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Costs and benefits of rabies control in wildlife in France

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Summary

The author presents an evaluation of the cost of wildlife rabies in France. This study included the vaccination of domestic animals, the reinforcement of epidemiological surveillance networks and the support provided to diagnostic laboratories, the expenses associated with outbreaks of rabies (animal losses and associated economic losses), the clinical observation of those animals which had bitten humans and the preventive vaccination and post-exposure treatment of humans. A substantial percentage (72%) of this cost was the preventive vaccination of domestic animals. In France, as in other European countries in which the red fox (*Vulpes vulpes*) is the species most affected, two main strategies for controlling the disease at the reservoir level were evaluated, namely: fox depopulation and the oral vaccination of foxes. The combined costs and benefits of rabies and of both strategies were compared and included either the cost of fox culling or the cost of oral vaccination (baits, bait delivery and follow-up to ensure the efficiency of the vaccination).

The cumulative annual costs of both strategies remained comparable until the fourth year, after which the oral vaccination strategy became beneficial. This forecast was made in 1988, readjusted in 1993 and confirmed by *ex post* analysis five years later. The expected benefits of oral vaccination have now been obtained. Fox depopulation has only ever resulted in a transient lull in the occurrence of the disease, while oral vaccination has proved to be capable of eliminating rabies even in situations in which fox populations were increasing.

Keywords

Control – Cost-benefit analysis – Economics – France – Rabies – Red foxes – Vaccination.

Introduction

Since 1968, in France, as in other countries infected by terrestrial wildlife rabies, the red fox (*Vulpes vulpes*) has been the species most affected, accounting for 80% of all laboratory diagnoses, however, this species directly gave rise to only 2% of human treatments. Vaccination of domestic species played the major role in protecting man from infection, although clearly, this preventive action was never intended to affect the natural reservoir of the disease. Irrespective of endemic rabies in foxes, pre-exposure vaccination of domestic animals would have to be repeated indefinitely. Only direct action on the reservoir species carried the potential of breaking the transmission chain of rabies in wildlife, reducing the threat to human health and the expenses associated with protection. The question was which strategy to choose: the application of fox depopulation, or oral vaccination of foxes. In France, fox culling was the only control measure in use. With the high costs of oral vaccination of wildlife, national authorities needed to compare the costs and benefits of both strategies before taking any decision to change the control policy. This paper describes the approach taken and evaluates the robustness of the evaluations that were proposed in 1988 and 1993.

Methods

The information, data and references presented are principally based on a study that was initiated in France in 1988 (13), then established in 1993 (1). This *ex ante* analysis is then compared with the actual situation that prevailed in the country over the following years. All costs were originally

in French Francs (FF) with a constant value over time, then converted into US$ at the constant rate of US$1 = FF5.2.

The benefits that were expected from the disappearance of wildlife rabies were the elimination of expenses associated with rabies prevention, in addition to the expenses associated with direct losses due to rabies. These parameters are summarised in Table I.

Evaluation of the cost of wildlife rabies

Expenses associated with rabies prevention

Vaccination of domestic animals

Cattle under the direct threat of exposure to rabid foxes have been efficiently protected by vaccination. This vaccination was funded by the breeders and in some cases also financially supported by local authorities. Approximately 40% of the cattle over one year old were vaccinated each year in the contaminated area. The rabies vaccination was combined with vaccination against foot and mouth disease, which was compulsory. This explains the relatively low cost of rabies vaccination for cattle: the mean cost was US$1.35 per animal (i.e. a total of US$2,910,470 for the 2,162,065 cattle vaccinated in 1987). In five *départements* (departments are administrative units with a mean area of 6,000 km^2) the cattle were not vaccinated; instead the breeders subscribed to an insurance policy (a total of US$57,700 was paid by these breeders) which was less expensive than vaccination, and refunded the price of animals that died of rabies. Thus, in 1987, the total cost of the prevention of rabies in cattle was estimated to be US$2,970,000.

In other domestic species (cats, dogs, horses) the number of animals vaccinated each year was not officially recorded. The figure had to be deduced from the number of doses sold by private companies (estimated at 4 million doses). The cost of the vaccine purchased by the owners was included in this evaluation (4,000,000 × US$3.85). However, as the rabies vaccine was administered in conjunction with foot and mouth disease vaccine which was compulsory, the cost of the veterinary consultations has not been included in the calculation.

Culling of foxes

The fox culling operations were conducted by hunters and gamekeepers. A high proportion of the cost of these operations (hours worked, transport, weapons, etc.) was covered by these individuals themselves and was therefore not taken into account. The estimated cost included the following:

- the bounties given by national and local authorities for the proof of the destruction of a fox (the bounty rate ranged from US$10 to US$19 according to the *département* (total: US$873,000)

- the gas employed for killing the foxes in their dens (chloropicrine) (total: US$297,000).

Reinforcement of local veterinary administrations

To help tackle rabies (by provision of appropriate manpower and equipment) the local veterinary administrations received US$86,150 from the central government. It is assumed here that this amount was equally distributed between three activities: collection and transport of samples for rabies diagnosis, fox culling and information dissemination. Added to the expenses incurred for the collecting of suspected animals (diagnosis), is the postal charge for the transport of samples to the laboratories in charge of the rabies diagnosis (US$50,200).

Table I
Costs and benefits of rabies vaccination of foxes

Costs	Benefits
Expenses associated with vaccination campaigns	**Abolition of expenses associated with:**
Organisation of collaboration	*a)* **Rabies prevention**
Publicity	Vaccination of domestic animals
Applied research	Culling of the wild reservoir species
Baits	Human post-exposure treatment
Bait distribution	Information on rabies
Assessment of bait quality	Surveillance of animal rabies
Survey of bait uptake, rabies incidence and human risk associated with vaccination campaigns	*b)* **Rabies outbreaks**
	Domestic animal losses
Expenses required after rabies eradication	Economic value of human death
Research and epidemiological surveillance	Reduced tourism
Import controls	

Grants given to the *Entente Interdépartementale de Lutte Contre la Rage*

The grant of US$109,000 given to the *Entente Interdépartementale de Lutte Contre la Rage* (EIDLCR), an association of *départements* fighting against rabies, was designated for two main activities: fox culling, and information, in the respective proportions of 75% and 25%.

Diagnosis of rabies in suspected animals

A grant of US$1,289,000 was given to the laboratories in charge of rabies diagnosis.

Clinical observations of animals that had bitten humans

The observation of animals that had bitten humans was undertaken by private veterinarians and these expenses were covered by the owners of the animals (US$1,060,000).

Treatment of humans

This category of expenses included the post-exposure immunisation of humans exposed to animals suspected of being infected with rabies (US$1,635,000), the surgical treatment of wounds, tetanus prevention (US$481,000), and also an estimation of the loss of working days by those under treatment (US$962,000). In addition, the value of pre-exposure treatments of humans was US$77,000.

Expenses associated with rabies outbreaks

Human losses

Luckily, due to the efficient prevention of rabies, no human loss due to fox rabies has ever been recorded in France. Thus, the difficult question of assessing the economic value of human death was avoided. In the context of dog rabies, Fishbein *et al.* (9) evaluated this cost by calculating the potential lifetime earnings of those who died from rabies. This would be expected to vary with the age and economic status of patients.

Loss of livestock and domestic animals

As regards domestic animals and livestock, losses were only evaluated for cattle. This included the value of the cattle killed by rabies (US$1,540 per animal) and the cost of the three-month embargo imposed on the affected farms (US$770 per outbreak per farm). The latter cost was evaluated based on a dairy farm, although the figure could have been higher for other production systems, such as selected breeding farms.

Reduced tourism

Wildlife rabies is a cause of concern which is generally over-estimated by the public living in rabies-free countries. It is difficult to evaluate to what extent this affects tourism and income from tourism in an infected country. It seems likely that many people might choose domestic tourism opportunities rather than face the prospect of quarantine for their pets on return from a rabies endemic country.

Evaluation of the efficiency of wildlife depopulation

Rabies control made use of all the available methods – trapping, shooting (by day or by night), gassing dens and poisoning. These were performed by trappers, hunters, landowners and farmers, either with or without the direct support of the authorities, by bounties or payment of professional teams. Extended bibliographies on the subject can be found in Lewis (12), Debbie (7) and Aubert (2). Well-documented historical examples of such campaigns are scarce.

Fox depopulation was reported to have been used successfully in the Dijon area of France between 1921 and 1928. Foxes were poisoned with strychnine baits. However, a careful examination of the records indicates that the last case of sylvatic rabies (a dog bitten by a fox), occurred in 1928, i.e. two years after the last official record of a poison baiting campaign. As elsewhere in Europe at this time, canine rabies was endemic in the region. At the beginning of the fox epidemic, the number of rabies cases in dogs had doubled. The Dijon epidemic in foxes may therefore be interpreted as a direct consequence of the outbreaks in dogs. It can be assumed that the dog virus strain, although highly invasive in the fox population, was not sufficiently adapted to the fox to maintain itself in this host. However, the virus persisted in the dog populations in the same areas.

Reports of the rabies epidemic in Corsica in 1945 and 1946 also claim success for fox depopulation. This rabies outbreak was probably associated with the landing of troops from north Africa (11). Fox rabies was eventually eliminated, however, it is not possible to conclude whether this was a consequence of the fox culling campaigns or a consequence of high mortality due to rabies itself that deprived the disease of hosts. In this case, as in Dijon, the rabies virus originated in dogs and was not maintained in the fox population.

A general feature of such older reports is that although many accurate accounts are provided, comparative data on the density of wild carnivores before and after the period of control are not supplied.

In the province of Alberta in Canada, the outbreak of fox rabies in 1952 was tackled with large scale operations, conducted in forest areas by trapping and poisoning (600 coyote traps and 429,000 strychnine baits) and in rural areas by poisoning (75,000 cyanide capsules and 163,000 strychnine baits) (4). The mortality was extremely high: 105,000 coyotes, 50,000 foxes, 7,500 lynx, 4,200 wolves, 1,850 bears, 500 skunks and 64 cougars. The result was that Alberta was freed from rabies. However, in 1971, rabies was reintroduced, this time carried by the skunk. The success of fox culling in Alberta supports the view that a

host population infected with a heterologous strain of rabies virus will give rise to an unstable endemic cycle, that is, a cycle weak enough to be interrupted by a population reduction programme. In the case of the Alberta episode, rabies was introduced by foxes but largely affected coyotes (5).

After 1956, the culling campaigns elsewhere in North America and in Europe intensified. A figure exceeding the rate of 0.17 wild carnivores killed per km^2 per year was reached in Alberta, but this did not bring the same success as the earlier campaign.

In Europe, Denmark, taking advantage of its location on a peninsula, introduced intense fox population reduction programmes against successive outbreaks of rabies. During the first outbreak (1964-1965), the spread of rabies was halted after intense gassing 30 km north of the southern border. Two protective belts were maintained; in the first belt, fox populations were reduced by gassing and shooting until less than 20% of the initial numbers remained, and in the second, shooting only was used. The second outbreak in 1969 and 1970 crossed both protective belts, but rabies was halted 60 km north of the southern border by extending the gassing belt (16). The protective belts were maintained until 1975. A third outbreak occurred in 1977, but this gradually decreased in intensity under the pressure of gassing and was controlled in 1982. Since then, Denmark has remained free from terrestrial rabies without fox control due to the control of rabies in northern Germany.

In other parts of the European continent which are less geographically isolated than Denmark, the results of rigorous culling operations have been more controversial. In France, for example, no clear relationship could be established between the award of bounties and any variation in the incidence of rabies (2). Between 1976 and 1985, the density of bounties distributed in the infected area remained fairly constant each year, although the density of rabies cases in the same area varied (Fig. 1). Because of the natural rate of turnover, the fox population is essentially an annual crop (6). Wherever the bounty system was used, problems were encountered; in France, a proportion of foxes were falsely claimed to have been killed in areas under control, and in North America, where trapping is traditional, bounties encouraged the stealing of animals from traps (7).

In a mathematical simulation of a spatial model of fox rabies, Mollison and Kuulasmaa found that the disease maintains itself through wandering foci, mostly well separated from each other, so that population density is only reduced locally, at any one time (15). In fact, rabies achieved more dramatic population reductions locally, in some cases leading to its own eradication. The analysis of all the data published on the transitory success of fox depopulation policies in Europe demonstrates that the reinfection of areas swept by rabies was only delayed by the organised reduction of fox populations, and that this goal was more easily achieved in areas isolated by natural barriers which hamper immigration, as in the alpine valleys of France (2), Italy (10) and Switzerland (17).

Convincing evidence that the depopulation of foxes constitutes a sustainable control method for rabies has never been produced, but the evidence suggests that oral vaccination of foxes does provide sustainable control (Fig. 2). Moreover, according to Aubert *et al.* (3), such oral vaccination is efficient even when the fox population increases (Fig. 3).

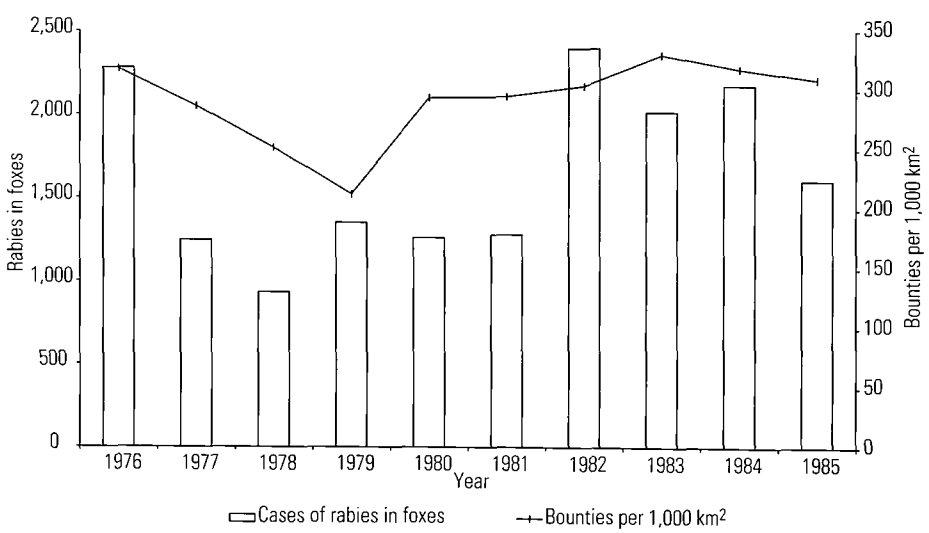
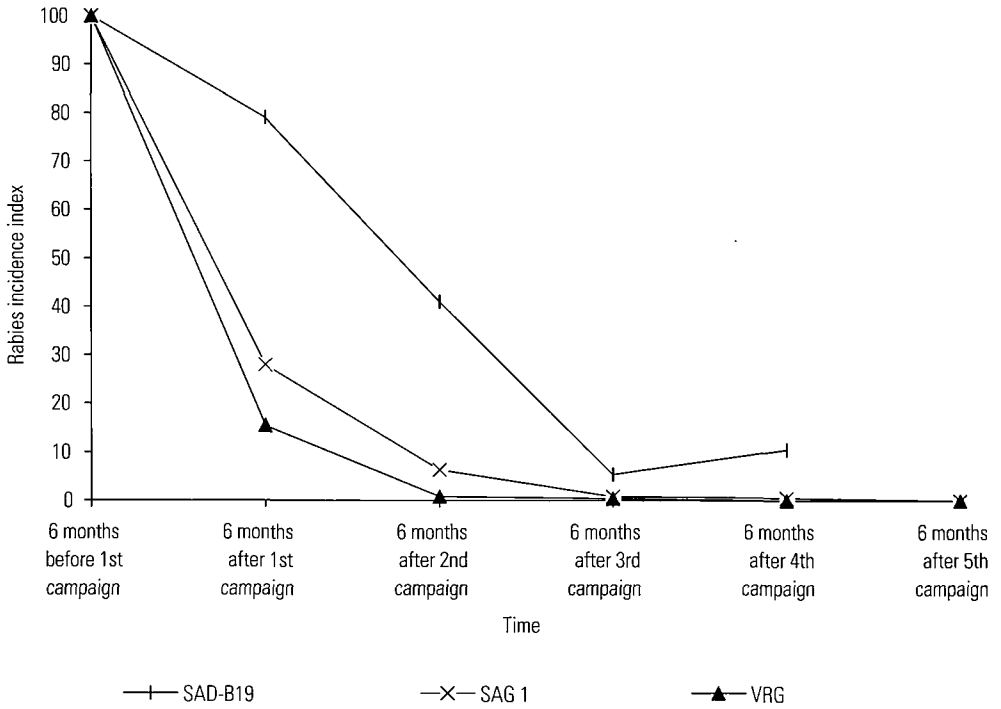


Fig. 1
Bounties awarded for the deaths of foxes in France (number of bounties per 1,000 km^2 of the infected area) and number of rabies cases in foxes from 1976 to 1985



SAD-B19 : Street Alabama Dufferin-B19
SAG 1 : Street Alabama Gif 1
VRG : Vaccinia-rabies glycoprotein

Fig. 2
Index of rabies incidence (all species) in the same areas vaccinated repeatedly with vaccine baits (14)
All rabies case densities have been adjusted to the 100 index which represents the case density before vaccination

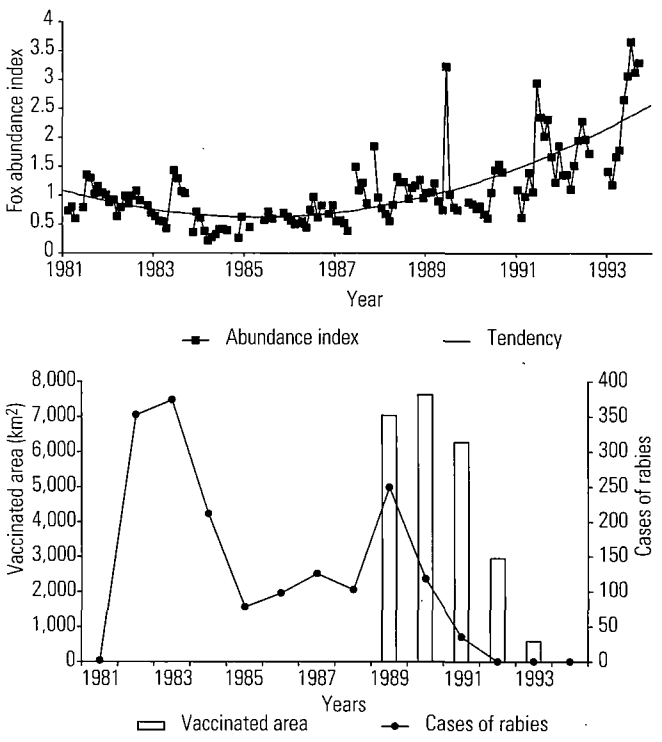


Fig. 3
Fox abundance index, size of the vaccinated area and number of rabies cases (all species) in the French *département* of Jura
The fox abundance index method is described by Aubert *et al.* (3)

Cost-benefit analysis of wildlife vaccination

The cost of vaccination campaigns included the following:

- the cost of baits

- the cost of bait delivery by helicopter (baits containing rabies vaccine were distributed by helicopter over areas inhabited by foxes (Fig. 4)

- the cost of surveillance systems; components of this include bait quality testing in the laboratory and in the field (i.e. titration of the vaccine virus and checking of the thermostability of the bait coating); evaluation of bait uptake; surveillance of rabies incidence and of the human risk associated with vaccination campaigns. These expenses were proportional to the size of the vaccinated area and were US$17, US$9 and US$2 per km^2 respectively.

Combination of costs and benefits

When combining the costs and benefits, the parameters related to the size of the infected area were distinguished from those related to the size of the vaccinated area and the number of campaigns, as explained below.

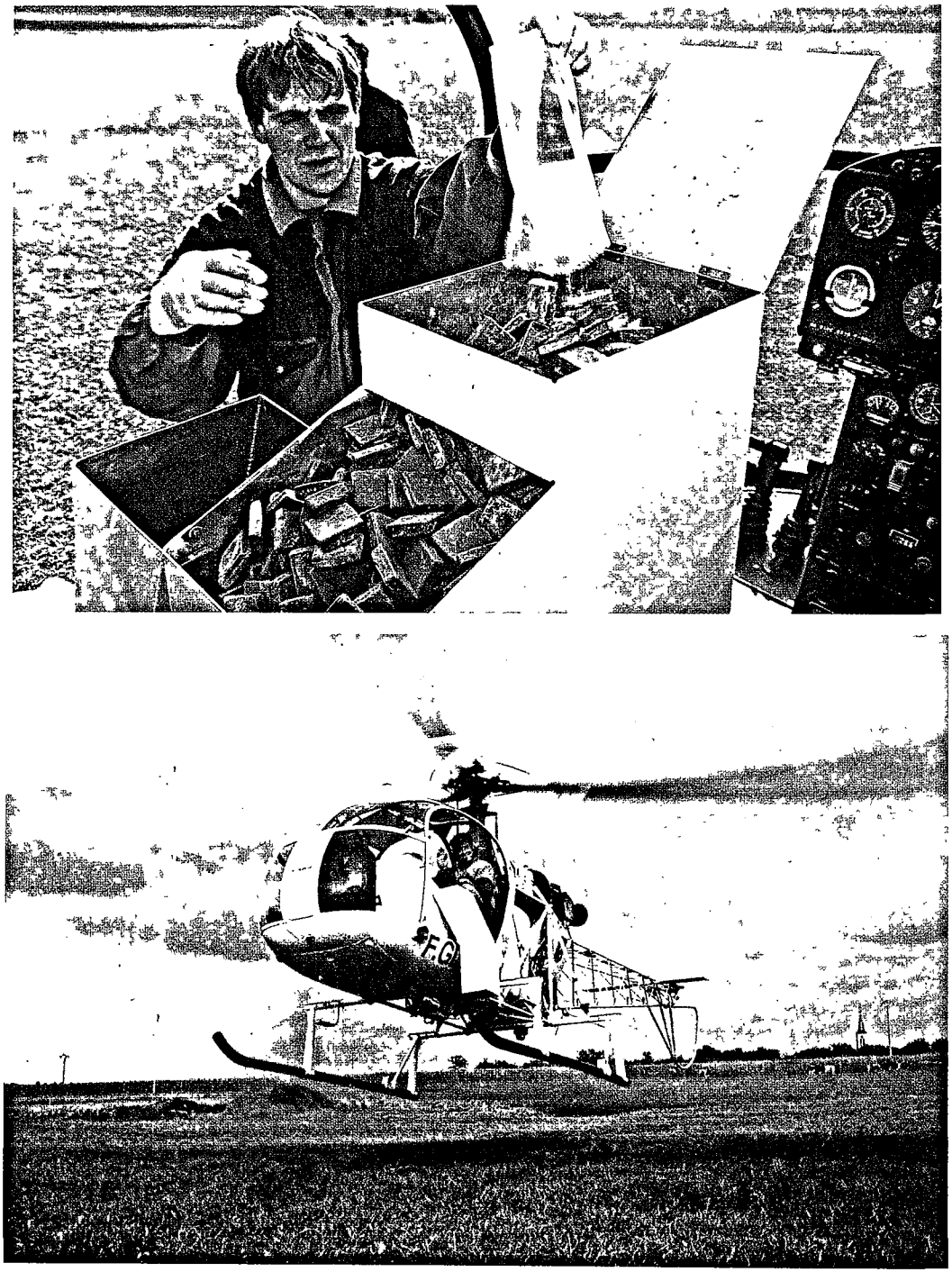


Fig. 4
Loading of baits and departure of the helicopter
Courtesy: *Agence française de sécurité sanitaire des aliments* – Nancy Malzéville, France

Most of the yearly expenses in relation to rabies outbreaks were extrapolated from the year 1987, and it was assumed that these expenses were correlated with the size of the infected area. When the infected area varied in size, the corresponding expenses were directly adjusted to take this into account.

The vaccination of foxes began in 1986. The cost of this strategy has therefore been cumulated since this year and compared with the cumulative cost of the non-vaccination scenario, as follows:

a) non-vaccination of foxes: in this scenario it was considered that the policy of fox culling was pursued, and that this would have halted the advance of rabies into the non-infected part of France

b) vaccination of foxes: this scenario considered the use of oral vaccines as the national control strategy.

When the French veterinary authorities decided to change their strategy, the financial support of fox culling was transferred to fund fox vaccination. The same organisations that were partly involved in managing fox culling were subsequently involved in vaccination operations. The local veterinary and hunting authorities maintained the collection of the samples necessary for the evaluation of the bait uptake and vaccination efficiency. This was also the case for the EIDLCR. Thus, with the exception of the bounties given for foxes killed (which were abolished in July 1990) and the payment for gas (which was stopped in January 1991), the funds given to local veterinary authorities and to the EIDLCR, initially intended for the limitation of fox populations, were still being allocated to these organisations, but this time, for the implementation of vaccination campaigns. Unlike the cost of baits, bait distribution, and surveillance of the vaccinated area, these grants were not proportional to the size of the vaccinated area.

When the study was undertaken, the epidemiological situation in France and in neighbouring countries indicated a decline in rabies incidence. At that time, the hypothesis of a steady decrease in the size of the infected area was considered as the worst scenario. However, even with the decrease of the infected area, the authors considered that the expenses directly involved with rabies surveillance and prevention in humans (including information expenses) still applied in the areas freed from rabies during the two previous years.

Concerning the vaccination of domestic animals, cat and dog owners continued vaccinating pets several months after the local disappearance of the disease in foxes. This was not the case with cattle breeders, who ceased vaccination for economic reasons, even in the infected area. The ban on foot and mouth disease (FMD) vaccination in 1992 greatly increased the price of the rabies vaccination which was previously performed in conjunction with FMD vaccination. Therefore, an overestimation of the cost of vaccination of cats and dogs was given by extrapolating the vaccination proportion of these species to the largest size of the area that was infected during the previous two years – and for cattle, by extrapolating this proportion to the size of the area infected during the previous year. Assuming a constant proportion of cattle vaccination, it was considered that cattle losses were proportional to the size of the infected area in the year in question.

When this cost benefit study was carried out (1993) (1), a complete elimination of fox rabies from large areas was expected, with some foci remaining until 1995. Additionally, long-term vaccination of a 30-km wide strip along the eastern French border was seen as a necessity. Similarly, the surveillance of rabies had to remain active after eradication and the cost of this was estimated to be equivalent to 5% of the cost of the diagnosis effort conducted during the year with the highest incidence.

Figure 5 illustrates the cumulative costs of both strategies, commencing in 1986. From 1986 until 1989, sizes of the vaccinated areas were not large enough to obtain any substantial benefit from oral vaccination and both strategies were equally expensive. Even when oral vaccination covered over 100,000 km^2 (since 1990), the costs of both strategies remained comparable. It was predicted that in 1994, the

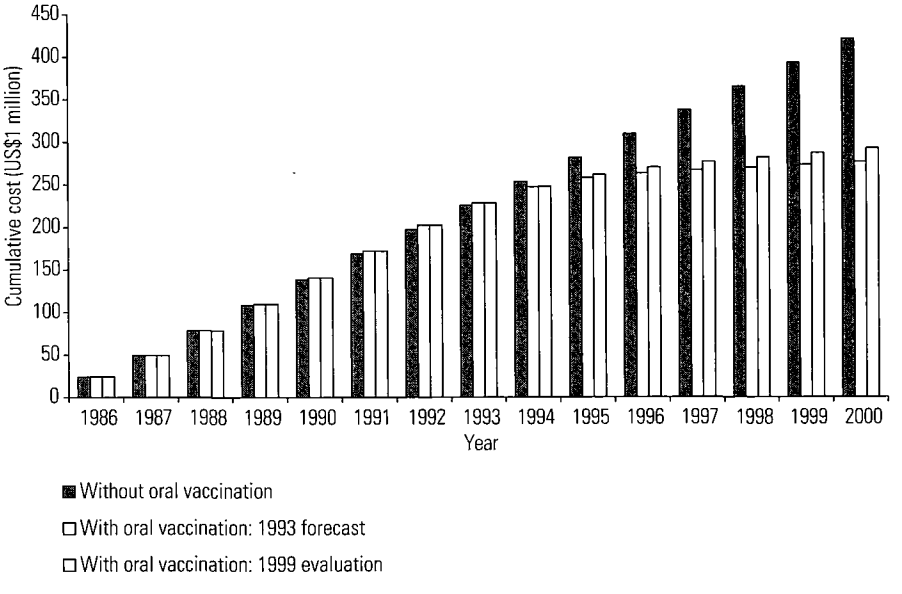


Fig. 5
Evaluation of the cost of rabies in France according to two scenarios: traditional prevention and control of the disease (including fox culling) or wildlife oral vaccination. The second scenario was evaluated in 1993 and re-evaluated in 1999 (costs have been cumulated since 1986)

cumulative cost of the wildlife vaccination strategy since implementation in 1986 would be lower than the cumulative cost of depopulation.

New evaluation of the study

Five years have passed since the first study was published (in 1993). To compare between the earlier forecasting and the actual situation that subsequently prevailed, costs and benefits have been re-calculated applying the same rules (using the same Microsoft Excel© spreadsheet) and using the same constant individual costs (i.e. individual costs for human treatment, the cost of individual vaccine dose for domestic animals, the cost of individual vaccine baits, the cost of distributing vaccine baits per km^2 and the cost of rabies diagnosis). Consequently, this re-evaluation only considered the actual variation in the size of the infected area, of the vaccinated area (and their associated costs) and of the actual number of human treatments.

As predicted, rabies has been eliminated from extensive areas, but larger areas have had to be vaccinated. In 1995 and 1996 the areas vaccinated were twice the size forecast. However, the size of the immunity belt which has been maintained along the north-east border since 1997 corresponds to the forecast made in 1993. During the last three years, rabies outbreaks in France occurred only at the borders to endemic foci in neighbouring countries.

The number of human post-exposure treatments remains very high: 5,934 in 1998, which represents a 40% decrease compared with the number recorded in 1990. This reduction is rather limited compared with the decrease in the infected area that was obtained during the same interval. The area covered 133,000 km^2 in 1990, and was evaluated to be less than 4,000 km^2 in 1998, which constituted a 97% decrease.

As illustrated in Figure 5, the *ex post* analysis did not produce a significantly different evaluation of the merits of the wildlife vaccination scenario. As a result, the global conclusion of the initial work remains in the favour of this scenario: since 1994, the wildlife vaccination scenario has been cost beneficial compared with the traditional fox culling scenario.

Discussion

The major part (72%) of the cost of rabies in France in 1987 was constituted by preventive vaccination of domestic animals (Fig. 6).

It has been demonstrated that the vaccination of cattle was efficient but was not cost beneficial (8), the single justification was the prevention of infection of farmers and their families. Considering the present market for beef, and the ban on FMD vaccination, anti-rabies vaccination of cattle would have been dramatically reduced even if the oral vaccination of foxes had not been undertaken. In fact, when this vaccination was reduced in the model from 1992, fox vaccination became beneficial in 1995, only one year later than in the *ex ante* analysis. The largest economy would have been to eliminate the need to vaccinate cats and dogs. However, this would not have been a responsible action considering the role played by these species in human infection.

It must be stressed that this cost-benefit analysis was performed with a deliberately optimistic view of the incidence of the disease without fox vaccination. It was stated that the size of the contaminated area would not increase. This

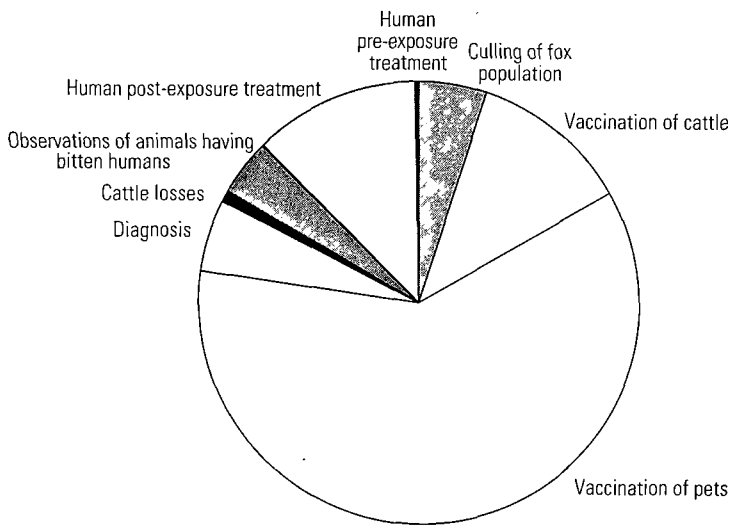


Fig. 6
Evaluation of the distribution of the cost of rabies in France in 1987

assumption was not realistic, considering that the rivers that constituted a barrier had been crossed southwards by rabid foxes in 1989. Another handicap for evaluating the benefits of fox vaccination which had to be introduced in this forecasting model was that fox vaccination did not cover the entire infected area until the autumn of 1989. If treatment of the whole infected area had been possible from the beginning, the benefit of fox vaccination would had been reached within four years.

The *ex post* analysis suggests that the promised benefits of oral vaccination have been obtained. However, greater economic benefits could have been obtained in France, had human post-exposure treatments been decreased in accordance with the surveillance data provided by the Veterinary Services.

This analysis illustrates the benefit of wildlife vaccination.

■

Coûts et bénéfices du contrôle de la rage sylvatique en France

M.F.A. Aubert

Résumé

Le coût de la rage sylvatique en France a été évalué en incluant la vaccination des animaux domestiques, le renforcement des réseaux d'épidémio-surveillance, le soutien aux laboratoires de diagnostic, le coût des pertes en animaux et leurs coûts associés, la mise en observation des animaux mordeurs, la vaccination préventive et les traitements humains. La part la plus importante de ce coût (72 %) est représentée par la vaccination des animaux domestiques. En France, comme dans les autres pays européens affectés par la rage vulpine, il convenait de choisir entre deux stratégies de lutte contre le vecteur de la maladie : soit la limitation des populations de renards, soit la vaccination orale de ces animaux. Les coûts et bénéfices combinés de la rage et de ces deux stratégies ont été comparés : ils comprenaient soit le coût de la destruction des renards, soit le coût de la vaccination orale (coût des appâts vaccinaux, de leur distribution et du suivi de l'efficacité de la vaccination).

Les prévisions, établies en 1988 puis affinées en 1993, indiquaient que les coûts annuels cumulés de ces deux stratégies restaient comparables jusqu'à la quatrième année. Après celle-ci, la vaccination orale devenait rentable. Ces prévisions ont été vérifiées cinq ans plus tard : l'application de la vaccination orale a apporté les bénéfices promis. Quoi qu'il en soit, pour ce qui concerne l'efficacité, la destruction des renards n'a jamais dans un passé récent ou plus lointain, apporté plus qu'une limitation transitoire de la rage. Au contraire, la vaccination orale des renards contre la rage s'est révélée capable d'éliminer la maladie même lorsque la densité des populations de renards était en augmentation.

Mots-clés

Analyse coût-bénéfice – Économie – France – Prophylaxie – Rage – Renard roux – Vaccination.

■

Rentabilidad de la lucha contra la rabia en la fauna salvaje en Francia

M.F.A. Aubert

Resumen

El autor presenta una evaluación de los costos ligados a la rabia de la fauna salvaje en Francia. Para realizar este estudio se tuvieron en cuenta los factores siguientes: la vacunación de animales domésticos; el refuerzo de las redes de vigilancia epidemiológica y del apoyo prestado a los laboratorios de diagnóstico; los gastos ligados a brotes de rabia (pérdidas de animales y pérdidas económicas asociadas); la observación clínica de animales que hayan mordido a una persona; y las vacunaciones preventivas y tratamientos curativos de seres humanos. Un porcentaje sustancial (72%) del coste total correspondía a la vacunación preventiva de animales domésticos. En Francia, como en otros países europeos donde el zorro común es la especie más afectada, había que elegir una de las dos estrategias fundamentales para combatir la enfermedad en su reservorio salvaje, a saber: la despoblación de zorros y su vacunación oral. Para realizar el estudio se evaluó y comparó la relación coste-beneficio de la rabia y de ambos métodos, incluyendo en un caso los costes del sacrificio selectivo de zorros y en el otro los de la vacunación oral (preparación y colocación de cebos, seguimiento para comprobar la eficacia de la vacunación).

Los costes anuales acumulados de las dos estrategias permanecían en niveles comparables hasta el cuarto año, después del cual la vacunación oral empezaba a resultar rentable. Esta previsión, realizada en 1988, se ajustó en 1993 y se confirmó cinco años más tarde con un nuevo análisis. La vacunación oral empieza ahora a rendir los frutos esperados. Mientras que la despoblación de zorros nunca ha deparado más que una tregua transitoria en la incidencia de la rabia, la vacunación oral se ha revelado capaz de eliminar la enfermedad incluso en situaciones en que la población de zorros va en aumento.

Palabras clave

Análisis de la relación coste-beneficio – Control – Economía – Francia – Rabia – Vacunación – Zorro común.

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