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Implications of future management options

A report on behalf of Defra European Wildlife  
Division

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## **Introduction**

Feral wild boar have recently established several small populations in England and escapes of individuals continue to occur. Without active management the population may grow and new foci are likely to become established. Defra has been carrying out research and monitoring of the feral populations for several years and much valuable data have been gathered on the biology of wild boar in England, their impact and potential management techniques. Wild boar potentially impact on a wide range of interests and, as the population has persisted, it is now timely to review the Government's role in wild boar management in England.

This document outlines several potential management options for feral wild boar in England and the possible implications of each. The options range from doing nothing, i.e. no direct Government intervention, to a full-scale Government-led eradication campaign. There are also several intermediate options. The probable costs and benefits of each option are detailed and we have attempted to put an approximate monetary value on each.

### **Option a) No management on all current and future populations**

This would involve a continuation of the status quo with no active management of feral boar by Government departments or agencies. It is assumed, however, that limited culling would continue to be undertaken by individual land-owners or their agents.

The implications of a 'do nothing' policy by Government on the existing wild boar populations are unclear. Wild boar have a high reproductive potential and, in the absence of control, can rapidly increase in numbers. The widespread increase in boar populations across Europe in recent decades (e.g. Boisaubert & Sand, 1994; Csányi, 1995; Geisser, 1998; Hahn & Einfeld, 1998; Sáez-Royuela & Telleria, 1986; Schley, 2000) has occurred despite large numbers being killed by hunters. Relatively small founder populations can give rise to viable populations (Leaper *et al.*, 1999) and any adverse effects resulting from inbreeding could probably be overcome by the immigration of occasional escapes from captivity (Hone, 1995). To date, however, there has not been a great increase in numbers in any of the existing English populations though the number of breeding populations has grown.

Several modelling exercises have been conducted to try and predict the likely future trends in English feral boar populations. The original Central Science Laboratory risk assessment for wild boar in 1998 modelled the potential development of the Kent/Sussex boar population over a 15-year period (1997 to 2012; Goulding *et al.* 1998 & 2003). This gave a wide range of potential population sizes after the 15 years (see Annex 1) assuming a starting population of 100 animals. The range of annual growth rates estimated a potential population after 15 years of between 130 and 3,500 individuals.

In practice, it appears that the Kent/Sussex population (the largest in England) has remained nearer the lowest growth estimate with relatively little growth and spread, probably due to the high rate of culling it experiences. More recent modelling work on this population has shown that it may even be liable to extinction (Moore, 2004) although this modelling exercise assumed that high levels of culling were occurring throughout the boars' range (see Annex 1 for more detail).

The slow pattern of population growth (if any) in Sussex is also mirrored in the Dorset and Ross-on-Wye populations (Wilson, 2003). In all cases, culling, by land-owners and others, seems to be keeping the populations from increasing rapidly. It is of course possible that boar are following the classic population growth of invasive species which shows an initial slow growth phase followed by a period of rapid increase. This would mean that at some time in the future the boar population might reach a threshold after which it would rapidly expand. In summary, however, it is still difficult to predict if and when the existing feral populations will begin to grow significantly or indeed if they will become extinct due to the current heavy culling rate.

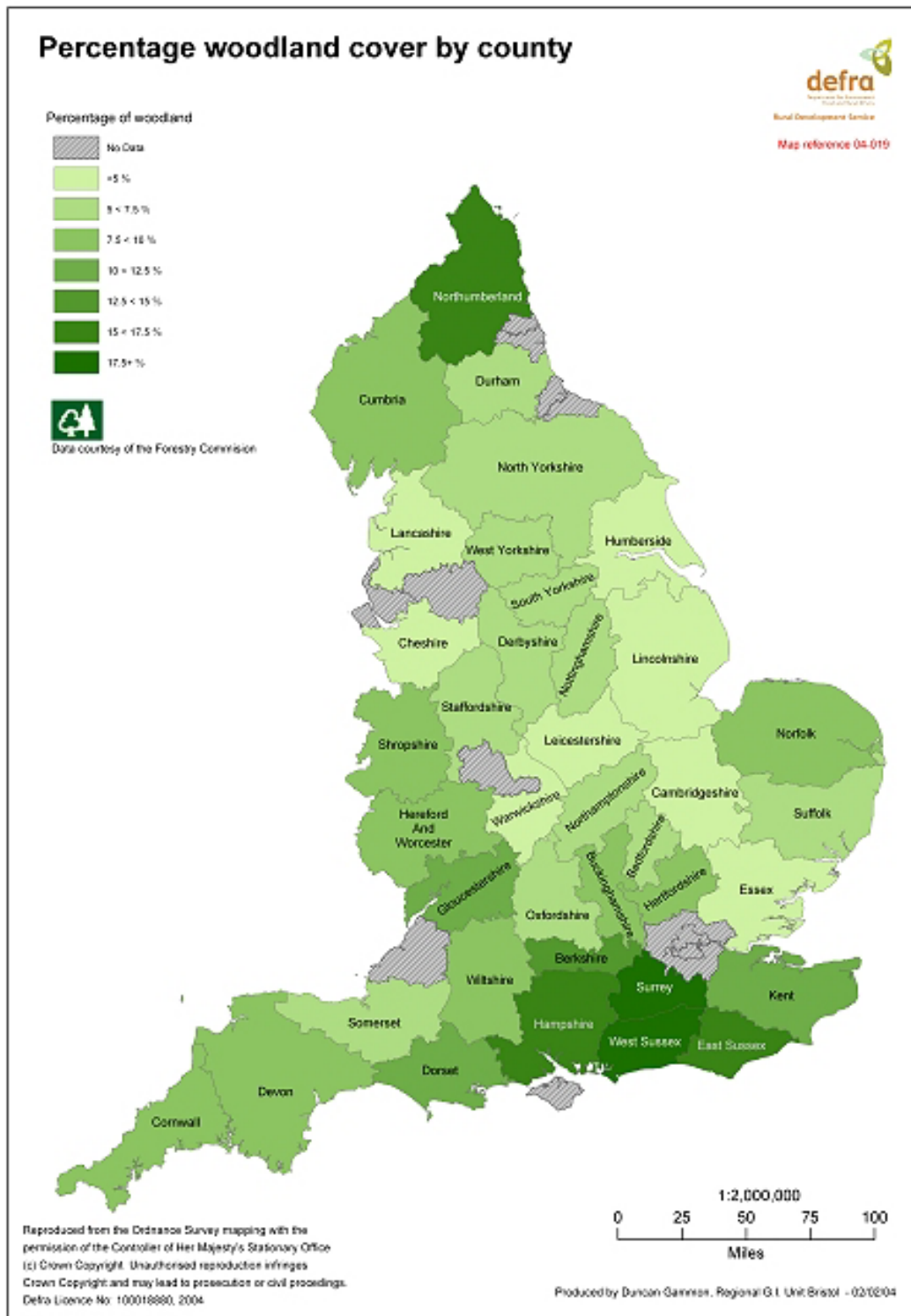
In addition to culling, the other key factor in determining the future spread and increase in wild boar populations in England is the availability of suitable habitat, in particular woodland. Wild boar are highly dependent on woodland or other cover throughout their range and most European countries with substantial and increasing boar populations have over 25% woodland cover (Table 1). Woodland cover in England (at 8.5%) is amongst the lowest in Europe but varies substantially between counties (Figure 1). This may provide a preliminary means of ranking different counties as low (e.g. <7.5% woodland cover), medium (7.5-12.5%), or high risk (>12.5%) of establishment of a persistent feral population.

The distribution of woodland in England shows that all but one of the high risk counties occurs in the south (Figure 1). These counties (Hampshire, Berkshire, Surrey, West Sussex and East Sussex) also contain a substantial proportion of the country's ancient semi-natural woodland (Forestry Commission data). From Essex through the Midlands, eastern England and into the north, the low level of woodland cover suggests that the risk of long-term establishment is probably low. However, individual extensive woodland areas, such as the Forest of Dean, may be high risk. It must also be noted that woodland cover is currently increasing in lowland England aided by schemes such as the Farm Woodland Premium Scheme and initiatives like the National Forest.

**Table 1:** Wild boar population size and forest cover in Europe.

<b>Country</b>	<b>Estimated Population*</b>	<b>Distribution of boar*</b>	<b>Forest as % of land area**</b>
Austria	Not available	Widespread	47.0
Denmark	None in wild	Local/managed	10.7
Estonia	10,000	Overall	48.7
Finland	300	Regional	72.0
France	450,000	Regional	27.9
Germany	600,000	Overall	30.7
Greece	500	Regional	27.9
Italy	Not available	Regional	34.0
Latvia	17,300	Overall	47.1
Lithuania	19,400	Overall	31.9
Luxembourg	15,000	Overall	22.2
Netherlands	3,000	Regional	11.1
Portugal	60,000	Widespread	40.1
Spain	Not available	Overall	28.8
Sweden	10,000	Regional	65.9
Switzerland	8,000	Regional	30.3

*\*Data from European Commission (1999) and Spitz (1999). \*\*Data from Forestry Commission (2003).*



**Figure 1:** Percentage woodland cover per rural county of England (FC).

If all woodlands in the 'high risk' counties of the south of England were colonised (over 1800km<sup>2</sup>), and a population density of 3.5 - 5 boar per km<sup>2</sup> is assumed, the area could hold between 6,300 and 9,000 boar. This size of population could be reached within 20 years if no culling was carried out,

given a founder population of 100 animals. This would represent a substantial source for further colonisation of remaining suitable habitats throughout the south of England.

In summary, though wild boar have the potential for rapid population expansion, this has not occurred to date in England due to heavy culling by land-owners and others. Woodland cover is also far lower than in most of the rest of Europe and this is likely to restrict spread. Existing boar populations will probably slowly increase in size and continue to slowly spread (mainly in wooded areas). Parts of East and West Sussex, Surrey and Kent, the Forest of Dean and New Forest are most at risk of colonisation in the near future. Other populations may become established following escapes or releases, particularly in areas with good woodland cover. In the long-term, boar are likely to become established over large areas of England, but will mainly be restricted to areas where woodland cover is high and where shooting pressure is low.

#### *Benefits:*

##### Monetary

No Government involvement would have no immediate monetary impact for Government as no active management would be involved.

##### Shooting

As a large and formidable quarry species, boar are an important source of sport shooting (and therefore revenue) in much of Europe. This is also occurring in the fledgling English populations and is likely to increase if the boar population rises.

##### Food source

Boar are an important source of game meat in continental Europe and there is also a flourishing business in the supply of boar meat from the feral English populations. This would probably increase in importance if the English population was allowed to increase in numbers and spread. This would provide revenue to hunters and potentially offset some of the damage likely to occur on farmland.

##### Environment

The re-establishment of wild boar would represent the addition of a former native species of large mammal to the English fauna with possible restoration of a more 'natural' disturbance regime to English woodlands.

#### *Costs:*

##### Disease risk

The risk of disease transmission to domestic pigs (if there was an outbreak of Classical Swine Fever (CSF) or Foot and Mouth Disease (FMD)) and of feral boar becoming a wildlife reservoir of disease would increase. The potential costs of an outbreak facilitated or prolonged by the presence of feral wild boar could be very high e.g. the relatively limited outbreak of CSF in East Anglia in 2000 cost UK Taxpayers £17.4million (excluding administrative costs) while

the cost of the 2001 FMD outbreak was several billion pounds. Wild boar are also a potential vector species for bovine tuberculosis (bTB).

#### Crop damage

Direct damage to agriculture would become more widespread and frequent. Crops at particular risk include grassland, various cereals such as maize and wheat as well as root crops such as potatoes. Areas close to woodland would be at particular risk and eventually costs are likely to be several millions of pounds per annum.

#### Leisure sector

Negative impact on sports and leisure facilities would also increase. Particularly vulnerable to impact are golf courses, playing fields and camping and caravan parks.

#### Transport

The number of road traffic accidents (RTAs) is likely to rise with the potential for some human fatalities as boar are large, heavy animals. Particular problems are likely in areas with woodland in close proximity to busy roads.

#### General public

The (albeit small) risk to human safety would increase with an increasing boar population.

#### Environment

Impact on conservation interests would increase and become more widespread. Wild boar could have a significant negative impact on populations of some ground-nesting birds, hibernating species such as hazel dormice and species-rich grasslands.

### **Option b) Eradication**

This option would aim to remove all existing populations and individual boar from England in as short a timescale as possible. Several large-scale eradications have been carried out in the UK in the past 100 years. The most notable is the MAFF Coypu eradication which removed over 10,000 individuals from 12,000km<sup>2</sup> of East Anglia at a cost of approximately £4 million in today's terms. This campaign, conducted in the 1980s, used 24 full-time trappers and lasted eight years with all animals caught in live-catch cage traps. A Ministry of Agriculture muskrat eradication in the 1930s took seven years to achieve success. It employed up to 39 trappers using underwater leg-hold traps and covered about 6,000km<sup>2</sup> of central Scotland and Shropshire. The largest current eradication campaign is attempting to eradicate mink from 900km<sup>2</sup> in the Western Isles in Scotland. This uses live trapping and will have cost over £1.7m and taken almost five years by the time it is completed in 2006.

In comparison with the above eradications, wild boar populations are still relatively small (several hundred) and relatively localised. If eradication is to be pursued then it is imperative that it is carried out swiftly in order to improve its chances of success as well as to keep the numbers that need to be culled as low as possible. It is likely that a range of measures would be employed including trapping and shooting at bait stations. Other techniques which are in development (such as immuno-contraception) may also be used to limit population growth and reduce the number of animals that need to be culled. A necessary addition to any eradication campaign would be a reduction in the likelihood of further boar escapes from farms and the putting in place of contingency measures to deal with any such escapes.

It is likely that any eradication campaign would need to be carried out by Government as putting the onus on landowners to co-ordinate action over wide areas would be impractical. However, the current high rate of culling would make any eradication attempt far easier and less costly than would otherwise be the case. One potential problem is that of access to private land. Some land-owners may be unwilling to allow trapping or shooting of boar on their land and compulsory access is not feasible in the absence of a disease outbreak. However, it is thought likely that access problems could be sufficiently overcome to ensure the success of any campaign. A modelling exercise, based on demographic information for two of the English populations and removal rates based on previous trapping success, suggests that eradication is highly feasible. It would also be relatively short-lived (2-3 years) employing up to four staff full-time.

#### ***Benefits:***

##### **Agriculture**

Agricultural interests and Government would benefit in the long term as the risks of disease transmission of CSF and FMD to domestic pigs from a wildlife reservoir would be greatly reduced. Both diseases have the potential to cost

the economy tens of millions of pounds. The potential for another wildlife vector species for bTB would also be removed.

Direct damage to agriculture would be eliminated though this is relatively minor compared to the potential losses associated with a disease outbreak. Potential difficulties with UK trading partners caused by having an extant wild boar population would also be removed.

#### Government

The removal of a potential costly species before it becomes too widespread to eliminate would be the main benefit of eradication.

#### Transport

The potential of increasing boar-related RTAs and the cost in money and human injury and death these are likely to incur would be eliminated.

#### General Public

The (albeit small) risk to humans of attack would be removed.

#### Costs:

##### Monetary

The monetary cost of an eradication campaign is likely to be relatively low. Costs estimated from the modelling exercise indicate a total cost of approximately £400K.

A continuing contingency capability would need to be in place to react rapidly to new escapes. This has been costed at approximately £30K per annum but would be covered by the eradication costs for the first two years. Monitoring of wild boar farms would also be needed, though this could use existing Defra staff.

#### Environment

The principal non-monetary cost would be that this is the deliberate removal of a former native species which is viewed by some as a valuable addition to English biodiversity.

#### Conservation

The impact of boar on conservation woodlands is also likely to be beneficial and their removal would be a return to the *status quo* of the last 600 years.

#### Animal welfare

There are also humaneness considerations but the likely number of boar that would need to be culled is probably relatively low (approx. 1,000 individuals). This is compared with the weekly slaughter of approximately 20,000 domestic pigs in England for human consumption and also the probable cull of several thousand individuals annually if a widespread wild boar population became established.

**Option c) Eradication of feral pigs/hybrids coupled with managing wild boar**

This would involve two contrasting management policies based on the phenotypic appearance of the animals living ferally. All obvious feral pigs or hybrids would be removed while animals which look like wild boar would not be deliberately eradicated. The main problem with this strategy is the reliance on phenotypic characteristics which may not accurately reflect the genetic status of the boar involved. Distinguishing feral boar from hybrid animals is not always straightforward.

***Benefits:***

The main benefit of this strategy is that obvious hybrid and feral domestic animals will be removed and any remaining animals will have the appearance of true wild boar. Thus, if boar do become re-established, it is with animals that (phenotypically, at least) resemble true wild boar rather than just being feral pigs.

Other benefits will be similar to those outlined under Option (a), above.

***Costs:***

In essence, it is likely that this strategy will have little monetary cost as few feral populations of pigs or obvious hybrids have been found in the recent past.

The main problem is that there will remain an increasing number of feral animals which have the appearance of wild boar which will continue to pose a threat to agriculture and possibly some conservation interests (see costs under Option (a), above).

#### Option d) Manage existing wild boar populations on a regional basis

This would involve effective eradication of existing and future populations of all feral pigs and wild boar over areas of the country with high densities of domestic pigs. This would amount to a regional eradication policy for much of eastern England. There would need to be effective monitoring of existing wild boar farms for escapes in these areas and a contingency capability to eliminate any escapees in these areas before they become established. There may also be a need to restrict wild boar farms in these areas or to ensure more secure containment standards than elsewhere. Wild boar and feral pigs in other areas of the country would be allowed to remain but would almost certainly need control to limit their negative impacts. The control carried out by land-owners and others may be sufficient to limit any negative impact of boar in the existing populations.

##### *Benefits:*

###### Disease risk

The main benefit of this option is that it would greatly reduce or eliminate the threat of disease transmission to the largest concentrations of domestic pigs while allowing boar to remain in areas of lower risk (those areas with less dense concentrations of domestic pigs).

###### Animal welfare

There would be a very much reduced number of animals (probably less than 100) which would need to be culled compared with a full eradication. However, if a widespread population did become established in south and west England large numbers of these boar would probably need culling annually.

##### *Costs:*

###### Monetary

The monetary cost is likely to be low (estimated at £40K) as most existing populations are in southern and western England and little culling would be needed initially in eastern England. There would be a need to have a continuing contingency capability to eliminate escapees in the control zones though this is likely to have little monetary cost (£30K per annum).

###### Disease risk

It would not remove the risk of disease transmission to domestic pigs in regions where feral boar are not controlled. It would also not impact on the potential risk of transmission of bTB to cattle.

Other costs potentially as for option (a) in those areas where populations are allowed to persist.

**Option e) No active management on the existing established populations but prevent new populations becoming established.**

This would involve no co-ordinated culling on the three existing breeding populations which may spread and increase in number of individuals (see predictions under option (a)). Any new escapes would be culled and all existing outlying populations would also be eliminated.

***Benefits:***

**Monetary**

This is low-cost in terms of immediate monetary expenditure. The estimated cost of removing existing small populations is approximately £75K.

**Animal welfare**

There would be a very much reduced number of animals (probably less than 100) which would need to be culled compared with full a eradication.

***Costs:***

**Monetary**

The monetary cost of this option would be small in the immediate term as only small, mainly non-breeding populations would need to be controlled. There would be a continuing need for a contingency capability to eliminate escapees and monitoring of existing and new farms would also be necessary.

Other costs potentially as for option (a) in those areas where populations are allowed to persist.

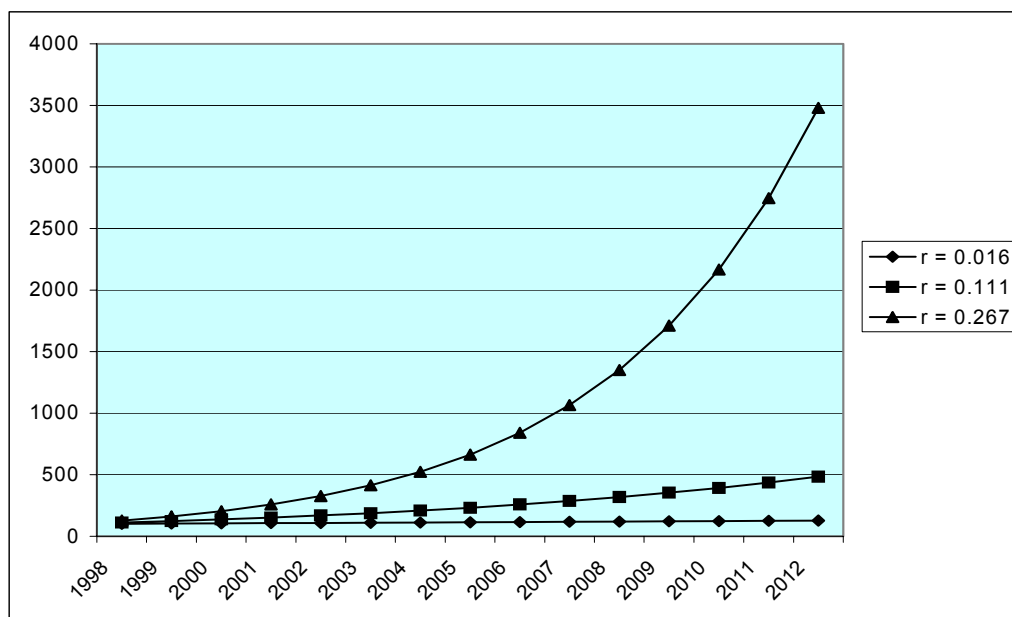
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## Annex 1. Modelling the potential future growth in wild boar populations.

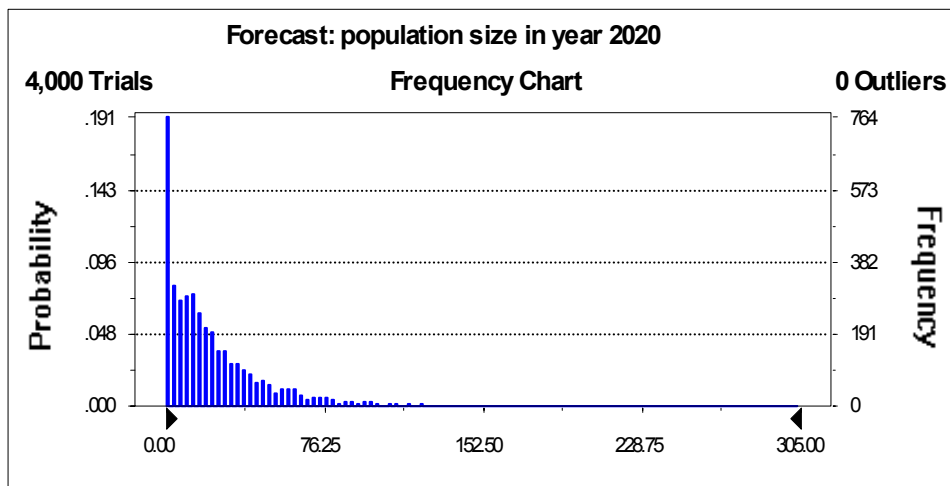
The original Central Science Laboratory risk assessment for wild boar in 1998 modelled the potential development of the Kent/Sussex boar population over a 15 year period (1997 to 2012; Goulding *et al.* 1998 & 2003). This gave a wide range of potential population sizes after the 15 years from a starting population of 100 animals. The large range was due to the wide range of potential growth rates which might occur. After 15 years the potential population sizes from the Sussex population were between 130 and 3,500 (Figure A). The lower of these assume a high rate of mortality while the higher figure assumes that mortality levels are low. It is possible that the intrinsic growth rate of the current feral populations is even higher than the highest estimate below, as 60% of sows recorded in East Sussex reached breeding condition in their first year.



**Figure A:** Projected wild boar population growth over 15 years in South East England, based on a starting population of 100 animals and minimum, average, and maximum likely growth rates ( $r$ ) (Goulding *et al.*, 1998 & 2003). However, the actual growth in the populations has been closest to the lowest potential growth rate probably because of heavy culling, and a second modelling exercise conducted in 2004 at the end of the CSL research project (VC0325) suggested that the population is of doubtful viability.

This more recent CSL model, using values of estimated fecundity and mortality rates derived from the Sussex population, showed that the population had a 19% chance of population extinction by the year 2020 (Figure B). Running the model results in a finite annual population growth rate

( $\lambda$ ) of 0.87 (s.d. 0.07) but it assumes that all of the population is subjected to the same level of hunting throughout its range. This is unlikely to be true as several areas within the current range are known to have no culling and these probably act as 'source' populations for surrounding 'sink' areas. However, a number of mean parameter values can give a stable population ( $\lambda = 1.00$ ) and these are generally within the error of measurement e.g. increasing the survival rate of juveniles from 0.3 to 0.34. Overall the sensitivity of the annual growth rate is greatest for adult survival (49%), second-year survival (24%) and juvenile survival (15%), rather than productivity. This shows that even small changes to the mean annual mortality (e.g. due to changes in hunting pressure) could result in an annual growth of between 0.70 and 1.01. If part of the population continues with a reduced hunting pressure then this sub-population will continue to act as a source for the remainder of the population which will usually be declining.



**Figure B.** The results of 4,000 simulations of the population model run over 16 years. Population size (number of individuals) at 2020 is on the X axis. The Y axis shows both frequency (the actual number of the 4,000 simulations which resulted in a given population size by 2020) and the probability (the frequency/4,000) of achieving each final population size. Almost 20% of the simulations result in extinction by 2020.

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