together in terms of the risk assessment.
- European Community harmonised rules and UK PETS rules for pet travel between different areas of the world
- Prevalence of *Echinococcus multilocularis* in various countries and territories and any estimated trends in prevalence in wild (final and intermediate) hosts.
- Prevalence of *Echinococcus multilocularis* in pets in endemic countries.
- An analysis of the difference between the current UK rules and the harmonised EU rules and any effect of such a difference may have on the risk of introducing *Echinococcus multilocularis* to the UK.
- Issues of non-compliance, whether within the veterinary services or with pet owners, will be addressed in the context of this risk assessment but will not be assessed as an indicator of risk.
- Effectiveness of treatment protocols and risk management options.

7.1.2 Exclusions

- Illegal imports (including smuggling of animals, passport/certificate fraud, etc);
- Tick-borne diseases.
- Movement of other pet animals which may act as intermediate hosts for alveolar echinococcosis (such as pet rodents) and not specified in Regulation EC/998/2003.
7.2 Definitions
For the purpose of the release assessment, the following definitions will apply:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU harmonised rules</td>
<td>As described in Regulation (EC) No. 998/2003 (EC).</td>
</tr>
<tr>
<td>Pets</td>
<td>Animal species listed in Annex I to Regulation (EC) No. 998/2003 accompanying their owners or a natural person responsible for such animals on behalf of the owner during their movement and are not intended to be sold or transferred to another owner.</td>
</tr>
<tr>
<td>Alveolar Echinococcosis</td>
<td>Infection caused by the tapeworm, <em>Echinococcus multilocularis</em>. Not Cystic Echinococcosis, which is caused by <em>E. granulosus</em>.</td>
</tr>
<tr>
<td>EU Member States and Equivalents</td>
<td>Countries which are party to treaties of the European Union or which have adopted EU law as a member of the European Economic Area and territories which have special relationship with a Member State.</td>
</tr>
<tr>
<td>Movement</td>
<td>Any movement of a pet animal between Member States or its entry or re-entry into the territory of the Community from a third country.</td>
</tr>
<tr>
<td>Prevalence</td>
<td>The proportion of individuals in a population having the disease at a given time.</td>
</tr>
<tr>
<td>Incidence</td>
<td>The number of newly diagnosed cases during a specific time period.</td>
</tr>
<tr>
<td>Negligible prevalence</td>
<td>The risk of introducing <em>Echinococcus multilocularis</em> from populations where the annual incidence is below 1 in a million is considered negligible, even without applying a specific risk-mitigating protocol (EFSA, 2006).</td>
</tr>
<tr>
<td>Release Assessment</td>
<td>The likelihood of an infectious agent being introduced into the UK animal population.</td>
</tr>
<tr>
<td>Exposure Assessment</td>
<td>The likelihood of an introduced infectious agent spreading to indigenous pet or wildlife population.</td>
</tr>
</tbody>
</table>

7.3 Terminology related to the assessed level of risk
For the purpose of the release assessment, the following terminology will apply (OIE, 2004; EFSA, 2006):

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1 November 2009, the list includes the following countries and territories: Ascension Island, United Arab Emirates, Antigua and Barbuda, the Netherlands Antilles, Argentina, Australia, Aruba, Bosnia and Herzegovina, Barbados, Bahrain, Bermuda, Belarus, Canada, Chile, Fiji, Falklands Islands, Hong Kong, Jamaica, Japan, Saint Kitts and Nevis, Cayman Islands, Saint Lucia, Montserrat, Mauritius, Mexico, Malaysia, New Caledonia, New Zealand, French Polynesia, Saint Pierre and Miquelon, the Russian Federation, Singapore, Saint Helena, Trinidad and Tobago, Taiwan, USA, Saint Vincent and the Grenadines, British Virgin Islands, Vanuatu, Wallis and Futuna, Mayotte.
7.4 Dependencies

Very broadly, the likelihood of the introduction of *Echinococcus multilocularis* into the UK would depend on:

- the prevalence of *Echinococcus multilocularis* in the country of origin (i.e. wildlife intermediate and definitive hosts, domestic animal population, or both);
- potential exposure of pets to *Echinococcus multilocularis* infection in country of origin;
- The risk reduction measures (e.g. tapeworm treatment) in place;
- The level of compliance with the risk reduction measures put in place to prevent introduction of *Echinococcus multilocularis*.

7.5 Assumptions

For the purposes of this qualitative risk assessment, we assume that:

- The current incidence in wildlife observed in some EU Member States is increasing and it is extremely unlikely any country would be able to undertake a truly effective eradication programme;
- There has been an increase in number of human cases across some EU Member States associated with urban foxes;
- In the event of a neighbouring country becoming a new EU Member State in the future, that country is one of those that is already listed in the Regulation and this event would have no effect on changing the likelihood of the importation of disease;
- Most of the countries in the northern hemisphere would report cases of alveolar echinococcosis in humans to the relevant international organisations; cases in animals may not be reported;
In most cases, fraudulent activities would effectively be detected by competent authorities;

Treatment of pets is only temporary and will not prevent a pet becoming re-infected.

7.6 Release assessment

*Echinococcus multilocularis* is the causative agent of Alveolar Echinococcosis (AE), a parasitic disease which is frequently fatal in humans. In cats, dogs, foxes and other definitive host animals infection causes no clinical signs and is easily treatable. In intermediate hosts (generally rodents and related mammals, but can also include dogs, pigs and horses) it causes the formation of cysts (usually in the liver) which is lethal if left untreated. It has a restricted but variable distribution across the globe, being detected only in the northern hemisphere. The distribution across Europe closely follows the distribution of the main definitive host, the red fox, *Vulpes vulpes*.

This assessment considers the potential introduction of *Echinococcus multilocularis* to the UK from the import of a pet from (i) an EU Member State and equivalent, (ii) listed Third Countries, and (iii) unlisted Third countries (see section 6.2. Definitions).

7.6.1 Pet Movements – Countries

The three main groups of countries and territories for the purposes of the pet movements system are listed below.

a. *Member States and equivalents* – include EU Member States, but also countries in the EEA, and equivalent, such as Switzerland, Norway etc.

b. *Listed third countries* – include rabies free countries which the Commission considers to present a negligible rabies risk (e.g. Australia, New Zealand), or where there is convincing evidence that effective systems are in place to manage rabies and therefore “the risk of rabies entering the Community as a result of movements from their territories has been found to be no higher than the risk associated with movements between Member States” (e.g. USA),

c. *Unlisted third countries* – includes countries which have not been accepted for listed EU status or those that have never applied for such listing.

Broadly speaking, a pet could become infected with *Echinococcus multilocularis* by ingestion of an infected rodent host thus completing the parasite life cycle or by direct or indirect contact with another infected pet or wild canid (fox etc), which would cause an aberrant infection in the pet. If the pet was not treated once the tapeworm matured and produced eggs then the pet would represent a risk of transmitting disease to other individuals in contact with it, or that infected faeces would contaminate the environment. Treatment of the pet, if delivered correctly, is 100% efficacious at eliminating the parasite.
However the treatment used is not ovicidal and eggs may continue to be infective for considerable periods of time in the right environmental conditions (as long as over 450 days at 4°C and 95% relative humidity [Gajadhar and Allen, 2004]). It takes 24 hours for the drugs to have had a complete effect in clearing the pet of adults and eggs. The timing of treatment and careful disposal of infective faeces are the two critical pathways in preventing an incursion of *Echinococcus multilocularis* associated with the movement of a pet animal from an endemic area.

Note: a domestic pet infected with eggs would develop an aberrant infection and would be of risk if scavenged by further definitive host.

Countries currently categorised as listed third countries include Argentina, Australia, Belarus, Bosnia Herzegovina, Canada, Chile, Croatia, Japan, Mexico, New Zealand, Russia, USA (See Map 1 below). For a full list, please see the Defra website at [http://www.defra.gov.uk/wildlife-pets/pets/travel/pets/procedures/support-info/other.htm](http://www.defra.gov.uk/wildlife-pets/pets/travel/pets/procedures/support-info/other.htm)
Very broadly, the likelihood of the introduction of *Echinococcus multilocularis* into the UK would depend on:

- the prevalence of *Echinococcus multilocularis* in the country of origin (i.e. in wildlife or domestic animal population, or both);
- potential exposure of pets travelling to the UK (treated or untreated) to *Echinococcus multilocularis* in country of origin;
- The risk reduction measures (e.g. permanent identification, anthelmintic treatment, waiting period after treatment, quarantine requirements) in place;
- The level of compliance with the risk reduction measures put in place to prevent introduction of *Echinococcus multilocularis*.

### 7.6.2 *Echinococcus multilocularis* incidence

Alveolar echinococcosis has a wide geographic distribution in the northern hemisphere only: Central Europe, northern and central Asia and parts of North America (McManus, 2010). However there is little information on the frequency distribution of the parasite in reservoir hosts from many endemic regions. Several studies have looked at the transmission in dogs in China, where *Echinococcus multilocularis* is a significant problem in certain communities and related to the numbers of domestic dogs rather than wildlife. In these studies, prevalence in wild canids can be as high as 60% and in dogs as high as
25% (WHO-OIE, 2002). In some countries, wildlife reservoirs, such as red foxes and arctic foxes, are more important in zoonotic risk (McManus, 2010). In Japan, the incidence in foxes in Hokkaido has been steadily increasing, as have the number of foxes encroaching in urban areas (Kamiya and others, 2006). Similarly in Europe there have been reports of increases of *E. multilocularis* infection in urban foxes (e.g. Schweiger and others, 2007; Deplazes and others, 2004). Estimates suggest as many as 30% may be infected in certain areas in Europe (OIE, 2006). A recent study has looked at the global burden of disease using many data sources for the prevalence and these are used in this risk assessment (Torgerson and others, 2010). The report concluded that there are an estimated 18,000 cases annually, giving a global burden (in DALY’s) in line with other neglected tropical diseases in humans. This is mainly due to the poor prognosis in many cases, where untreated patients have a life expectancy of ~8 years. Other publications estimate the global burden of disease as 0.3 to 0.5 million cases annually (McManus, 2010). Control once disease becomes established, is well documented as being problematic because of the sylvatic cycle and the role of wild rodents. Only one region has successfully eliminated *E. multilocularis* once it became established – the Japanese island of Rebun – and this was carried out by eliminating all the fox and dog populations (McManus, 2010).

### 7.6.2.1 The UK

Evidence for disease freedom: Six hundred and four fox carcasses were collected over 1999 and 2000. Using a cestode-specific coproantigen ELISA test, 5.5% of faecal samples tested positive for cestodes (*Taenia* or *Echinococcus* sp.) but using a specific PCR, none tested positive to *E multilocularis* (Smith et al, 2003). From 2005 to 2010, 384 fox carcasses were collected from various regions across GB and all tested negative for *E. multilocularis* by species-specific PCR (Unpublished data from FERA). A previous study, published in 1995 (Richards et al 1995, Vet Parasitol 59:39-51) did not identify any *E. multilocularis* infection in foxes (although *E. granulosus* was identified). There have been no reports of autochtonous infection in humans of *E. multilocularis*. One imported case (ex Afghanistan) in a human was reported in 2000 (Craig, 2003).

Estimated prevalence is therefore <0.1%. The EFSA scientific opinion (2006) has suggested that the number of foxes used in these studies is sufficient to demonstrate disease freedom and that this should be repeated every five years. It is considered the UK has evidence to prove it has been disease free for at least ten years.

In terms of intermediate host density, the most common mammal in the UK is the field vole, *Microtus agrestis*, estimated at 75 million and a suitable host for *E. multilocularis*. Fox density in the UK is highly variable. In the UK, definitive host (the red fox) density varies between one fox per 40 km² in rural areas, and 30 foxes per km² in urban areas where food is abundant (IUCN, 2010).
7.6.2.2 EU and EU equivalent countries

Red foxes (*Vulpes vulpes*) are the main definitive host for the parasite in Europe, and they have a wide distribution across most of the region. There has been a reported increase in incidence in foxes over the past few years in some European countries, probably related to the increase in fox population, and of particular concern is the increase in urban foxes (Schweiger and others, 2007; Hannoset and others, 2008; Berke and others, 2008). Prevalence in the red fox population varies between 5 and 40% (EFSA 2006). There has also been an increase in urban foxes identified as infected with *E. multilocularis* in Copenhagen, Geneva, Stuttgart and Zurich (HPA, 2008). Although the number of human cases of alveolar echinococcosis (AE) remains very low, this has been increasing over the last few years (Schweiger and others, 2007). Surveillance and diagnosis are problematic and depend upon sampling dead foxes. Nevertheless, a trawl through recent academic literature identifies many European regions with infected fox populations. These data are consolidated in Map 2, below. Some areas of Europe (Switzerland, Austria, parts of France and Germany) are considered endemic.

Because of the variation in sampling strategies and diagnostic methods, it is difficult to compare one study against another, but it apparent that the disease has expanded in geographic range in the last decade (EFSA, 2006).

The most important intermediate hosts in Europe are the common vole and the water vole. Although these are usually associated with meadowland and waterways, infected water voles have been found in urban and periurban areas (Stieger and others, 2002).

In Sweden, in December 2010 a fox was shot and subsequently tested positive for *E. multilocularis*. Following this case, a second fox carcase from the same location tested positive in March 2011 (Osterman and others, 2011). Sweden had in place not only the requirement for pet treatment, but also a surveillance programme since 2000, during which time nearly 3,000 foxes (*Vulpes vulpes*) 68 raccoon dogs (*Nyctereutes procyonoides*) and 35 wolves (*Canis lupus*) were tested and found negative for *E. multilocularis*. In 2010, 304 foxes were tested and one (out of 55 from the same region) was found positive and on post mortem it was estimated the fox harboured more than 500 tapeworms. Since February 2011, the surveillance was intensified in the South West region and 3,189 foxes were submitted for sampling and to date one more (of 1,140 tests so far) is positive. The authors conclude that these cases are unlikely to be due to fox movement from other infected areas (i.e. Denmark) but more likely a result of frequent pet movements. The extent of *E. multilocularis* infection is not yet known (Osterman and others, 2011).

7.6.2.3 Listed Third countries and others of concern

The disease is believed to be confined to the northern hemisphere. There are many reports of *Echinococcus multilocularis* in arctic foxes (*Alopex lagopus*) outside Europe, such as Alaska and Siberia. In North America, Echinococcosis is limited to the Arctic regions of Alaska and Canada and a few northern States of the USA. It is also prevalent in Russia and Japan and much of Europe, including EU Member States. Increasing fox population, increasing encroachment into urban areas and spill-over infection into
domestic dogs and cats has increased concern about this disease as a public health hazard.

7.6.2.4 Worldwide (Unlisted Third Countries)
The other major endemic areas are Turkey, Central Asia and Western China particularly at altitudes over 400 m a.s.l. (where some communities have 5% human alveolar echinococcosis) (Ziadinov and others, 2010). It is estimated that in China alone there are 380,000 cases of echinococcosis (both cystic and alveolar) with 50 million people at risk. These diseases are considered among the most severe parasitic diseases in the western provinces of China and their incidence is increasing (Li and others, 2010).

Map 2: Worldwide global prevalence of *Echinococcus multilocularis* (after Torgerson and others, 2010).

Countries that are OIE members would be expected to report *Echinococcus multilocularis* cases in pets, domestic animals, wildlife or humans in the OIE yearly disease reports. However it is usually aclinical in pets (and therefore will not be diagnosed or reported) and wildlife surveillance is non-existent or very limited in many countries. So any reporting to the OIE is likely to under-represent the global situation.

The current rules for pet movement into and around the EU are based on how different areas of the world represent different *rabies-related* risks to the UK depending partly on the country disease status but also other variables such as:

- The level of *rabies* present in the given country (sylvatic or urban);
- the quality and integrity of its veterinary services (both private and official);
• the legal framework applicable in the particular countries (regarding notification of diseases, approval and marketing of anthelmintic treatment, deworming campaigns, registration of pets etc.);
• eradication programmes in either wildlife or pets or both;
• surveillance programmes in place and reporting results and cases to the international organisations;
• It does not take into account the prevalence of *E. multilocularis* in those countries.

Current EU rules allow the non-commercial movement of cats and dogs into the UK under the PETS scheme, such that pets from EU MSs or Listed Third Countries can enter the UK without entering quarantine provided they have a pet passport, appropriate identification, proof of rabies vaccine status and documented compliance with tick and tapeworm treatment. Pets from Unlisted Third Countries must undergo six months quarantine in the UK at the beginning of which they are vaccinated against rabies and treated for ticks and tapeworms. In the event of a pet from a Listed Third Country being fully compliant with rabies vaccination, but not with tick and tapeworm treatment, the pet may be released early from quarantine once the necessary treatment is complete. In the event of a pet from an EU Member State not being fully compliant with Tick and Tapeworm treatment, checks are made at the exiting country and the pet and owners would not be permitted to travel.

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**Map 3**

Number of pets (cats and dogs) arriving into the UK from the countries listed in Annex II of the EC Directive 998/2003.

Map 3 Number of pets (cats and dogs) arriving *into the UK from* the countries listed in Annex II of the EC Directive 998/2003.
The maps above indicate the numbers of pets arriving from the two groups of countries. Last year, according to TRACES, the EU electronic trade notification system, nearly 4,000 pets travelled to the UK directly from Listed Third Countries (under the PETS scheme). In the same period, nearly 1300 pets travelled to the UK from Unlisted Third Countries and went into quarantine in the UK for 6 months prior to release. The majority of those pets were from South Africa and Turkey.

7.6.3 Incubation period
The life cycle of the pathogen takes up to 30 days from infection of the definitive host (wild canid or pet) with the immature stage of the parasite until the tapeworm reaches adult stage and is patent (producing protoscoleces with eggs). The parasite survives in the definitive host for up to 100 days and can produce eggs every day. Once a pet is treated it can become reinfected after just 48 hours.

7.6.4 Treatment and surveillance in EU
In most parts of Europe, *E. multilocularis* is maintained in a sylvatic cycle with foxes and voles as the main hosts. But there is increasing evidence of urban foxes and dogs becoming more important for the synanthropic cycle (where humans can become infected). Therefore routine treatment (with praziquantel or epiosprantel) should be applied regularly alongside careful management of dog faeces. The treatment is active for 24 hours, but the pet can still be evacuating eggs for several days after treatment, so careful disposal of faeces is necessary during this period. If the pet becomes re-infected between
treatment and movement, the infection will be undetected (as it relies on presence of eggs in faeces) and the parasites reach patency within five weeks, therefore it is important to repeat treatment. There are no national treatment regimes for this parasite in Europe. Recommendations would be made by private veterinary surgeons to pet owners, particularly in endemic areas. Control of foxes or rodents should again employ treatment, using praziquantel-containing oral bait. This has been used successfully in Germany.

There is no specified surveillance in the majority of EU Member States for *E. multilocularis* in the wild definitive host (red fox). Countries with freedom (Ireland, Sweden, Finland, Norway and the United Kingdom) conduct surveillance in the wild fox population. Otherwise, there may be some limited surveillance in some countries conducted in special circumstances, such as around a human case. There is very little evidence of surveillance in the rodent intermediate hosts.

### 7.6.5 Worldwide treatment and surveillance

There are very few reports of national control programmes for *E. multilocularis* infection in wildlife. Japan and Germany are two of the few to do so (Kamiya and others, 2006). Treating foxes with oral bait containing the anthelmintic has had a positive effect on controlling infection in the definitive host, whereas culling is counterproductive. However this system of control is costly and requires collaborative effort in terms of targeting control.

There is no specified surveillance in wildlife in many endemic countries. Human cases may be reported to the OIE by some countries, but not all. Any data on prevalence in non-EU countries comes from published papers or one-off studies. These data suggest a continuing problem, as assessed by human infection rates (Torgerson and others, 2010)

### 7.7 Exposure Assessment

It is considered that there are three pathways of exposure if an infected pet harbouring adult *E. multilocularis* is admitted into the UK:

i. Infected faeces are ingested by a human

ii. Infected faeces are ingested by a rodent

iii. Infected faeces are ingested by another pet or wild canid

In the case of the human, there would be a non-negligible risk of contracting Alveolar Echinococcosis from the pet. This risk level would remain the same whether the pet has been brought to the UK or not. In terms of mitigation, this is a matter of communication to pet owners to be aware of the possible risk of ingesting pet faeces.

In the case of infected faeces being ingested by a rodent (which is a suitable intermediate host), there could be a high risk that this would lead to establishment of the disease in a
sylvatic or synanthropic cycle in the UK in time. This would be dependent upon the density of intermediate hosts, the density of foxes or other suitable definitive host and the amount of eggs per gram being released into the environment. *Echinococcus* tapeworms become patent at around 30 days and produce eggs up until death at around 100 days. If the pet enters the UK with an old infection (where all adults are at least 90 days old for example) the number of eggs released into the environment is less than if a pet is harbouring a young infection, as the older adult worms would soon be dead and self re-infection would not lead to patent infection. Therefore it is important that treatment is given as close as possible to the entry date to the UK.

In the case of infected faeces being ingested by another pet, this would lead to that pet becoming an aberrant host harbouring a metacestode infection. There is negligible risk of onward transmission to the owner or establishment in the wildlife population of the UK. It is not known how frequently this occurs or how often pets are misdiagnosed with liver cysts of a different aetiology, but it is believed to be rare (Scharf and others, 2004).

### 7.8 Risk Mitigation Measures

#### 7.8.1 Permanent identification

While this is not a direct risk mitigation measure, permanent identification of a pet (eg with electronic microchip) requires a veterinary visit, and therefore implies a level of owner care for the pet, which increases the likelihood that a pet may be treated regularly as awareness of requirements for anthelmintic treatment will be higher. All pets travelling from EU Member States and Listed Third Countries require permanent identification and therefore this allows a veterinary surgeon to certify that the specific animal has been appropriately treated prior to its arrival for embarkation.

#### 7.8.2 Treatment

Treatment is using a one-off dose of a suitable anthelmintic, such as praziquantel or episantrrel. This drug is proven safe, effective and cheap. There are few if any reports of drug resistance or adverse side effects. However, it is preferable that the drug is administered by a vet as the pet passport can then be countersigned and there is less risk of treatment being unsuccessfully administered.

#### 7.8.3 Waiting period (in country of departure)

The most risk-averse waiting period would be that currently in use in the UK as animals are treated and after a waiting period in the country of departure, would arrive to the UK with no further risk of excreting infective eggs. However this has proven to be the most common reason for non-compliance on arrival the UK border. The treatment is known to work within this 24-48 hour period and re-infection is highly therefore unlikely. However the
longer the waiting period, the greater the risk of a treated animal being re-infected before it travels. If an animal had become re-infected during the waiting period before travel, treatment would be recommended between four and six weeks after arrival to ensure infection has reached patency and can be treated effectively. However this would be difficult to enforce and is a risk for the pet owner and other contact animals during this period.

Sweden currently has a ten day treatment window, although it is recommended to pet owners to wait for treatment until two to three days prior to travel. Finland currently has a 30 day treatment window. Ireland and Malta have the same requirements as the UK. Norway, although not an EU MS, has equivalent rules, which include a ten day treatment window followed by further 7 day post arrival treatment.

7.8.4 Quarantine
Currently quarantine is only used if the animal is non-compliant with any of the requirements or is travelling from an Unlisted Third Country. If a pet from a Listed Third Country is only compliant with rabies vaccination and identification requirements (i.e. tick and tapeworm controls not complied with), the quarantine period is shortened while treatment is carried out.

7.8.5 Biosecurity
Once infected cats and dogs that have arrived in the UK without receiving appropriate treatment to stop the production of infective *Echinococcus multilocularis* eggs they will shed these eggs in their faeces. Such eggs will not only be found in their faeces, but may also be on the infected animal’s fur or hair. Therefore other individuals in direct contact with the infected animal can become infected by these eggs, as well as the scope to become infected through direct contact with the faeces. Increased responsibility on dog and cat owners to always promptly clear up faeces produced by their pet could effectively minimise this risk pathway, but is unlikely to be complied with at all times, even if it is in parks and other communal areas. Whether UK wildlife is initially infected in a park or a back garden is academic: once this infection enters UK wildlife it will be extremely difficult to eradicate.

7.8.6 Compliance
Understanding how different controls affect compliance is a very important factor in determining the effectiveness of the pet movement system. While it is impossible to make any accurate assessment of the full extent of illegal activity, according to the Animal Health Agency, there were 196 unauthorised landings of pets detected during 2008. This indicates that pet animals are being landed without authorisation or correct certification into the United Kingdom and that the incentives to comply will have an impact on the effectiveness of the system.
The high barriers to compliance under the current UK rules (a six-month wait before an animal can move between Member States or listed Third countries, six-months quarantine for movements from unlisted Third countries, and severe consequences for non-compliance) mean that the system is very likely to considerably incentivise more rule breaking than the harmonised EU rules. The risk assessment by Ramnial and others (2009) concluded that ‘less than 100% compliance’ can considerably alter the risk of entry of a pet incubating rabies under EU harmonised rules as well as under PETS rules, where there is no quarantine. While this risk assessment does exclude consideration of illegal imports, it should be noted that illegally imported pets will not enter quarantine. A key concern therefore is the effect of harmonisation on compliance. It is important to note that the highest number of failures under the current UK rules is for tick and tapeworm treatment. This necessitates considerable administrative burdens on the agencies as well as inconvenience for the pet owner.

A recent QRA on rabies by the VLA on the effect of harmonisation on the risk of introduction of rabies in to the UK concluded that there would be an increase in this risk from pets originating in Listed Third Countries and EU MS & Equivalents, but that there would be no increase in risk from Unlisted Thirds. As the incidence of *Echinococcus multilocularis* is higher in the EU and Northern Hemisphere (including Listed Third Countries) it would be expected that the risk of introduction of this disease to the UK would increase, if harmonisation would no longer require tapeworm treatment.

### 8 Commentary

#### 8.1 General considerations

a) Some areas of the EU are still experiencing cases of *Echinococcus multilocularis* primarily in wildlife, and in a very few limited instances in the domestic pet and human populations. The levels in urban foxes in certain countries is believed to be increasing and this is considered an increased risk to the resident human and pet population in those countries.

b) In Listed Third Countries and certain EU equivalents (e.g. Russia, Croatia and Bosnia), where *Echinococcus multilocularis* is present, the risk is proportionate to the number of stray dogs and urban foxes. It is possible that the risk is not as closely related to the number of infected rural foxes as contact between them and a domestic pet would be less likely.

c) Unlisted Third Countries in the Northern hemisphere (e.g. China) still present a non-negligible risk, partly due to the inconsistency in reporting. The highest risk to pets is the presence of *Echinococcus multilocularis* in countries with high populations of red foxes or other wild definitive hosts as well as stray, roaming or feral dogs.
8.2 Current Pet Movement rules

There are two possible broad scenarios by which a pet may become infected with *Echinococcus multilocularis*, one of which is concerning lack of awareness of necessity for any sort of tapeworm treatment and the other concerns a willingness to treat but inability to do so within a safe window:

a) An untreated pet was not supervised by the owner and came into contact with either infected faeces or infected rodents in the country of origin. The owner fails to notice that the pet has become infected (there are few if any clinical signs with *Echinococcus multilocularis* infection), does not treat it for tapeworm and the pet travels to the UK while infected with the parasite.

b) A treated pet travelled more than two days after treatment, was not supervised by the owner and came into contact with either infected faeces or infected rodents in the country of origin. The owner fails to notice that the pet has become infected (there are few clinical signs with *Echinococcus multilocularis* infection), the pet travels to the UK while infected with the parasite, and treatment is not carried out within limited weeks of arrival.

Table 2 below summarises the current risk mitigation measures under the pet movements rules and Table 3 summarises possible scenarios for future risk mitigation measures. These measures are designed to address and mitigate the risk of the introduction of *Echinococcus multilocularis* from the country of departure (both EU Member State and otherwise) to the UK.

Table 2: Current measures

<table>
<thead>
<tr>
<th>Member States</th>
<th>Current Rules</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>24-48 hour window for treatment. Drug administered and signed off by a certified veterinary surgeon.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Sweden</td>
<td>10 day treatment window with recommendation of treatment 3 days prior to travel. Drug administered by a certified veterinary surgeon.</td>
<td>Negligible to Very Low</td>
</tr>
<tr>
<td>Finland</td>
<td>30 day treatment window. Drug administered by a certified veterinary surgeon.</td>
<td>Very Low</td>
</tr>
<tr>
<td>Ireland</td>
<td>24-48 hour window for treatment. Drug administered and signed off by a certified veterinary surgeon.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Malta</td>
<td>24-48 hour window for treatment. Drug administered and signed off by a certified veterinary surgeon.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Norway (not EU)</td>
<td>10 day treatment window with additional post import treatment at 7 days (difficult to enforce)</td>
<td>Negligible to very low</td>
</tr>
</tbody>
</table>

8.3 Possible future measures

In terms of future measures for *Echinococcus multilocularis* treatment, several possible scenarios are considered below, with potential increases in risk. It is considered that there is a major risk reduction from applying our current treatment regimes and there would be an increase to a low level of risk by extending the current treatment window. This cannot
be quantified but will increase by a small amount incrementally as the length of time since treatment increases.

The recent cases of infected foxes in Sweden leads to a higher risk level being assigned to the scenario 3 (1-10 day treatment). In particular, two foxes were found and one harboured over 500 worms. A risk assessment carried out by Bodker and others (2006) looked at the risk of *E. multilocularis* spreading from Denmark to Sweden using a measure of eggs deposited according to an estimated prevalence of adult worms in travelling pets under different treatment regimes. This daily egg production (number of eggs produced by a dog in 24 hours) depends on the prevalence of adult worms in the dog. The number of adult worms in a dog depends on the exposure time in an infected area after treatment and before moving to a non-infected area. The worms can live for 180 days, but they must be 27 days old to produce eggs. The study concluded that if deworming takes place 10 days before import there is still a risk of transmission. Dogs from a high endemic area are a higher risk. Crudely, in highly endemic areas where average infection of an untreated dog is 3000 worms, the model estimates that a reinfection rate is 3000 worms/180 days lifespan which is 16.7 worms per dog per day. In areas of low endemicity, average intensity is 19 worms per dog, therefore reinfection rate is 19/180 or 0.11 worms per dog per day.

Bearing in mind that the current 24-48 hour regime is the most risk-averse treatment window, the following scenarios are postulated:

**Table 3: Possible measures**

<table>
<thead>
<tr>
<th>Mitigation Scenario</th>
<th>Possible change in rules</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>Treatment on entry. Drug administered and signed off by a certified veterinary surgeon.</td>
<td>Negligible but difficult to enforce and with considerable burden on enforcement agencies. Some residual risk if pets not controlled for 24 hrs after arrival as viable eggs can be shed in the faeces during this period.</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>Window moved to 24-72 hours. Drug administered and signed off by a certified veterinary surgeon.</td>
<td>Small increase in risk, none in risk level (still negligible) but expected increase in compliance and reduced administrative burden.</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>Window moved to 1-10 days. Drug administered and signed off by a certified veterinary surgeon.</td>
<td>Non-negligible increase in risk to low (increased risk, as the evidence from Sweden suggests this is a low risk window according to the level of surveillance where 2 out of over 3,000 foxes, samples in 2010-2011 were identified as positive).</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>Treatment window 24–72 hours. Drug administered by owner and no requirement for veterinary supervision. Requirement to show proof of purchase of treatment.</td>
<td>Small increase in risk, none in risk level but perceived increase in compliance and reduced administrative burden.</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>Treatment window of 0-72 hours. Drug administered and signed off by a certified veterinary surgeon.</td>
<td>No increase in risk to pet owner (who will already be at risk from their infected pet); risk to in-contact pet dogs of infection, but not of onward transmission; small increase of risk of infected faeces contaminating the environment for short period of time.</td>
</tr>
<tr>
<td>Scenario 6</td>
<td>No treatment (harmonisation with</td>
<td>Increase to low risk for the pet being moved, but</td>
</tr>
</tbody>
</table>
In terms of pet movements between EU MSs and between EU MSs and listed Third countries:

- The current UK PETS system mitigates the risks related to the movement of a pet infected with *Echinococcus multilocularis* after treatment and before movement by requiring movement to occur within 24-48 hour post-treatment.

- The EU harmonised regime does not require treatment against *Echinococcus multilocularis* from either an EU MS or from a listed Third Country. This concern has prompted the request to continue the requirement for tapeworm treatment beyond 31/12 2011.

In terms of the policies related to pet movements to the UK and EU from unlisted Third countries:

- The UK quarantine rules are designed to detect the majority of cases of rabies where pets are incubating this disease at the time of importation. However there is also a requirement to treat against tapeworms and if rabies requirements are fulfilled the pet can be released early from quarantine. Under harmonisation, there will be no requirement for tapeworm treatment, however most pets from unlisted Third countries are from South Africa, where disease is absent. Pets from Turkey or China would remain a concern.

In terms of the levels of pet movements and how that may be expected to change in the future:

- Currently there are approximately 90,000 pet movements annually into the UK from EU Member States.

- It is fully expected that once the UK harmonises with the EU rules, this number will increase as the rules are relaxed.

### 9 Overall conclusions

Harmonisation with EU rules for the non-commercial movement of pets does not include a stipulation for tapeworm treatment. On the basis of scientific evidence presented in this risk assessment, and providing rules are followed with complete compliance, we consider that:

In terms of pet movements:
• Changing to harmonised EU rules would lead to an increase from negligible to low in the risk of introducing *E. multilocularis* into the UK by a legal pet movement from an endemic EU MS. This will not diminish as long as such EU MS have no effective control programmes in place, and the risk could rise if prevalence rises in these countries.

• Changing to harmonised EU rules would lead to an increase from negligible risk to low risk of introducing *E. multilocularis* into the UK by a legal pet movement from a Listed Third country to the UK.

• Changing to harmonised EU rules would lead to an increase from negligible risk to low risk of introducing *E. multilocularis* into the UK by a legal pet movement from an unlisted Third country.

• Current pet movements to the UK suggest that the number of pets entering the UK from unlisted third Countries (many with zero incidence) is far less than those from EU MSs or Listed Third countries (including those where disease prevalence is endemic). Therefore the increase in risk may be more significant when concerned with pet movements from EU MSs and Listed Third Countries. However the Unlisted Thirds do still include China and Turkey where disease is a concern.

• In terms of the pathogen becoming established in the UK on moving to harmonised rules we consider there is a high risk of this occurring within the next ten years or so, based on:

  I. a continuing increase in geographic distribution of the pathogen in the northern hemisphere;

  II. the volume of pet movements from endemic EU MS;

  III. the increase in movements expected with harmonisation;

  IV. the immunological naivety of the UK fox and vole population;

  V. the current lack of requirement for an approved surveillance programme in UK red foxes;

  VI. Comparable situations in other islands, such as Japan.

While the most risk-averse scenario for a tapeworm treatment window remains 24-48 hours, we recognise the difficulty in sustaining this unilaterally. Therefore other scenarios for the treatment window were considered. Moving to 72 hours would have a small increase in risk of re-infection of the pet, but this could be mitigated by a recommendation to pet owners to repeat tapeworm treatment after 28-35 days of arrival in the UK. Moving to 0 hours may have a small increase in risk to the pet owner and other pets or contracting disease and an increased risk of infecting intermediate hosts. To mitigate this risk, it would be recommended that pet owners are careful about disposal of faeces for the first 24 hours after arrival in the UK.
10 References


Unless otherwise stated, this document uses official information received from the World Organisation for Animal Health, Paris, France (http://www.oie.int/eng/info/hebdo/A_INFO.HTM) and the European Commission, Brussels, Belgium (Animal Disease Notification System, Weekly Reports, CVO Emergency Notifications, SANCO Documents). Maps were produced using ESRI Data and maps CD - 2002. Note: All maps in this document are for visual purposes only.

Note: Maps are based on numbers reported to the OIE and WHO for 2009. Not all countries fully declare the numbers of cases in wildlife.