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# Species profile for Fallow deer

**Report prepared for**

**Woodside Park Estate**

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# SPECIES PROFILE

## Fallow deer

## *Dama dama*

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## October 2013

## 1. SUMMARY

Prized as an ornamental species in many countries, the fallow deer displays a variety of coat colours, ranging from red, brown, almost black, and pale fawn, with numerous white spots. The males have impressive antlers that can measure up to 70 centimetres in height. The natural distribution of the fallow deer is difficult to define because of introductions and re-introductions. Free-living herds have been established in the United States, Canada, Europe, United Kingdom, the West Indies, South America, South Africa, Madagascar, New Zealand, Fiji, and Australia.

The fallow deer is not globally threatened and is listed as least concern by the IUCN as it is a widespread and abundant species in Europe. However, in its Turkish native range this species is under serious threat and the subspecies *Dama dama mesopotamica* is listed on Appendix I under the Convention on International Trade in Endangered species. Export and import of this subspecies is therefore subject to regulation under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*.

Fallow deer are often considered pests as they can damage the natural environment by eating native vegetation, damaging trees and assisting the spread of weeds. They may also contribute to erosion and degrade water quality. Damage to forestry seedlings, agricultural and horticultural crops, commercial flower crops, orchards, irrigation systems and fences has been reported. In dry seasons, feral deer can compete with cattle for pasture and supplementary feed.

The fallow deer has a high climate match with Tasmania and 24 grid cells, covering the north and east of the State, have a climate match score of 7 or 8. The remaining 6 grids have scores of 4 to 6 indicating a moderate climate match in the south west of the State. In Tasmania fallow deer may compete with Tasmanian native marsupial species for food and generally add to grazing pressure, and ground dwelling or nesting birds may be threatened by trampling of habitat by fallow deer.

Imported from England in 1836 to provide a hunting resource, this species is already established in Tasmania. Feral populations of the fallow deer occur around the midlands and extend throughout the north east of the State.

## 2. NAME AND TAXONOMY

| | |
|---|---|
| **Kingdom:** | **Animalia** |
| **Phylum:** | **Chordata** |
| **Class:** | **Mamalia** |
| **Order:** | **Cetartiodactyla** |
| **Family:** | **Cervidae** |
| **Genus:** | **Dama** |
| **Species:** | ***Dama dama*** |
| **Common names:** | **Fallow deer, European fallow deer, Mesopotamian fallow deer, Persian fallow deer, Texas fallow deer** |
| **Subspecies:** | **European fallow deer (*D.d.dama*) and the Mesopotamian fallow deer (*D.d.mesopotamica*)** |

**Taxonomy:**

Generally this species is referred to as fallow deer (*Dama dama*) with two subspecies: *D. d. dama* and *D. d. mesopotamica*. Although some authorities disagree whether there are one or two species of European fallow deer, most place it in its own genus, Dama (although it is sometimes included in the genus Cervus). Fallow deer originated in the eastern Mediterranean region of southern Europe and Iran, and possibly, parts of North Africa. The type specimen of European fallow deer came from an introduced population in Sweden (Klinkenberg 2012).

Feldhamer *et al.* (1988) and Geist (1998) included *Dama mesopotamica* in this species, though it was regarded as a separate species from *D. dama* by Haltenorth (1959), Ferguson *et al.* (1985), Uerpmann (1987), and Harrison and Bates (1991) (Masseti and Mertzanidou 2008). The IUCN Red List follows Pitra *et al.* (2004) in treating *D. mesopotamica* as a separate species, based on a major study on the evolution and phylogeny of old world deer (Masseti and Mertzanidou 2008).

The Mesopotamian fallow deer is 35-40% heavier than the European form and its antlers have palms near the base as opposed to palms at the distal end like those that occur in the European fallow deer (Chapman and Chapman 1997).

**Hybrids:**

The Mesopotamian fallow deer has been imported into Australia and New Zealand to cross with farmed fallow deer to increase their size and provide hybrid vigour (Corinda Fallow Deer Farm, 2013). There is no information in the literature of hybridisation of the fallow deer with any other species.

### Other species:

In addition to the fallow deer, five other deer species are established in the wild on mainland Australia in varying numbers: red deer, rusa deer, sambar deer, hog deer and chital deer. The red deer and fallow deer are the most widely distributed, whilst the sambar deer are found in the highest densities (WA DAF 2013). Only the fallow deer occurs in Tasmania.

## 3. DESCRIPTION

Adult male fallow deer are 130 - 170 cm long with a shoulder height of 85-95 cm and weigh 60-100 kg. Females are 130-150 cm long with a shoulder height of 75-85 cm and weigh 30-50 kg (Wikipedia, 2013). The tail length is 15-24 cm. The species has great variations in the colour of the coat, and may be rich brown, reddish brown, pale fawn, grey-brown to almost black, with numerous white spots. The under parts are white; the buttocks are white and are margined with black. Only males have antlers, which are flattened and palmate with numerous points. The males develop a single unbranched horn the second year, and each succeeding year the horns are larger and have more points, until the fifth or sixth year. The front outer curve of the antlers is 635-940 mm, and the tip-to-tip measurement is 305-762 mm. These multi-pointed, palm-like antlers are very distinct to those of other species. Fawns are usually slightly darker in colour than adults and spotted with white (Page *et al* 2008, Chapman and Chapman 1997, Corbet and Harris 1991, Nowak 1999, Long 2003).

## 4. CONSERVATION AND LEGAL STATUS

CONSERVATION STATUS

*Red List Category – Lower Risk Least Concern*

*Dama dama* is not globally threatened and is listed as least concern by the IUCN. As a result of introductions by the Phoenicians, Romans, and Normans, it is a widespread and abundant species in Europe, hence is

listed as Least Concern. However, in its Turkish native range this species is under serious threat (Masseti and Mertzanidou 2008).

This species is not listed under the Convention on International Trade in Endangered species (CITES), except for the subspecies *Dama dama mesopotamica*, which is included on CITES Appendix I. Appendix I lists species that are the most endangered among CITES-listed animals and plants (UNEP-WCMC. 2013). This subspecies was once considered to be extinct, but in the 1950's a small population probably containing fewer than 50 individuals was found along several rivers in western Iran, near the border with Iraq. However, by 1988 the last wild population had all but disappeared. Individuals taken from the wild form the basis for a semi-captive herd of 140 deer in north-western Iran (Nowak 1999 in VPC 2007).

LEGAL STATUS AUSTRALIA

The *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* regulates the export and import of species included in the Appendices to CITES under Part 13A. International trade in specimens of the subspecies *Dama dama mesopotamica* is therefore subject to regulation under this legislation.

Feral fallow deer are a Class 3 declared pest animal under Queensland legislation. Class 3 pests are established in Queensland and have, or could have, an adverse economic, environmental or social impact. Landholders are not required to control Class 3 pests unless their land is in or adjacent to an environmentally significant area. It is an offence to introduce, feed, supply or release Class 3 pest animals, without a permit (QLD DAFF 2012).

In NSW 'herbivory and land degredation caused by feral deer' is listed as a key threatening process. This determination includes all six deer species, including fallow deer, known to have formed viable feral populations in Australia (NSW DEH 2011).

In Tasmania the fallow deer are a partly protected species under the Wildlife (General) Regulations 2010 (DPIPWE 2011a). As such they are subject to an open season during which they may be taken by shooting by licensed hunters. The regulations also provide for the taking of fallow deer under permit on specified land for crop protection purposes.

The fallow deer is not currently listed as a species that may be imported into Tasmania under the *Nature Conservation Act 2002* and therefore import of this species into Tasmania is not permitted.

The importation of the fallow deer into Tasmania by Woodside Park Estate will not contribute to any international effort to breed the species given its status of Least Concern with IUCN. The purpose of obtaining a specimen of this species is to enhance the genetic diversity of the breeding stock at Woodside Park Estate.

## 5. LIFE HISTORY

The maximum recorded longevity for fallow deer in captivity is 21 years. It has been estimated that in the wild, these animals can live up to 25 years (AnAge 2013). Males attain full size at 5-9 years of age and females at 4-6 years of age (AnAge 2013).

Fallow deer have an annual breeding season. The period when fallow deer are fertile and able to conceive is longer than the period of heightened sexual activity known as the rut, which occurs during April in Tasmania. Females can cycle up to seven times during the breeding season. However, if sufficient males are available they usually conceive during the first cycle during the rut. Gestation is 230 ± 4 days and most births in Tasmania occur during December/January (Locke 2007).

During the autumn mating season, males establish and defend small territories. The gestation period is approximately 8 months and usually a single fawn is produced (Feral.org .au). Their weight at birth is generally 2 to 4 kg. Females become sexually mature at approximately 16 months and there after breed once a year. As is typical in most ungulates, most young males, though capable of breeding, are prevented from doing so by older, dominant males. Consequently, most male fallow deer begin mating when around five or six years old (Klinkenberg 2012).

Females often become secretive and try to find hiding places prior to giving birth. The female usually gives birth during the daily period of least activity. The mother-fawn bond is established immediately after birth when she licks it clean. The mother does not rejoin the herd immediately after birth. The mother hides the fawn in dense bushes and only returns to nurse it (every 4 hours for the first 4 months) during the day. Rumination in the fawn does not begin until 2 to 3 weeks of age. The mother begins weaning the fawn when it is around 20 days old but weaning continues until the fawn is around 7 months old. After 3 to 4 weeks the mother and fawn rejoin a herd of females and their young. After approximately one year, the young are independent (EOL 2013).

## 6. HABITAT REQUIREMENTS AND PREFERENCES

The fallow deer is a highly adaptable species that can survive in a wide range of habitats, including forest, shrub land, grassland, pastureland and plantations (Masseti and Mertanidou 2008). They live in a variety of climates ranging from cool-humid to warm-dry areas (EOL 2013).

Although the fallow deer occupy a great variety of habitats, generally some forest is required for shelter (Nowak 1999). Habitat utilised is often a combination of vegetation types, and includes open woodlands with undergrowth, adjacent grasslands, parklands, plains, light hilly country with dense grassy cover and sparse woods or brushy areas (Feldhamer et al 1988 in Page *et al* 2008, Long 2003). They frequently forage in agricultural or other open land outside of woodlands; populations can be supported in smaller woodlands or scattered copses in agricultural land (Corbet and Harris 1991, Thirgood 1995).

The species is not noted for any migratory behaviour (Nowak 1999). Home range size varies depending on availability of food and other factors such as shelter, degree of disturbance, climate factors, and density of animals (Feldhamer et al 1988 in Page *et al* 2008, Nowak 1999). Home range size averages 0.5-1 km2 (Long 2003) and the winter range increases by about 50% (Corbet and Harris 1991).

Males occupy two seasonal home ranges, which may or may not overlap; one during the rut and one when they are in bachelor groups (Feldhamer et al 1988, Chapman and Chapman 1997). In the mating season, at least in some areas, many of the older, more powerful males establish small territories centred about 100 m apart (King 2005).

In Tasmania, Statham and Statham (1996 in Locke 2007) found that fallow deer had home ranges of 870 ha for males and 590 ha for females representing larger home ranges than reported in other countries like Britain where home ranges are often under 100 ha (Chapman and Chapman 1997).

## 7. NATURAL GEOGRAPHIC RANGE

The natural distribution of the fallow deer is difficult to define because of introductions and re-introductions. Its present worldwide distribution is due almost entirely to the activity of humans, with most introductions occurring in the 19th and 20th century. In Europe fallow deer have been introduced over a longer period from the 11th to 20th centuries. During the last interglacial period the fallow deer was widespread in Europe, from England to Russia. During the following Wurm glacial period (lasting 60,000 years) its range diminished and fallow deer only existed in a few places at the end (about 10,000 years ago) of the period. Unlike other deer species, fallow deer did not re-colonise Europe after the last Ice Age and it is now thought that the present distribution is most likely largely human-made (Nowak 1999, Long 2003).

The species originally occurred in the Mediterranean region of southern Europe, Asia Minor and Palestine to Iran, and probably in northern Africa. The populations in Asia, to the east and south of Turkey, and in Africa, sometimes have been referred to as a separate species, *Dama mesopotamica*. However, this species is now extinct in Africa and Asia, except for a few survivors in western Iran (Feldhamer et al 1988, Nowak 1999, Long 2003).

Continental Asia Minor is considered as the only geographical range where the fallow deer has persisted as a native form. The Island of Rhodes is thought to possess the last remnant of the most ancient fallow deer populations (Masseti and Mertzanidou 2008).

While the fallow deer was spreading into new areas, it was disappearing from its original range because of both excessive hunting and climatic changes. The genus *Dama* apparently disappeared from Africa in the 19th century, from the mainland of Greece in the early 1900s, and from Sardinia in the 1950s. At the same time, it became very rare in the Asian parts of its range (Nowak 1999).

## 8. INTRODUCED GEOGRAPHIC RANGE

Free-living herds have been established in the United States, Canada, Europe, United Kingdom, the West Indies, South America, South Africa, Madagascar, New Zealand, Fiji, and Australia. Many fallow Deer are also maintained in captivity for exhibition or for commercial production of meat and antler velvet (Nowak 1999). The worldwide distribution of fallow deer is estimated at 7.8 million $km^2$ (calculated using climatch modelling: BRS 2011).

*Australia*

Scattered populations of fallow deer are present in Australia from south-east South Australia to Stanthorpe in Queensland, and a large population is established in Tasmania. Fallow deer were first introduced to Tasmania in 1836, and to the mainland around 1844. From these dates until about 1924 there were several more introductions in different parts of the country, including: Albury, Delaware, Burgowanah, and Jindera, New South Wales; Phillip Island (died out in the 1920s after surviving for 60 years), Narbethong-Healesville, Kinglake, Yarra Glen, the Grampians, Blackwood and Brisbane ranges, Victoria; Warwick, Stanthrope, and Maryvale Station Queensland; Pewsey Vale and Adelaide Hills, South Australia; Cape Leeuwin, Gingin, Gidgegannup, and Pinjarra, Western Australia. Fallow deer were released at Port Essington, Northern Territory, in 1912, but failed to become established. Small populations still survive in the vicinity of original points of liberation in all States except Western Australia; (Page *et al* 2008)).

## 9. DISTRIBUTION IN TASMANIA

The fallow deer is the only species of deer present in the wild or farmed in Tasmania (DPIPWE 2011b). They were introduced to Tasmania from stock imported from England in 1836 to provide a hunting resource. During the subsequent decades fallow deer were released in different districts and this resulted in what became known as 'the deer range' – the area occupied by fallow deer, which centred around three main areas of the state; (i) west of the Midlands Highway, roughly between Oatlands, Bothwell, Steppes and Cressy (referred to as the Interlaken area), (ii) east of the Midland Highway and south of Avoca (the Ross/Campbell Town area), and (iii) east of the Midlands Highway and north of Avoca (the Deddington/Blessing ton area) (DPIPWE 2011b).

The fallow deer population in Tasmania has increased steadily since its introduction with conservative estimates in the 1970s of 8,000 animals, estimates from a limited state-wide survey in 1990 indicating a population of 16,000 to 20,000. By the mid 2000's it was estimated that the population had reached 30,000, although it is likely that the herd has declined to in the order of 20,000 in the late 2000s as a consequence of prolonged and severe drought and culling. Evidence for this decline is available in anecdotal reports of reduced observation rates, reduced fallow deer density recorded during regular forester kangaroo surveys, and declines in the number of bucks harvested by recreational hunters (DPIPWE 2011b).

Since 1994, many properties have managed wild deer according to the principles of quality deer management encouraging hunters to show restraint in the harvest of young male deer combined with an increased harvest of female deer. Annual seasons are proclaimed for the taking of male deer and antlerless deer. Outside of the seasons, deer may be taken under Crop Protection Permits issued to landowners who are suffering browsing damage from deer or implementing Quality Deer Management harvest quotas (DIPWE 2011b).

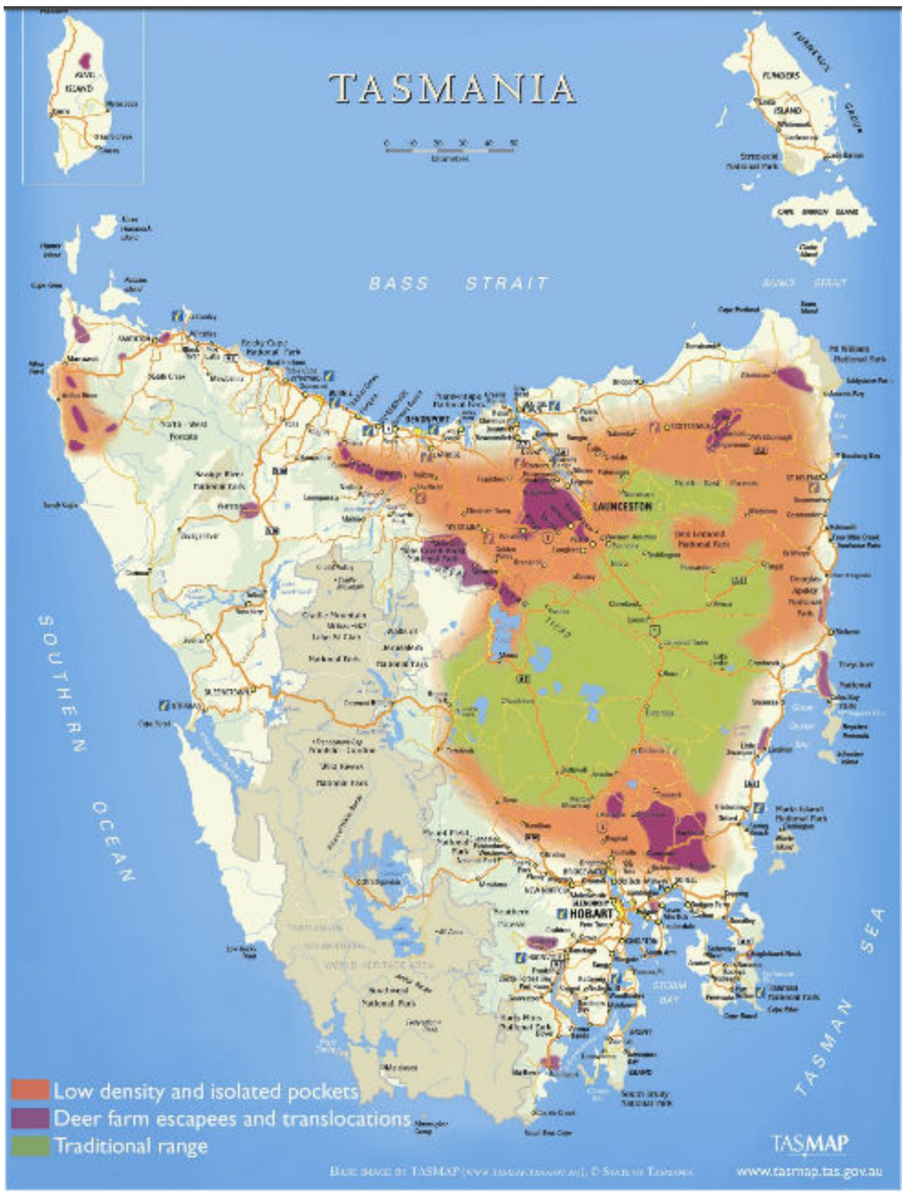


Figure 1: Distribution of fallow deer in Tasmania (Source: DPIPWE 2011)

The worldwide distribution of the fallow deer includes some areas similar in climate to Tasmania. The Climate matching software (BRS 2011) calculated 24 grid squares with a score of 7 or 8, which suggests these areas have a highly suitable climate for the fallow deer. The remaining 6 grids have scores of 4 to 6 and the climate in these areas would also be considered suitable. These scores were obtained using the Bomford risk assessment model (2008) which has been modified by DPIPWE for assessments in Tasmania (DPIPWE 2011a). A Climatch score of eight indicates that there is a moderate to high risk of this species becoming established in Tasmania, and in fact there are already established feral populations in Tasmania (Figure 1).

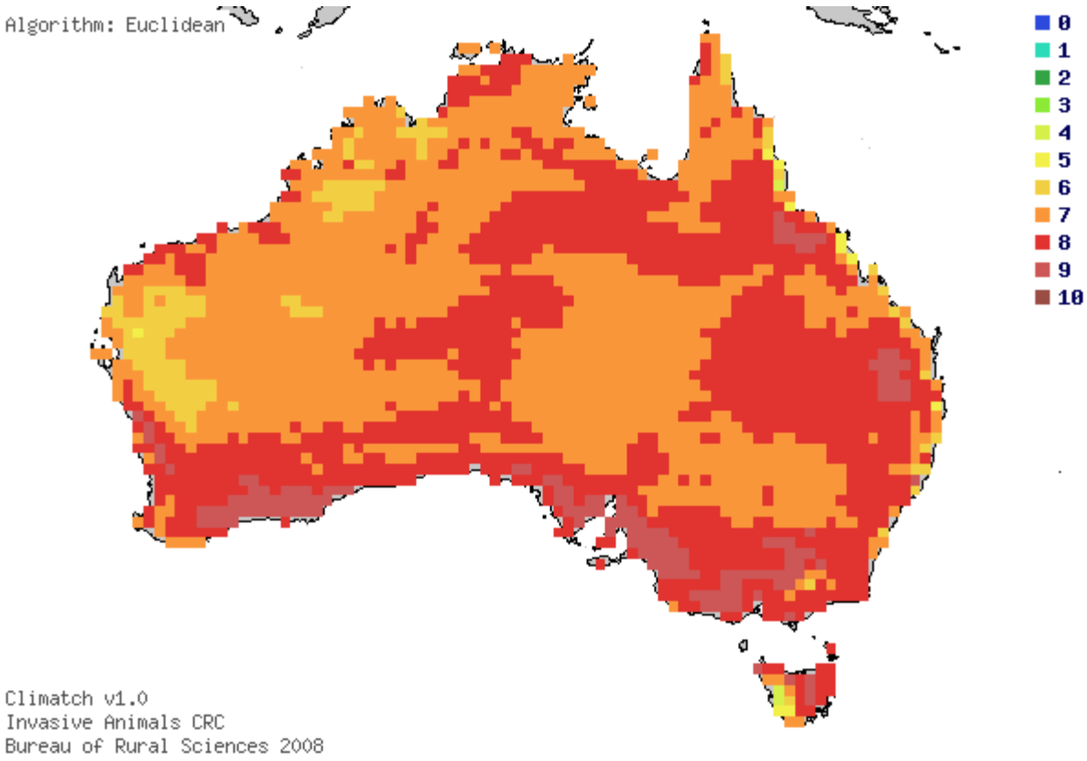


Figure 2: Climate match results showing the potential geographic distribution of the fallow deer in Australia. Areas with a higher score (orange and red) are more likely to provide suitable habitat based on climate (Source: CLIMATCH http://adl.brs.gov.au:8080/Climatch/).

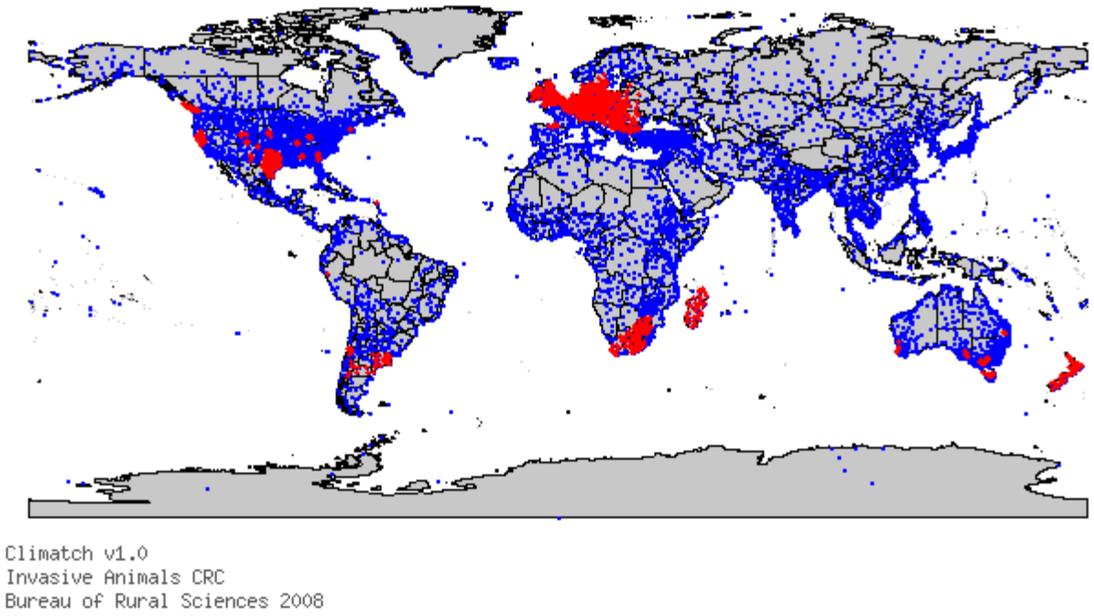


Figure 3: Map of showing the global distribution of the fallow deer as selected for CLIMATCH modelling. (Source: CLIMATCH http://adl.brs.gov.au:8080/Climatch/).

## 10. DIET AND FEEDING BEHAVIOUR

Fallow deer are ruminants with a four-chambered stomach for bacterial fermentation of food. Being predominantly grazing animals, they prefer a mosaic pattern of open areas for feeding interspersed with scrub, forest or woodland for cover (Chapman and Chapman 1997). Fallow deer predominantly graze on a wide variety of grasses, herbs, forbs, and sedges, but they also commonly browse trees and shrubs (Corbet and Harris 1991, Nowak 1999, Locke 2007) including in Australia, banksias and wattles (Feral.org.au).

Fallow deer will also browse young shoots, beech mast, chestnuts, acorns, roots, vegetables, flowers and cultivated crops, dried leaves, bark of trees and mosses, fungi and lichens (Page *et al* 2008, Long 2003).

Fallow deer display a crepuscular pattern of grazing with peaks of activity during dusk and dawn (Locke 2007). Fallow deer herds display diurnal behaviour, where they are active during the day as well as other situations where the deer display nocturnal behaviour with most activity occurring after dark. This variation in behaviour is evident between populations of fallow deer in different areas, but can also occur in a population in response to disturbance or availability of resources (Chapman and Chapman 1997).

## 11. SOCIAL BEHAVIOUR AND GROUPINGS

The social behaviour of fallow deer varies; in some areas they do not appear gregarious, but in other areas herds of as many as 30 individuals are commonly seen throughout the year. (Feral.org.au 2013). Seasonal variation in group size has been observed in fallow deer herds in Britain (Chapman and Chapman 1997). Females (does) and their current offspring (fawns) and sub-adult followers (yearlings) form groups known as doe herds while the mature males (bucks) form bachelor groups. For a considerable part of the year the doe herds live separately from the bachelor groups with the two groups coming together for the autumn rut.

While this pattern of social organisation is perhaps the general rule, fallow deer display great social plasticity and the pattern can vary from place to place and seasonally (Locke 2007).

The breeding season, or 'rut', occurs in Autumn. Males hold 'rutting stands' to defend groups of females. The males spend most of their time establishing their territory (rut stand) by pawing the ground to create scrapes where they may urinate, thrashing understory vegetation with their antlers, and by producing low-pitched groans and grunts. At the onset of the rut, since deer are polygynous, the females also appear at the rut stand. Males may stop feeding at this time. Many subordinate males unable to establish territories remain around the edges of the herd, but they are chased away by the rutting male if they enter the territory (EOL 2013).

Mating occurs during the rut. Males fight often and violently during the mating season but injuries are rare; their fights involve a ritual shoving with the antlers that follow fixed rules. When mating, the male approaches the female many times, sniffing and licking her genital areas in order to determine if she is in estrous. The female responds with a high-pitched whine and moves away. Eventually the female allows the male to mount (EOL 2013).

Fallow deer have a good sense of smell and hearing, and have very good vision. They communicate through body language, smells, and vocalizations. Fallow deer have six types of vocalizations: barking, which is an explosive alarm call used by females; bleating, which is produced by females during parturition or with their young; mewing, given by any deer during submission postures; peeping, produced by fawns in distress or contacting their mothers; wailing, an intense distress sound by a fawn older than 2 days; and groaning, produced by rutting males. The most common visual communication among *Dama dama* when disturbed is alerting, where they gain an upright stance with their head held vertically and their body rigid. They may also use different forms of touching, stiff-walking, tail positions, and head positions to communicate (EOL 2013).

## 12. NATURAL PREDATORS AND DISEASE

Fallow deer are hunted by humans, and preyed on in other countries by large predators such as wolves, cougars, lynx, bears, mountain lions, bobcats and coyotes. Fawns are occasionally taken by foxes. The vigilant behaviour and herding habits of the fallow deer helps to protect them from predation (Blue Planet Biomes 2013, Elliot *et al.* 1990).

Free-ranging deer are thought to be relatively free of major diseases (Corbet and Harris 1991 in Page *et al.* 2008), however, being ungulates, they can carry diseases that infect domestic stock (Feral.org.au 2013) and there is therefore risk of wild deer transmitting diseases or parasites to domestic stock (Jesser 2005).

The Agriculture and Resource Management Council of Australia and New Zealand (2000) provides a list of major emergency diseases which may affect wild animal populations in Australia. The following diseases from the list have been identified as potentially affecting wild deer:

- Bluetongue
- Foot and mouth disease
- Screw worm fly
- Vascular stomatitis
- Transmissible spongiform encephalopathy, particularly chronic wasting disease

There are several deer species with expanding wild populations that may be involved in the spread of ovine Johne's disease between cattle herds and sheep flocks (Hart and Bomford 2006).

Wild fallow deer sometimes impede efforts to reduce the regional incidence of Bovine Tuberculosis (Feral.org.au 2013), but they have a limited distribution and most populations are not involved in this issue (King 2005 in Page *et al*. 2008).

*Zoonoses*

There are reports of fallow deer carrying Q-Fever (*Coxiella burnetii*) antibodies. Symptoms of this disease in humans can include chills, fever, sweating, headache, and endocarditis; the overall mortality is low, probably 1% or less in untreated cases (Stevenson and Hughes 1988 in Page *et al*. 2008).

Fallow deer may act as hosts for disease carrying ticks, such as Lyme Disease - transmission of spirochaete through tick bite; symptoms include malaise, fatigue, chills, pyrexia, headache, episodic polyarthritis, cardiac and neurological abnormalities; If diagnosed in the early stages, Lyme Disease can be cured with antibiotics but without treatment, complications involving joints, the heart, and the nervous system can occur (Stevenson and Hughes 1988 in Page *et al.* 2008).

Wild deer may also be a source of Leptospirosis, a bacterial disease caused by spirochaetes of the genus Leptospira. It is among the world's most common zoonoses, but a relatively rare bacterial infection in humans. It can be transmitted to humans by water contaminated by animal urine having contact with breaks in the skin, eyes or with the mucous membranes (Page *et al.* 2008)

Infection from these zoonotic diseases is more likely in hunters and agricultural workers. However, the potential for disease transmission becomes an increasing public health issue as wild deer intrude more into outer urban areas. In closely settled areas, the disease is likely to be transferred from deer to humans through domestic animals such as dogs (Jesser 2005).

## 13. THREAT TO HUMAN SAFETY

Fallow deer are generally extremely timid and nervous. However, fallow bucks can be aggressive and can be dangerous when rutting (Jesser 2005). One of the characteristics of the rut is that mature bucks, which are usually secretive and wary, become bold and lose much of their fear of people (Chapman and Chapman 1975).

The annual number of vehicle collisions with ungulates (including fallow deer) in Europe is estimated to cause material damage amounting to US$1 billion. In Europe, the rate of collisions between vehicles and deer in general is 74,000 a year, which results in 300 people killed and 30,000 injured. The cost to motorists is massive (Groot Bruinderink and Hazebroek 1996 in Page *et al.* 2008). Deer (including fallow deer) related road traffic accidents are likely to result in between 7 and 32 deaths and 750 to 3,200 human injuries in England each year (Wilson 2003).

## 14. HISTORY AS A PEST

Feral deer can damage the natural environment by eating native vegetation and damaging trees. Damage to forestry seedlings, agricultural and horticultural crops, commercial flower crops, orchards, irrigation systems and fences has been reported. In orchards, feral deer sometimes selectively eat new growth and ringbark trees, leading to reduced orchard viability. In dry seasons, feral deer can compete with cattle for pasture and supplementary feed (QLD DAFF 2012).

Where deer density is high, diversity and abundance of plant species is lower. Weeds may flourish in areas where deer are not adequately controlled. Deer also assist the spread of weeds into new areas, and they may contribute to erosion and degrade the water quality in creek and river systems (DSEWPC 2011).

*Browsing damage*

By browsing on tree seedlings, shrubs and climbers, deer tend to reduce stem densities, limit height growth and reduce foliage density, creating a more open understorey. Light penetration to the ground can increase, providing more plant cover close to the ground. Deer tend to reduce the diversity of seedlings, and that effect is greater at higher densities of deer. The effects of deer on the amount and composition of regeneration appear to depend on site characteristics, including the light regime and composition of the ground vegetation (Gill and

Beardall 2001). High grazing by deer suppresses regeneration, by severely reducing seedling density and by delaying growth of seedlings that do survive (Gill 2000).

In New Zealand, fallow deer are able to build up large numbers and cause severe damage to the vegetation, but they do not occupy high altitude forest and alpine grassland where the erosion risk from deer activity is severe (Long 2003). Fallow deer have caused severe modification to indigenous vegetation in some areas. In a few places densities are so high in native forests that they prevent the regeneration of their most preferred tree species (King 2005 in Page *et al*. 2008).

In some National Nature Reserves in the Czech Republic, browsing damage by deer, including fallow deer, is the primary cause of the reduction of natural regeneration. Structure, abundance and growth of surviving regeneration are fundamentally limited by food preferences of game and by the tolerance of the particular species to repeated damage (Cermak and Mrkva 2006).

Major impacts of deer on the ground flora of lowland woods in Britain have become common, often with a shift to grass-dominated vegetation. Recent studies have shown that the ground flora is being heavily affected by increased levels of grazing within British broadleaved woodland, particularly as a consequence of rising deer populations (Page et al 2008).

In one study in South America, there was a dramatic difference between understoreys with and without deer, as in the Nothofagus-Austrocedrus forests in Northern Patagonia with the scarcity of the subcanopy tree *Aristotelia chilensis* in the deer-affected area. Deer have drastically reduced the abundance of both *Austrocedrus* and *Aristotelia*, and seedlings and saplings were rare (Veblen *et al.* 1989 in Page et al 2008).

*Trampling damage*

Some common woodland plants are damaged by trampling, so that their abundance is reduced along deer paths or in areas where deer congregate. Hoof-scraping may destroy bulbs, or bring them closer to the soil surface where they are more vulnerable to attack by animals such as slugs (Kirby 2001).

*Thrashing damage*

Male fallow deer may also inflict considerable damage on individual trees by thrashing them with their antlers, both in aggressive display during the rut and in cleaning velvet from newly grown antlers in late summer (Corbet and Harris 1991).

*Habitat destruction*

The available research supports a common generalisation that increasing numbers of deer may strongly modify the abundances of particular species and overall composition in a wide range of plant communities (NSW DEH 2011).

Deer grazing and browsing may impact fauna indirectly. The majority of herbivorous insects feed almost entirely on one or a very limited number of plant species. As a result, their diversity is likely to be directly related to the richness of the plant community (Gill 2000, Stewart 2001). Deer also directly compete with herbivorous invertebrates for plant food (Stewart 2001).

The effects of deer in woodlands are known to result in habitat changes which can be detrimental to songbirds. The principal mechanism by which deer may affect habitat quality is through the reduction of low woody vegetation, which forms a key element of the preferred habitat of several species – this may be associated with loss of nest sites, increased exposure to predators and reduction of food (Gill, Robert and Fuller 2007). Deer browsing has resulted in reduction of canopy cover, reduction in density and cover of understorey vegetation, and an increase in grass cover. Abundance of bird species using the understorey, including all migrants, was significantly higher in coppice where deer were excluded (Gill *et al* 2007).

Where fallow deer have been introduced on Little St Simon's Island, Georgia, in the United States, the native white-tailed deer (*Odocoileus virginianus*) has disappeared (Long 2003). In Argentina, fallow deer populations cause habitat modification, affect tree composition,

structure and regeneration, and compete with and displace native deer species (Novillo and Ojeda 2008 in Page *et al.* 2008).

*Competition*

In Australia deer compete with kangaroos and wallabies for food and generally add to grazing pressure (DSEWPAC 2011). Macropods occupy the same ecological niche that would be occupied in part by deer on other continents. It may be reasonable to suggest that in Australia where deer populations are present in natural environments they may represent some degree of competition with macropods. However, the nature and degree of the competition is largely unknown (Locke 2007).

A study of the dietary overlap between fallow deer and Forester kangaroos (*Macropus giganteus*) in Tasmania found that there was a significant overlap in mid-winter, when food is most scarce, and that the deer had much wider feeding range than Forester kangaroos (Duncan 1987 in Page *et al.* 2008). The study found that both species ate grasses and that fallow deer ate more shrub species than the kangaroos. Further research is required before accurate conclusions could be drawn and at this stage any effect fallow deer have on native herbivores remains speculative (Locke 2007).

The view that deer cause harm to Australian ecological communities is evidenced by the fact that degradation, herbivory and habitat loss caused by deer species has been nominated for listing as threatening processes under the threatened species legislation of both Victoria and New South Wales. While the New South Wales nomination was successful, in the case of Victoria, the nomination was rejected by the Scientific Advisory Committee on the basis that it lacked credible scientific evidence supporting the claims of deer impacts (Locke 2007). This disparity in the status of deer between States reflects the current range of views and the lack of scientific knowledge on the ecological impacts of deer in Australia. The Bureau of Rural Sciences (Hart and Bomford 2006) did not even list deer as a pest in any category ('serious pest', 'moderate pest' or 'minor or non-pest') in a review of pest animal management in Australia.

*Agricultural damage*

It is probably only in areas of high density that fallow deer can become pests of forestry and agriculture. In woodland they damage young plantings or prevent regeneration of coppice. In agricultural areas they feed in farmland and may constitute a problem by competing with stock for feed (Long 2003). Deer cause damage to farm woodlands by bark-stripping, primarily restricted to the winter period when food is short (Putman and Moore 1998). In New Zealand, fallow deer cause some damage to watershed protection forests and pasture lands (Long 2003).

In Europe, fallow deer occasionally eat turnips, beet and other crops, and may cause considerable damage. In England the most common damage by fallow deer is grazing of early spring grass and corn crops (Long 2003). Fallow deer can cause damage to fruit orchards, mainly be browsing vegetative growth rather than causing damage to tree bark/stems or fruits (Page *et al* 2008).

In south-east Queensland damage to forestry seedlings, agricultural crops, commercial flower crops and orchards has been observed. Fallow deer are direct grazing competitors with cattle. Competition with livestock, combined with the need for expensive deer exclusion fencing means that it can be costly for a primary producer to manage deer (Jesser 2005).

Primary producers in Tasmania have expressed concern in the past that large numbers of fallow deer cause damage to crops, trees, pastures and fences, and regularly request and obtain permission to cull large numbers of deer to control crop damage (Locke 2007).

## 15. POTENTIAL IMPACT IN TASMANIA

This species is already established in Tasmania. Fallow deer hunting has been conducted since their introduction and hunting arrangements have evolved in that time. Since the early 1970s there have been several significant changes to the way in which fallow deer are managed and the hunting seasons applied. Hunting arrangements and fallow deer

management more broadly have remained largely unchanged since 1995 and deer are currently managed as a hunting resource while minimising their negative impacts on crops by allowing deer to be taken under Crop Protection Permits.

Application of Bomford's import risk analysis (2008) modified by DPIPWE (2011) for application in Tasmania assessed the fallow deer as an extreme risk of becoming a pest once established in Tasmania. Fallow deer are from the Order Artiodactyla, an Order demonstrated to have detrimental effects on the environment causing habitat degradation, and the family Cervidae, a family particularly prone to causing agricultural damage. The fallow deer is reported to cause severe damage to native vegetation and to crops in other countries.

Fallow deer may cause damage to the habit of Tasmanian native fauna. Ground dwelling or nesting birds may be threatened by trampling of eggs and/or nests by fallow deer, and ground dwelling marsupials may be threatened by competition for food or trampling of habitat by deer.

Susceptible Tasmanian native species may include:

Birds: Brown quail, painted button quail, ground parrot, spotted quail-thrush and Richard's pipit.

Mammals: Long-nosed potoroo, bettong, pademelon, red-necked wallaby, eastern-grey kangaroo, common wombat, spotted-tailed quoll, eastern quoll, Tasmanian devil, dusky antechinus, white-footed dunnart, southern brown bandicoot, eastern-barred bandicoot.

There are also listed threatened plants, threatened invertebrates and threatened vegetation communities that may be threatened by trampling and grazing by fallow deer.

The fallow deer has a high climate match with Tasmania and 24 grid cells, covering the north and east of the State, have a climate match score of 7 or 8 overlapping with the range of susceptible species. The remaining 6 grids have scores of 4 to 6 indicating a moderate climate match in the south west of the State, also overlapping with the range of susceptible species.

Commodities that may be susceptible to this species are sheep, cattle, timber, cereal, oilseeds, grain legumes, fruit, vegetables, other livestock and other crops such as nuts and flowers. There have been reports of damage at serious levels to these or similar commodities occurring in other countries. A climate match with Tasmania for this species shows that more than 20% of the range of susceptible commodities overlap with grid squares with a climate match score of 8.

## 16. PREVIOUS RISK ASSESSMENTS

The Vertebrate Pests Committee (2007) assessed *Dama dama* as being in the Extreme Threat Category. Species placed in the Extreme Threat Category "...should not be allowed to enter, nor be kept in any State or Territory. (Special consideration may be given to scientific institutions on a case by case basis.)". In an earlier assessment by the Vertebrate Pests Committee the fallow deer was placed in category 3b - kept under permit for private, commercial or exhibition (VPC 2007).

Page *et al.* (2008) carried out a risk assessment for Australia of the fallow deer applying Bomford (2008) using PC CLIMATE (Brown *et al.* 2006, Bureau of Rural Sciences 2006). The fallow deer was assessed as being in the extreme vertebrate pests committee threat category.

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