ORIGINAL ARTICLES

Surveillance report

FOX RABIES IN GERMANY – AN UPDATE

T Müller, T Selhorst, C Pötzsch

In comparison with conventional methods of wildlife rabies control, oral rabies vaccination of foxes (ORV) is without doubt the most (cost-) effective method in wildlife rabies control. As a result of ORV, several European countries have become rabies-free. Although rabies had been eliminated from much of Germany, there still exists a residual rabies focus in the border triangle of Hesse, Baden-Württemberg and Rhineland Palatinate. Corrective actions have been initiated to eliminate this last remaining rabies hotspot in Germany.

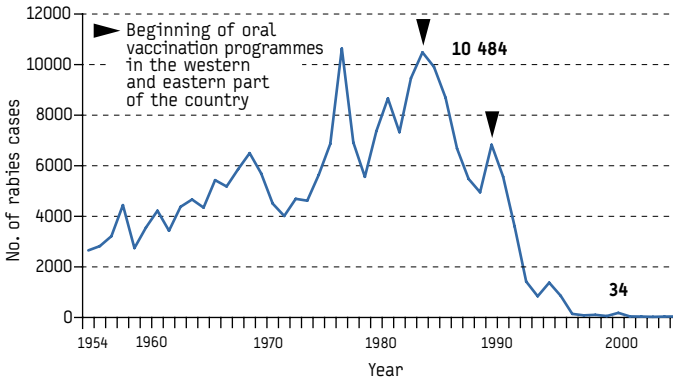
Euro Surveill 2005;10(11): 229-31 Published online Novembre 2005
Keywords: corrective actions, epidemiology, Germany, oral vaccination, rabies, setbacks

Introduction

Fox rabies arrived in northeast Germany in 1947 from the other side of the Odra River in Poland, and the disease rapidly moved westwards into West Germany. In 1951, the infection spread to foxes in southeastern Bavaria bordering Austria and what was then Czechoslovakia. In subsequent years there was dramatic progression of the disease in many parts of Europe, and rabies spread all over Germany [1]. Consequently, from 1953, the number of reported rabies cases steadily increased until 1968 [FIGURE 1]. As did other European countries, Germany attempted to solve the rabies problem using conventional methods of fox rabies control aimed at the disruption of the natural route of infection by reducing the fox density below a certain threshold. These included attempts to hormonally sterilize foxes, distribution of poison baits, trapping, digging and destroying fox cubs in dens, den gassing and intensive culling. None of these methods were successful in reducing and maintaining the fox population below this endemic threshold [2]. In fact, rabies incidence drastically increased nationwide in the late 1970s and early 1980s resulting in peaks of 10 634 and 10 484 reported rabies cases in wildlife and domestic animals in 1977 and 1983, respectively [FIGURE 1].

FIGURE 1

Development of sylvatic rabies (fox mediated rabies) in Germany, 1954-2005



Friedrich-Loeffler-Institut, Federal Research Institute for Animal Health, WHO Collaborating Centre for Rabies Surveillance and Research, Wusterhausen, Germany

Oral vaccination of foxes against rabies

Oral rabies vaccination (ORV) of foxes using modified live virus vaccines offered a new method of rabies control in wildlife. In Germany, the first field trial using chickenhead bait was conducted in the federal states of Hesse and Bavaria in 1983 [3]. Soon afterwards, ORV was markedly enhanced by the development of a new machine-made bait known as the Tübingen bait [4] that met the requirements for a large-scale vaccination program, which was launched in West Germany in 1985. In East Germany, ORV started in 1989 [5]. With the enlargement of vaccination areas reaching a maximum size of about 215 000 km^2 in 1995, the policy of using ORV became increasingly successful and rabies incidence decreased drastically in subsequent years [FIGURE 1]. However, achieving complete elimination of rabies using ORV was more complicated than originally predicted.

In Germany, the federal states are responsible for all animal disease control, including rabies control. Rabies incidence in certain areas of Germany clearly reflected these differences in vaccination strategies between the different federal states. Whereas in West Germany vaccination areas were frequently adapted to the current rabies situation resulting in a patchy pattern permanently changing with each vaccination campaign, in East Germany large-scale vaccination was used. The federal states in the east rapidly enlarged their vaccination areas and were able to continuously vaccinate the entire territory for several consecutive vaccination campaigns [6]. As a consequence, in the eastern parts of Germany, a rapid decrease in the number of rabies cases was observed in the early 1990s after the implementation of ORV. These eastern regions have been free of rabies for more than 10 years. In contrast, some areas in the west were declared 'rabies-free' too early: the status frequently proved to be unsustainable, and severe set-backs occurred [7]. Once large-scale vaccination was applied in the western regions, rabies was quickly eliminated. During the past 10 years, as in other European countries, the efficacy of oral fox vaccination campaigns has been increased by a permanent adaptation and optimisation of the vaccination strategy based on analysis of the prevailing conditions and recent scientific perceptions. These measures have included (i) den baiting, (ii) double baiting (repeated aerial distribution of baits 14 days after the first vaccination campaign in the same area using perpendicular flight lines with a distance of 1000 metres), (iii) summer vaccination, (iv) an increase of bait density and (v) a reduction of flight lines.

Recent and current rabies situation

As a result of ORV, the rabies incidence drastically decreased during the past 20 years from 10 484 rabies cases in 1983 to 56 in 1999; the lowest number of rabies cases ever reported in Germany. In 2000 a local increase in rabies incidence was observed with 182 rabies cases were reported, exceeding the level reached in 1998 [FIGURE 1]. For example, the rabies situation in Saxony reflected a classical cross-border problem at this time [FIGURE 2]. Here, an increasing rabies incidence in the neighbouring regions of the Czech Republic and Poland resulted in permanent re-infection along the common borders. This situation forced the veterinary authorities to safeguard the territory by maintaining a vaccination belt in those border areas [8]. The breakthrough in rabies control in the Saxony region came when continuous annual trilateral meetings with the countries involved were initiated which led to a considerable improvement of the vaccination strategies in the adjacent areas to Saxony. For more than three and a half years no rabies case has been reported from this region.

However, in 2000, the main problem was two separated endemic rabies foci comprising 3 western federal states [FIGURE 2]. Whereas the rabies incidence in North Rhine Westphalia was unaltered, the increase in rabies incidence was due mainly to a deterioration of the rabies situation in the border area of Bavaria and Hesse. North Rhine Westphalia had to face the problem of rabies in suburban and urban areas of the Ruhr, one of the most densely populated areas in Europe, during the final phase of rabies eradication. Due to improvement and adaptation of vaccination strategies that took into consideration the peculiar topographical features of a fragmented landscape and the high fox densities, the number of rabies cases decreased in 2001. The last observed rabies case due to sylvatic terrestrial rabies has been observed in Bavaria and North Rhine Westphalia were reported in March and June 2001 respectively, although rabies continued to be endemic in Hesse at a low level in subsequent years [TABLE]. Here, rabies has been endemic in a very limited area in the southernmost parts of the federal state, reflecting similar topographical and geographical features of a fragmented landscape to North Rhine Westphalia. Alth ough large scale vaccination using aerial distribution has been applied for several years, rabies cases in the past five years have been frequently associated with suburban and urban areas. While the rabies cases were initially limited to a 65 km2 region affecting two adjacent communities close to the city of Offenbach, due to inconsistent hand baiting the disease spread northwards into the suburbs of Frankfurt/Main in 2002 and in the following year also spread southwards into urban areas of adjacent districts. In 2004, rabies cases were mainly concentrated in the southernmost part of Hesse, the border triangle with Baden-Württemberg and Rhineland Palatinate [FIGURE 2]. Though Bavaria and Baden-Württemberg have maintained a preventive vaccination belt along the border with Hesse for over three years, an adjacent area in Baden-Württemberg became re-infected in December 2004. In order to reduce the infection pressure in the core area, emergency vaccination was carried out in the respective federal states in the same month. One month earlier, in November 2004, the rabies situation in Hesse had forced veterinary authorities to establish a 25 km deep preventive vaccination cordon in Rhineland Palatinate along the Rhine River. Unfortunately, rabies crossed the river and the first rabid foxes were found after 6 years of absence in January 2005, near the border with Hesse. In fact, the vaccination coverage in the fox population after this first vaccination campaign continued to be suboptimal, and up to April 2005 a total of 18 rabies cases were confirmed in that area. Up to the end of September 2005, a total of 30 rabies cases have been reported from Rhineland Palatinate [FIGURE 3].

TABLE

Rabies situation in German federal states ('Bundesländer'), 2000-2005 (bat rabies cases not included)

Federal State	Year					
	2000	2001	2002	2003	2004	2005*
Schleswig Holstein	0	0	0	0	0	0
Lower Saxony	0	0	0	0	1¥	0
Bremen	0	0	0	0	0	0
Hamburg	0	0	0	0	0	0
North Rhine Westphalia	35	9	0	0	0	0
Hesse	83	24	34	24	28	4
Rhineland-Palatinate	0	0	0	0		33
Baden-Württemberg	0	0	0	0	5	5
Bavaria	57	3	1¥	0	1#	0
Saarland	1	0	0	0	0	0
Berlin	0	0	0	0	0	0
Brandenburg	0	0	0	0	0	0
Mecklenburg Western Pomeranian	0	0	0	0	0	0
Saxony	6	4	0	0	0	0
Saxony-Anhalt	0	0	0	0	0	0
Thuringia	0	0	0	0	0	0
Total	**182**	**41**	**35**	**24**	**35**	**42**

* Situation at 19 November 2005
¥ Imported rabies case of dog origin
Imported human rabies cases

FIGURE 2

Rabies in Germany in 2000 and 2004

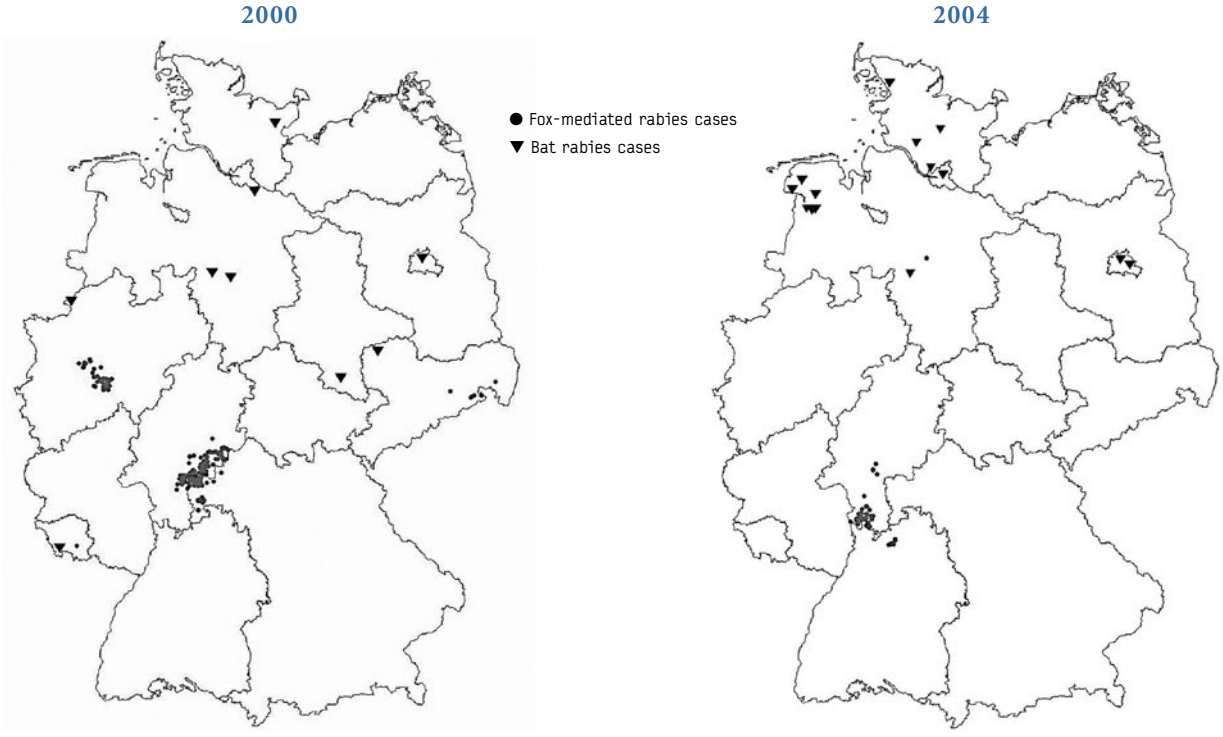


FIGURE 3

Rabies in Germany in 2005, situation at 22 September 2005

2005

● Fox-mediated rabies cases

▼ Bat rabies cases

Conclusions and corrective actions

The local increase in the number of rabies cases and the resulting spread of rabies in Germany in recent years are mainly due to (i) increased fox densities (ii) the persistence of rabies in areas with a extremely high density of settlements in which ORV is severely hindered (a phenomenon that no other country in Europe has been confronted with), (iii) inconsistent vaccination, e.g. missing complementary distribution of baits per hand in non-flying zones and (iv) insufficient prioritisation being given to rabies control in the final phase of its elimination. Because animal disease control, e.g. rabies control and ORV, is the responsibility of each federal state, insufficient cooperation in the planning of vaccination campaigns between neighbouring federal states has also been an important shortcoming.

As national and international concerns increased, several corrective actions have been implemented in 2005, aimed at improving vaccination protocols and a consistent vaccination strategy in the respective federal states aiming to eliminate the residual focus this year.

In addition to strict application of EU recommendations [9], the measures comprise:

- central planning and management of vaccination campaigns under the auspices of the national reference laboratory for rabies,
- drastic enlargement of vaccination areas in particular in Rhineland Palatinate, Baden-Württemberg and Bavaria to avoid further spreading of the disease,
- increased frequency of vaccination campaigns in hot spots (6 week intervals),
- strict complementary and intensified hand distribution in urban and suburban areas,
- intensified rabies surveillance beyond the recommended sample size of 8 foxes/100 km^2/year, as well as consequent follow-up investigations.

Furthermore, to overcome possible cross-border problems and to improve ORV programmes between neighbouring federal states, regular half–year consultations including all stakeholders have been implemented, at which the success of past vaccination campaigns is thoroughly evaluated, problems discussed and common planning of subsequent vaccination campaigns carried out. A completely new approach far beyond the EU recommendations is the documentation of the precise location of bait drops during aerial distribution using a satellite navigated and computer-supported fully automatic system (SURVIS) for distributing oral rabies vaccine baits [10]. This documentation allows real-time analysis of the quality of aerial distribution by calculating the resulting bait density on the ground after each vaccination campaign to identify areas with suboptimal bait densities where complementary hand distribution needs to be applied at a local level [11].

So far, the corrective actions taken in 2005 have resulted in halting rabies spread in the respective areas. Recent epidemiological analysis showed that rabies incidence has significantly decreased, and attainment of rabies elimination can be expected in due course [unpublished data].. Nevertheless, the implemented vaccination strategy must be continued for two more years after the last confirmed rabies case in order to achieve the rabies-free status [9].

References

1. Müller WW, Cox J, Müller T. Rabies in Germany, Denmark and Austria. In: King AA, Fooks AR, Aubert M, Wandeler AI. Historical perspective of rabies in Europe and the Mediterranean basin. OIE/WHO. 2004;79-89.
2. Müller T, Schlüter H. Oral immunization of red foxes (Vulpes vul¬pes) against rabies - a review. J. Etlik Vet. Microbiol. Ankara 1998;9:35-59.
3. Schneider LG, Wachendörfer, G, Schmittdiel, E, Cox JH. Ein Feldversuch zur oralen Immunisierung von Füchsen gegen die Tollwut in der Bundesrepublik Deutschland. II.Planung, Durchführung und Auswertung des Feldversuchs. Tierärztl. Umschau. 1983;38:476-480.
4. Schneider LG, Cox JH, Müller WW. Der Feldversuch zur oralen Immunisierung von Füchsen gegen die Tollwut in der BRD - Eine Zwischenbilanz. Tierärztl. Umschau. 1987;42:184-198
5. Stöhr K, Karge E, Gädt H, Kokles R, Ehrentraut W, Witt W, Fink, HG. Orale Immunisierung freilebender Füchse gegen Tollwut - Vorbereitung und Durchführung der ersten Feldversuche in den ostdeutschen Bundesländern. Mh. Vet. Med. 1990;45: 782-6.
6. Schlüter H, Müller T. Tollwutbekämpfung in Deutschland. Ergebnisse und Schlußfolgerungen aus über 10jähriger Bekämpfung. Tierärztl. Umschau. 1995;50: 748-758.
7. Vom Schloß A. Darstellung der Tollwutsituation in Nordrhein-Westfalen 1985-1995-Auftreten und Bekämpfungsstrategie. Tierärzl. Umschau. 1997;52:540-564.
8. Schaarschmidt U, Müller T, Albert G, Muluneh A, Cox J, Selhorst T, Schlüter H. Erfahrungen mit der Begleitdiagnostik zur oralen Immunisierung der Füchse in Sachsen unter besonderer Berücksichtigung einer standardisierten Tollwutserologie. Dtsch Tierärztl Wschr. 2002;109:219-225.
9. European Commission (2002): The oral vaccination of foxes against rabies. European Commission, Brussels. http://europa.eu.int/comm/food/fs/sc/scah/out80_en.pdf
10. Vos A, Muerke H, Holzhofer E, Gschwender P, Schuster P. A satellite navigated and computer-supported fully automatic system for distributing oral vaccine-baits against rabies: SURVIS, Proceedings of the 12th Rabies in the Americas conference, November 12-16, 2001, Peterborough, Ontario, Canada, 66.
11. Müller T, Staubach C, Selhorst T. Synchronising aerial and hand distribution of baits in urban settlements. 15th International Meeting on Research Advances and Rabies Control in the Americas, October 29-November 6th, 2004, Santo Domingo, Dominican Republic, 66.