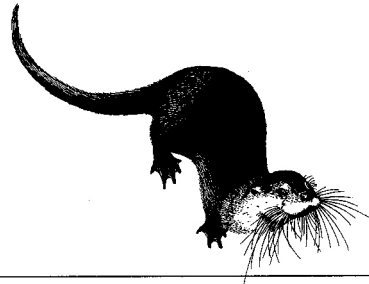


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## REINTRODUCING THE BADGER *MELES MELES*: STORIES OF FAILURE AND SUCCESS

by

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### 1. Introduction

The conservation of the badger *Meles meles* (L., 1758) in the Netherlands has received considerable attention in recent decades. After Van Wijngaarden & Van de Peppel (1964) had published data about the species' alarming decrease in numbers and distribution, a badger census was organized in each subsequent decade (Wiertz, 1991). The badger population reached its lowest level, with about 400 setts, around 1980. Intensification of agriculture, extensive re-allocation of land leading to the disappearance of small woodlots, hedgerows and slopes, increasing numbers of roads and cars, illegal persecution (the badger has been protected since 1947) and destruction of setts all contributed to the decrease. Gradually, however, protective measures were taken, which since about 1982 have been stimulated by the badger protection group Das & Boom. A 'Badger Management Policy' was conceived by the Dutch Ministry of Agriculture and Fisheries, and approved by Parliament in 1985. A 'fifteen-year-plan' was launched, with three phases of five years each. The aim during the first phase was to halt the decline in the badger population and to start reintroduction in now empty areas within the species' original range. In the second phase the population should start increasing again and the many small and isolated populations should begin to join up. Finally, in the third phase, the badger population should reach its 'optimum', both in distribution and density (Anonymus, 1992). Since 1980 the population has indeed increased, returning in 1990 to the 1960 level of about 600 setts.

Although reintroduction of badgers into empty areas should have begun during the first phase of the recovery plan, it was not until 1992 that the first reintroduction project started, because of the complex preparations required for a successful attempt. Landowners, farmers and gamekeepers have to agree with the return of the badger, the risk of mortality in the area has to be reduced by fencing and tunnelling roads, the fi-

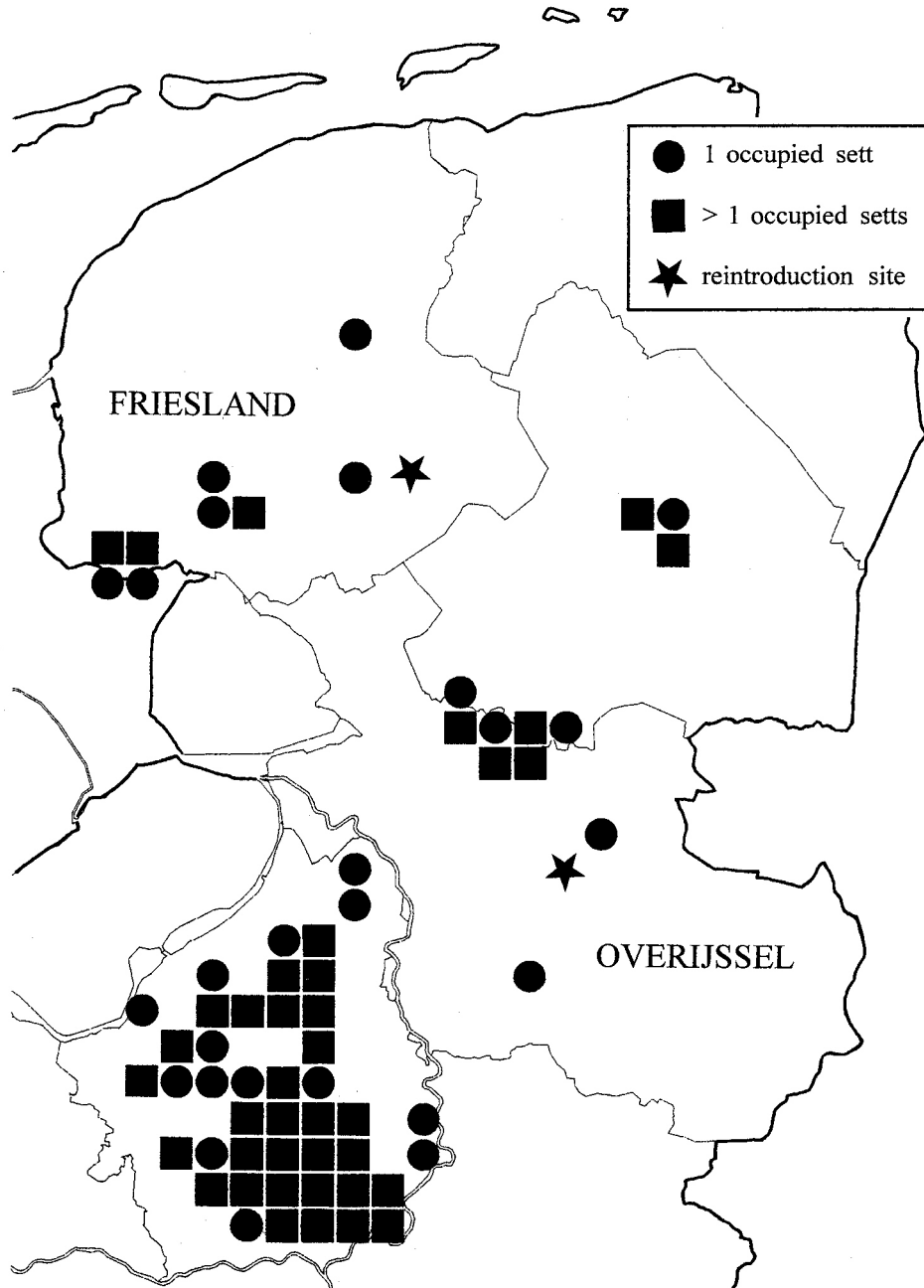


Fig. 1. Map of the north-eastern part of the Netherlands, with badger populations and the two areas of reintroduction. Adapted from Wiertz & Vink (1992).



Photo 1. The badger has been reintroduced in some areas of the Netherlands where it had disappeared decades ago. Photograph: J. van Osch, IBN.

nances for these provisions as well as for the construction of release pens and artificial setts, and for the accompanying research, have to be found, etcetera. It had been decided that the first reintroduction projects should be accompanied by intensive research, to maximize the success of further reintroductions. The Dutch Institute for Forestry and Nature Research (until 1991, the Research Institute for Nature Management) was entrusted with this research, for which funds were obtained from the Ministry of Agriculture, Nature Management and Fisheries and from Natuurmonumenten (the Netherlands' largest private organization for nature conservation), owner of the estate where one of the reintroduction projects was situated. Natuurmonumenten, the Frisian organization It Fryske Gea and the State Forestry Service (Staatsbosbeheer) also provided manpower, materials and other assistance in the field.

As the situation is now, it is unlikely that any further reintroductions will be monitored closely, due to lack of funding. The results reported here, of the first two reintroduction projects, will probably represent the only detailed accounts of what may happen to reintroduced badgers in the Netherlands. A further paper will deal with dispersal and other movements of reintroduced badgers (Mulder, in prep.).

## 2. Areas of reintroduction

### 2.1. Overijssel

The two areas in which badgers were reintroduced are situated in the centre of the province of Overijssel (52°29' N 6°28' E) and in the south-eastern part of the province of Friesland (52°58' N 6°09' E) (fig. 1).

In the first area badgers were reintroduced on the estate 'Eerde' in the valley of the river Regge, not far from where it joins the river Vecht. It is one of the last remaining, more or less untouched, ancient agricultural areas. The landscape is characterized by a mixture of woodland, fertile low-lying grasslands lining small brooks, roundish arable fields and small parcels of heathland. The arable fields (2-15 ha) are raised 1-2 m above the surrounding fields, as a result of an age-long deposition of cow and sheep dung, mixed with cut sods of heathland. Scattered through the area are old-fashioned farms, connected by dirt roads. The lowest grasslands are situated at 4.2 m above sea level and are inundated by the river almost every winter or early spring. The river Regge was canalized, i.e. enclosed between dams and barraged at every 10-20 km, about 80 years ago, and is now 20-25 m wide. The Regge valley in this region is lined with sandy hills, either pushed up to heights of at most 70 m above sea level by Ice Age glaciers (south-west side of the valley), or blown up to heights of 7-9 m above sea level in subsequent ages (north-east side). These hills are now almost entirely covered with (mostly coniferous) forest, planted 20-80 years ago.

The last badgers lived here in the fifties. Now the nearest badger populations are 7 km to the north-east (one solitary sett, present since about 1988), 17 km to the south (one solitary sett) and 15 km to the north-northwest (the edge of a population of about 15 setts).

Before badgers were released, two badger tunnels and one 'walking board' under a bridge were made, to provide the animals with opportunities to safely cross the intensively used road through the area of reintroduction. The road was fenced over a length of 100 m on either side of these crossings.

### 2.2. Friesland

The second area chosen for reintroduction was the south-eastern corner of Friesland. Most of this area was brought under cultivation rather recently, i.e. 50-100 years ago, by draining, ploughing and fertilizing the vast peat bogs and heathlands lying between low sandy ridges, 3-5 m above sea level. These ridges run from north-east to south-west and have been occupied by people since Stone Age times. Almost all farms are still situated here. The area is drained by a few small rivers running to the south-west. Badgers were released at both sides of the river Tjonger, which was canalized about a hundred years ago and now forms a straight stream, about 10 m wide. More than half of the area around the place of reintroduction is under cultivation, most of it consisting of grassland used for dairy farming. A few plots of maize are scattered between the grasslands. Many hedgerows and lanes of old trees still survive. About a quarter of the area is occupied by forest, mostly in the form of small lots of oak in between the grasslands, sometimes forming larger patches, often in connection with the heathlands. These heaths cover the remaining 15-20% of the area.



The last badgers lived here in the first decades of this century. Since then from time to time a solitary badger settled in the area for a few years. The last of these was present from 1986 to 1988, during which time it once was dug out, but was released alive. It probably drowned in the river Tjonger, which then had steep and smooth sides of timbering. That is to say, a dead badger was seen, floating 13 km downstream, in May 1988. This badger dug one large and at least one subsidiary sett in the area, both of which still existed at the time of the reintroduction. The nearest populations of badgers are now at about 30 km to the west, east and south-southeast, respectively (fig. 1). Shortly before the release of the badgers a single individual was discovered, living only 9 km west of the place of reintroduction. Another small, active sett, probably containing only one solitary badger, is situated 20 km to the north.

Two main measures were taken to prevent the untimely death of reintroduced badgers. The steep timbering of the banks of the river Tjonger, flowing right through the centre of the area of reintroduction, was removed over a length of 2.5 km, at both sides, and replaced by a gradual slope of loose, small rocks, which were soon completely overgrown with vegetation. In addition, a main road skirting the area of reintroduction at a distance of 1.5 km, was provided with three badger tunnels and accompanying fences.

### 3. Methods

#### 3.1. Badgers

Badgers were obtained from the asylum of the badger protection group Das & Boom. Capturing wild badgers in thriving populations for reintroduction elsewhere was not feasible under the circumstances. All but two of the badgers had been captured as orphaned cubs after the mother had been found dead on a roadside, and were raised in the asylum for 5 to 17 months prior to their release. The remaining two badgers survived a collision with a car and spent ten and twelve weeks, respectively, recuperating in the asylum, before being set free again in this project. More data about the badgers are listed in tables 1 and 2.

#### 3.2. Pens

Before finally being set free, the badgers were kept in a pen at the release site for a period of three to eleven weeks (photo 2). These release pens were always situated in woodland but never far from grassland, and enclosed enough dry and high ground to accommodate a large sett. The area enclosed varied from 500 to 1400 m<sup>2</sup>. The construction of the pens varied, but electric fencing was always used to keep the animals in (and out). At the start of the project a pen was used of welded mesh wire ('Casanet') with meshes of 25 x 50 mm. The fence was 170 cm high and was dug 50 cm deep into the ground, with an inward-turned, 50 cm wide horizontal shelf at the bottom. Two electric wires were placed 20 cm above each other along the upper part of the fence. Later on, pens of a more simple (and cheaper) design were used (photo 3). The standing fence consisted of wire netting ('Ursus') of the type used to fence in lambs, 80 cm high, with meshes of 12 x 15 cm (upper part) and 6 x 15 cm (lower part). Flat on the ground inside the standing fence a strip of chicken wire netting was laid, 80 to 120 cm wide and connected to the standing fence, to keep the badgers from digging holes underneath

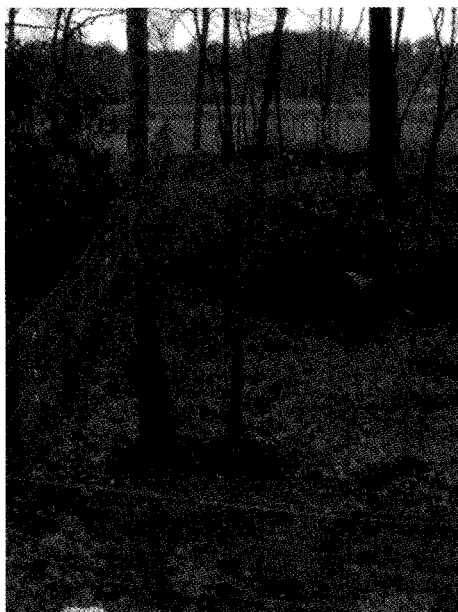


Photo 2. View over part of release pen 1, with one of the entrances to the artificial sett. Photograph: J.L. Mulder.

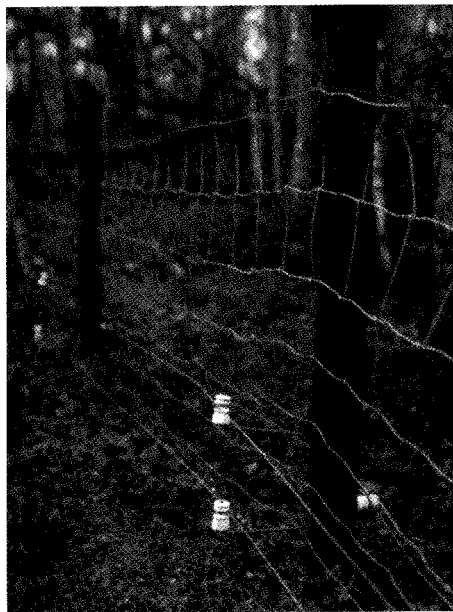


Photo 3. In release pens of a more simple design the badgers were kept in (and out) by electric wires and by chicken wire netting flat on the ground. Photograph: J.L. Mulder.



Photo 4. During their confinement in the release pens the badgers were provided with water and a mixture of dry dog food and fresh meat every evening. After their release they quickly learned to find their natural food sources. Photograph: J. van Osch, IBN.

Sex number	Area of birth	Date of capture	Age	Date of release	Pen number	Number of weeks kept in pen
F 41	Mid-Limburg	27 May 1991	juv.	22 May 1992	1	9.5
F 47	South-Limburg	20 May 1991	juv.	22 May 1992	1	9.5
M 42	North-Limburg	25 May 1991	juv.	22 May 1992	1	9.5
M 44	North-Limburg	27 June 1991	juv.	22 May 1992	1	9.5
M 56	SW-Friesland	17 May 1992	juv.	19 October 1992	2	2*
M 55	Veluwe	16 May 1992	juv.	26 October 1992	2	3
F 40	NW-Brabant	6 June 1991	juv.	10 November 1992	1	5
F 43	South-Limburg	17 May 1991	juv.	10 November 1992	1	5
F 51	Veluwe	17 May 1992	juv.	12 May 1993	2	4
F 54	SW-Friesland	19 May 1992	juv.	12 July 1993	3	6
M 52	Veluwe	16 May 1992	juv.	12 July 1993	3	6
F 72	NE-Brabant	4 May 1993	juv.	3 May 1994	2	10

\* escaped prematurely when the electric fence was defective.

Table 1. Data of the badgers released in Overijssel.

Sex number	Area of birth	Date of capture	Age	Date of release	Pen number	Number of weeks kept in pen
M 63	Mid-Limburg	29 April 1993	juv.	4 January 1994	4	10
M 65	North-Limburg	24 May 1993	juv.	4 January 1994	4	10
M 67	Mid-Limburg	9 June 1993	juv.	4 January 1994	5	10
M 78	Veluwe	22 June 1993	ad.	4 January 1994	5	10
F 79	Veluwe	3 December 1993	ad.	3 March 1994	5	3.5*
F 73	SE-Gelderland	25 May 1993	juv.	12 April 1994	5	9
F 68	Mid-Limburg	7 June 1993	juv.	12 April 1994	4	11
F 74	NE-Brabant	29 April 1993	juv.	12 April 1994	4	11
F 70	North-Limburg	24 May 1993	juv.	28 November 1994	6	5.5

\* escaped prematurely by digging underneath the fence.

Table 2. Data of the badgers released in Friesland.

the fence. Two electric wires were placed above each other along the lower part of the fence, at heights of about 10 and 25 cm, respectively. If badgers were to be kept out as well, this same construction was also used at the outside of the fence.

Pens of this design proved to be of sufficient quality to keep badgers inside for a number of weeks, provided the electric wires were functioning properly. Only one badger (an experienced, adult female) escaped prematurely from a pen with a properly functioning electric wire, out of 13 different badgers staying in such pens for a total of about 100 'badger-weeks'. She dug herself out underneath the strips of chicken wire and the standing fence. Another badger escaped when the battery of the electric wire was exhausted.

Every pen was provided with an artificial earth, consisting of a sunken wooden case (about 100 x 100 x 60 cm) connected to the surface by two concrete or PVC pipes, 4-8 m long. An extra hole in the side of the case allowed the badgers to dig from within the

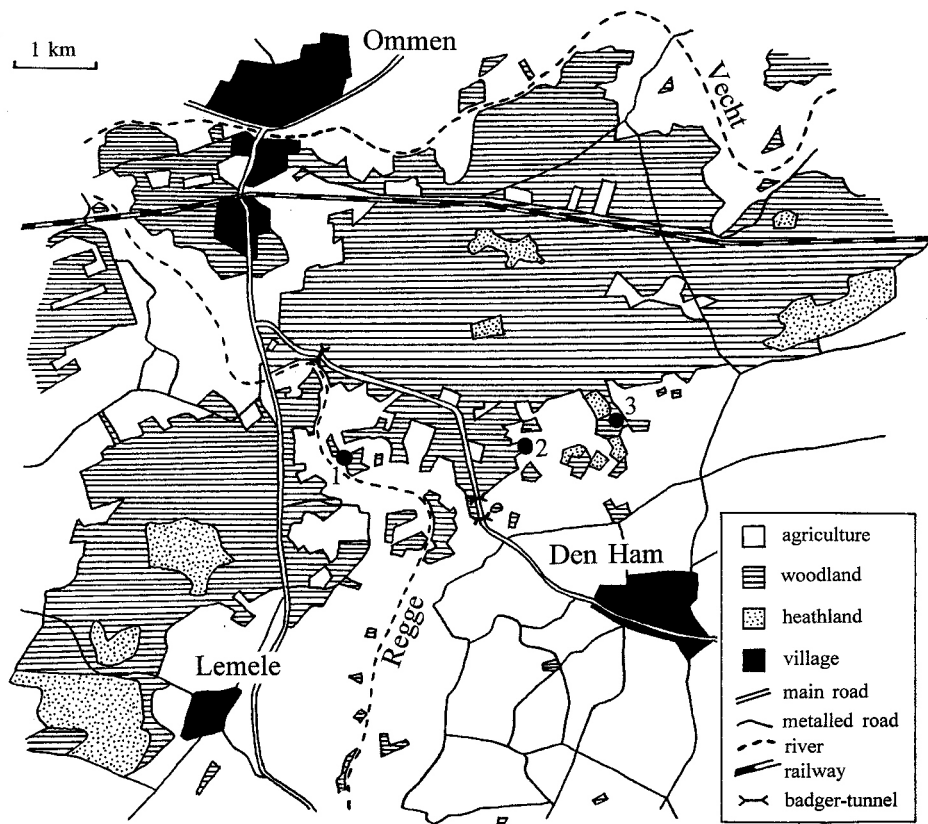


Fig. 2. Map of the estate 'Eerde' and surroundings, with the positions of release pens 1-3 and the badger tunnels.

sett. In one pen (nr 5, see fig. 3) a sett was made by enlarging the burrows of a rabbit warren from outside and from within, from a shaft dug into the centre of the warren. This shaft was subsequently covered by a wooden lid upon which soil was piled up.

Badgers were placed in the pens by releasing them into the pipes of the artificial sett. Every day food (a mixture of commercial dry dog food and fresh meat; photo 4) and water were provided and the fence was checked. After a period of several weeks of familiarization with the circumstances, the badgers were finally released by removing the electric fence and cutting several holes in the standing fence. Food was provided for a few more weeks, but usually the badgers very quickly learned to find food themselves. Figures 2 and 3 show the positions of the six release pens used in the two reintroduction areas.

### 3.3. Release schemes

Two somewhat different schemes of releasing badgers were followed. In Overijssel the badgers were released in small groups of one to four individuals of both sexes at a time, with several months in between the successive releases. In Friesland four males were re-

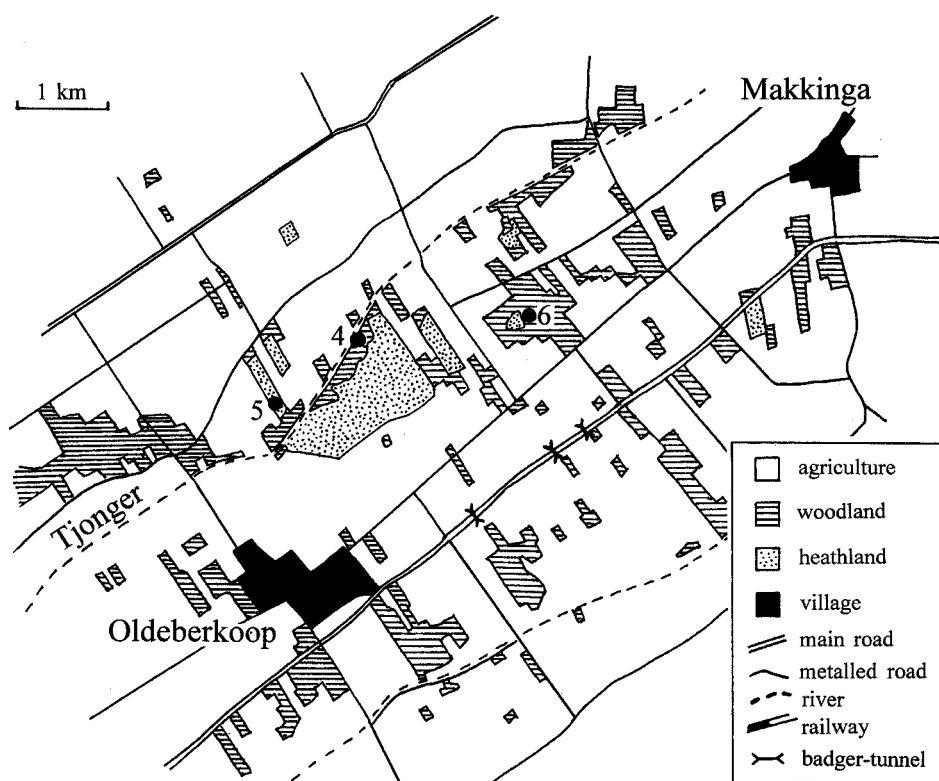


Fig. 3. Map of the reintroduction area in south-eastern Friesland, showing the positions of release pens 4-6 and the badger tunnels.

leased at the same time, in two groups of two, a few weeks later followed by two groups of two females at the same sites. The idea behind the latter procedure was that keeping the females in the area of release was crucial to a successful reintroduction. Releasing males first, in an area where no badgers lived before, might result in an enhanced suitability of the area for (female) badgers when these are released later: setts may have been dug by the males which have chosen to stay, badger paths to feeding grounds may have been established, etcetera. Furthermore, simultaneously releasing several males in different places may provide the females, after their arrival, with a choice of mates, contrary to the situation created in the first area of reintroduction, where small numbers of both sexes were released in succession. At the same time, regarding the second release scheme it was thought that the presence of females in pens might encourage the males to stay in the vicinity.

### 3.4. Telemetry

Several weeks before their planned release the badgers were transported to a veterinary surgeon and anaesthetized with ketamine hydrochloride. An identification number

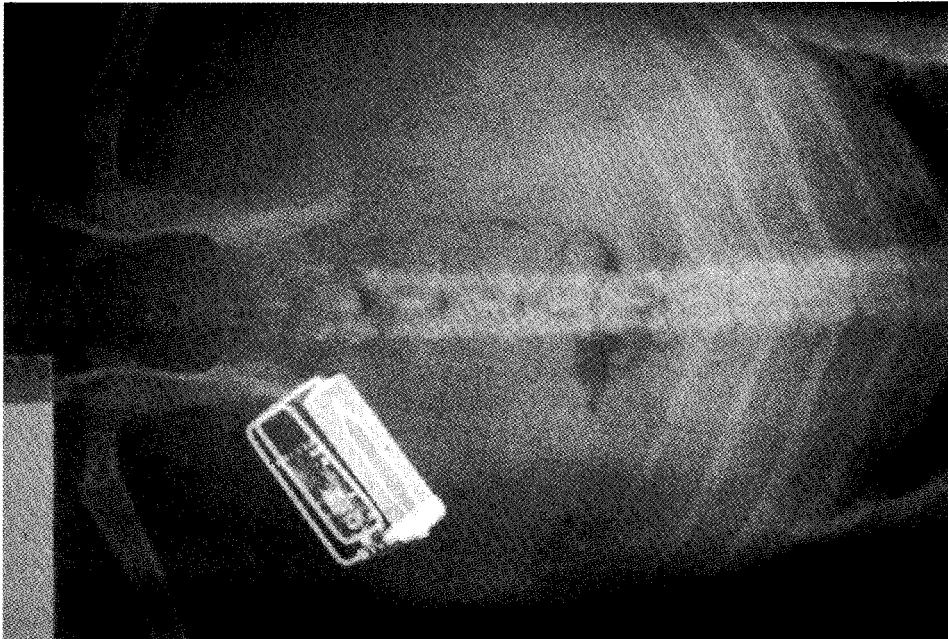


Photo 5. The implant transmitter floats freely in the abdominal cavity of the badger. X-ray photograph: W. Sobels.

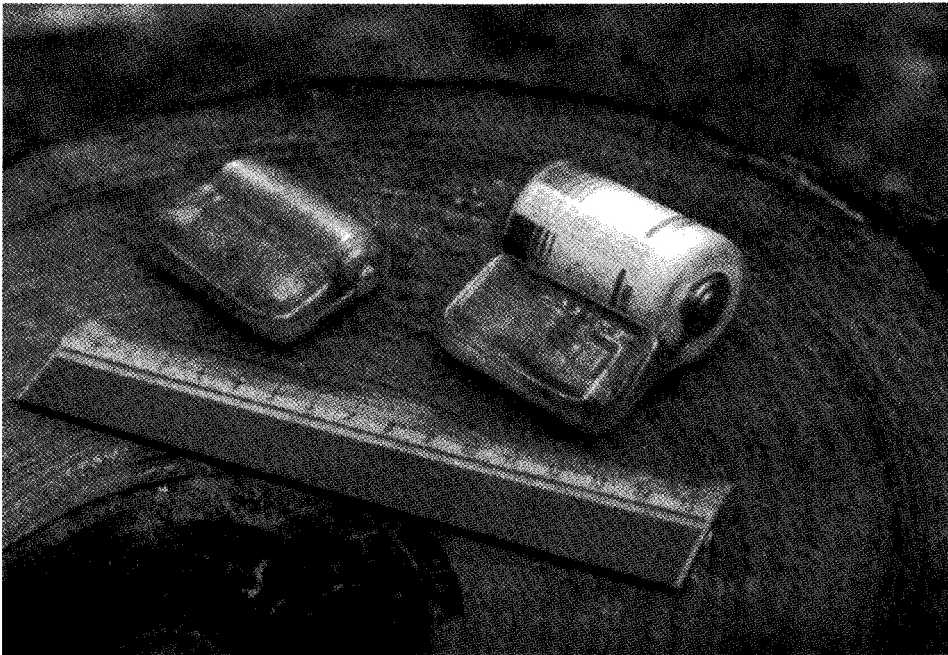


Photo 6. 30 Mc implant transmitters (two types) were used to study the movements of released badgers. Photograph: J.L. Mulder.

was tattooed in both groins and a transmitter (5.8 x 3.9 x 1.8 or 3.5 cm) was implanted through a 6 cm long median slit. The transmitter floated freely in the abdominal cavity (photo 5). The 30 Mc-transmitters were manufactured by the technicians of the Institute and were of two types, a short-lived 50-g and a long-lived 100-g transmitter (photo 6). Pulse rate was temperature-dependent: if a badger died, this could be detected from a slower pulse rate. Movement of the transmitter, and thus of the animal, could be detected from changes in signal strength. The signal was not emitted equally strongly in all directions, because of the loop-form of the transmitting antenna.

Badgers were mostly followed by car, fitted with a revolving loop-antenna (photo 7), at a 'working distance' of 100-500 m. Maximum receiving distance was about 800 m, exceptionally up to 1200 m. The 30 Mc-signal was not much absorbed by obstacles and soil, thus allowing us to find itinerant badgers sleeping underground in unknown areas by cruising all the roads in the area. When a badger's signal was lost for several days, it was usually searched for by a small aeroplane fitted with two whip-antennae. Flying at an altitude of 300-400 m, signal range was at least 4 km. Six out of nine lost badgers were located within an hour of systematic cruising flight; afterwards it appeared that the other three badgers had travelled further than we expected, so we had not searched for them in the right place.

An automatic system was used to record the presence of badgers at certain places, for instance in or close to setts or pens. A battery with or without a solar panel provided the feed for the system, which further consisted of a data-logger (Grant, Squirrel 1200), an interface and a receiver with aerial, both manufactured by the technicians of the Institute. The receiver could be programmed to scan the frequencies of the desired badgers only. An interface controlled the timing of switching between frequencies, as well as the transfer of signals to the data-logger.

Some badgers were recaptured after signs of impending transmitter failure or after exhaustion of the transmitter battery. They were caught in wire-mesh traps after several weeks of pre-baiting with a peanut-syrup mixture, or in wire-mesh traps set in openings in the fence of a pen in which another badger was placed to be released. One badger was recaptured when it slept in a dry culvert, by putting a cage in front of one end of the culvert and pushing an 18 m long broom into the other end. Badgers thus recaptured

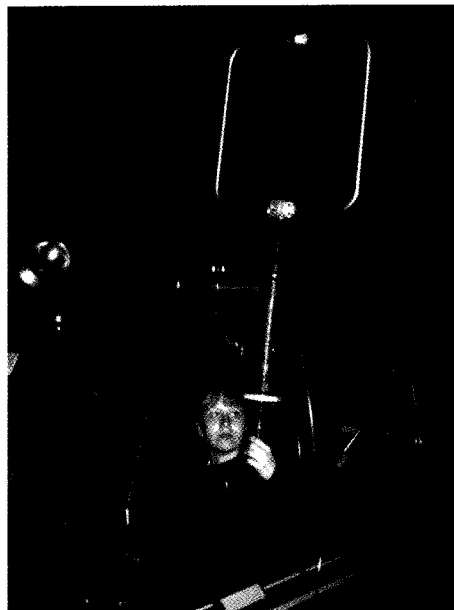


Photo 7. Badgers were mainly followed by car, fitted with a revolving antenna. Photograph: J.L. Mulder.

were brought to the local veterinary surgeon, their old transmitter was removed (sometimes after locating it by X-ray) and a new transmitter was implanted. These animals were released immediately after the operation by placing them, still unconscious, in the entrance of a subsidiary sett in their home range. We always waited until they recovered and disappeared into the sett. Such freshly operated animals invariably left the sett where they were released in the early hours of the first night and usually slept a few hours more than normal during the first 24 hours, but did not show other signs of distress. One individual even swam the river Regge, like he often did, already during the first night after the operation. Whenever badgers were recovered dead later, their operation wounds had healed beautifully. One badger died several months after the implantation of a new transmitter, as a result of massive tissue-growth around it. A coating, applied to prevent such body-reactions, appeared to have been missing on part of the transmitter.

#### 4. Observations

##### 4.1. Reintroductions in successive stages

###### Behaviour at the moment of the first release

In Overijssel twelve badgers were released in five subsequent stages. The first badgers to be released (two males and two females) grew up together in the badger asylum. When about one year old, they were placed in pen 1 on the 'Eerde' estate. After nine and a half weeks the animals were released by cutting four holes in one side of the fence on 22 May 1992. That evening, with the aid of infrared binoculars (Old Delft), we observed how the badgers reacted on the presence of holes in the fence. An hour after the beginning of activity in the pen one of the badgers discovered the holes, sniffed the freshly cut wire ends and the ground for minutes, but did not leave the pen. Instead it disappeared from sight. One hour later two badgers found the holes, sniffed every inch of the rim of each hole (where we had touched it while cutting) as well as the ground, very carefully. Very slowly one of the badgers moved through a hole, investigating every inch of the ground. It returned into the pen through another hole, all the time sniffing the vegetation, the fence and the posts. Gradually it extended its activities outside, followed by the second badger. Twenty minutes later the first badger was about 50 m away from the pen, but then a roebuck bellowed loudly, startling the yearling cows in the meadow where the badgers were exploring; the running cows made the badgers rush back into the pen. This incident did not stop their exploring, however, and by the end of the (short) night all four badgers had been outside the pen, the most daring of them (F 41) up to 400 m away. Three badgers returned to the fence in the early morning, but one (M 42) enlarged a rabbit burrow at about 200 m from the pen and slept there during the day.

###### Further developments

In the following nights three of the badgers gradually increased the area they explored around the pen. On most days they slept in the artificial sett in the pen. While following them, we often encountered the badgers on dirt roads and other paths. Sometimes they ran in front of the car for a few hundred metres. This behaviour may make



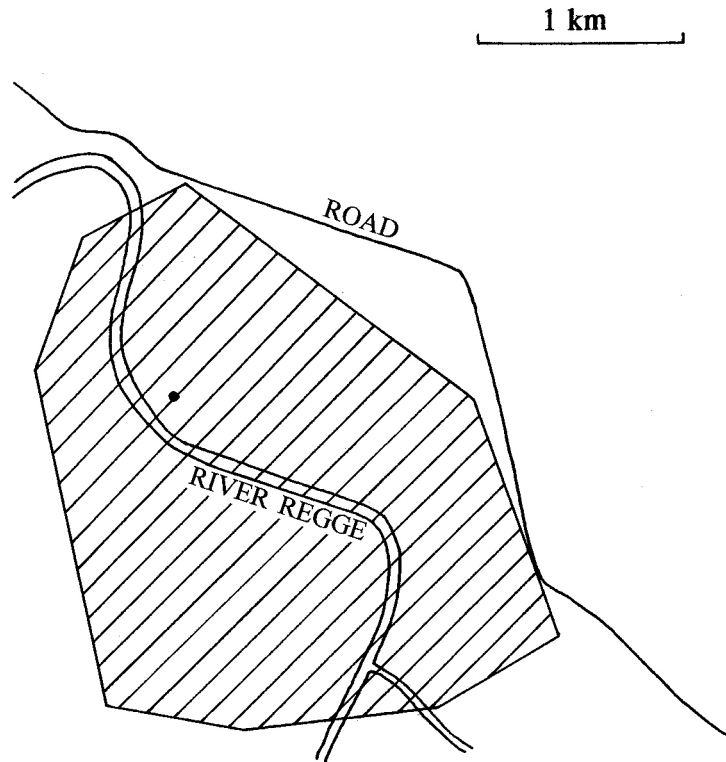


Fig. 4. Home range of M 42 and M 44 from July to November 1992. The position of release pen 1 is indicated with a dot.

them very vulnerable to traffic, but it seemed to disappear after some weeks; probably the badgers had built their own network of badger paths by then.

Badger F 41 behaved rather differently. In the asylum she had already distinguished herself as an extremely active animal. During the first night of freedom she ranged farthest of the four badgers, and in the second night she swam the river Regge and went to sleep in an old culvert more than 1 km away from the pen. The following night she crossed the river again, back to 'Eerde', but soon her signal was lost. During the day an area of about 16 km<sup>2</sup> was searched, but she was nowhere to be found. However, halfway through the next night (her fourth night of freedom) she was located again near the pen, where she slept the following day. The next four nights she stayed in the vicinity of the pen, ranging within an area of only about 20 ha, at least during the hours she was followed. However, in her ninth night of freedom she disappeared and her signal was never heard again, although a large area was searched by plane, both on day 5 and day 13 after her disappearance. Eventually her body was found, on day 34, 115 km to the north.

The other female, F 47, left the vicinity of the pen in the eighth night of freedom. Ten days later she was found in the nearest sett where wild badgers were living, 7 km to the

north-east. She stayed there and produced a litter in 1994, at the age of three. Unfortunately, she was killed on the road shortly afterwards; two cubs were subsequently caught at the sett. These were taken into the asylum, thus following in the steps their mother had taken three years earlier.

Both males eventually settled on the site of release, occupying a range of about 450 ha situated on both sides of the river Regge, which was often crossed, sometimes back and forth in the same night (fig. 4). In addition, the males made a few trips outside their range during the first four weeks after their release. M 42 left during the 23rd night and was discovered sleeping in a rabbit burrow the next day, 2.3 km north-east of the site of release. He roamed further to the north-east during the following night, but his signal was lost in the morning. That day his resting site could not be located, but the next day he appeared to rest only 1.5 km north of the pen. From there he ran 2.5 km to the west and back, slept in the same small hole again, to return to the pen during the next night. M 42 thus stayed away from the pen for four days, ranging at most 4 km distant from it. He was never found to make another excursion from his normal range.

M 44 first made an excursion in the seventh night after his release, and rested in a dry culvert 2 km north-east of the pen. The next night he ran 3 km to the south, unfortunately stumbled there upon the tracking car, and returned to the culvert. The following three days he slept in the pen again, but a day later he was discovered sleeping 1.4 km to the north-west, above ground under a bramble bush. Apparently he was on a second trip outside his range, returning to the pen after two days. No other excursions of this badger were observed.

The net result of the release of the first four badgers was that the two females left the area of reintroduction, whereas the two males settled there. They continued to use the artificial sett as their main resting site, but during the summer dug some subsidiary setts as well.

#### The second stage: four more badgers

On the 6th of October in the same year, two females (F 40 and F 43, born the previous year) were placed in pen 1. This pen had been closed again, on a day when both resident males rested elsewhere. It had been provided with electric fencing on the outside as well, to keep the males out. It took them four nights to discover the presence of their new 'brides'. From then on they visited the pen on most nights, judging from the latrines and holes dug along the fence.

The two new females were in fact released by the resident males. Five weeks after the arrival of the females a hole was discovered in the fence, where one of the former 'release holes' had been inadequately closed. It is not known how much direct contact there was between the animals during the dark hours, but the first three days after the discovery of the hole the males still slept outside the pen, whereas the females rested inside. The fourth day, however, the two males slept in the artificial sett together with F 43, while F 40 was found in a nearby subsidiary sett. Judging from their sleeping places during the day, F 40 avoided contact with the males for the next forty days, whereas F 43 rested together with one or both males at least half of the time in that period. The four badgers, however, shared the same home range.

In mid-December this situation suddenly changed. Female 40 returned to the artificial sett in pen 1 for the first time after her 'release', and rested there with M 44. The

next day, however, she changed company, now sleeping in the artificial sett together with M 42. From then on these two badgers stayed together, at first sometimes accompanied by M 44, but always left alone by the other female, F 43. By mid-January a completely new situation had evolved: two couples had apparently been formed, of which F 43 and M 44 had shifted their activities to the south-east, hardly ever returning to the vicinity of their release pen. This remained occupied by the other couple, F 40 and M 42, which continued to use the artificial sett as their main sleeping place until mid-April, when they moved to a new sett nearby.

#### The new males

On the same day in October on which the two new females were placed in pen 1, two new males (M 55 and M 56, born that same year) were released in pen 2, situated 2.4 km east of pen 1 (fig. 2). This pen was considered to be far enough outside the normal range of the resident males to be left alone by them. However, one of the latter males, M 44, discovered the pen after twelve days; he dug some shallow holes near the fence and had his day rest only 200 m away. As far as we know, he did not return to this pen again. The following night, M 56 escaped from pen 2: the electric fence appeared to be defective. The next evening M 56 was located 3 km to the north-east, where he apparently settled immediately, using two fox earths as his main resting sites during the next four months. Two days after his escape, however, he returned to the pen for one day, though the electric fence was working properly then.

The other male, M 55, was released eight days after the escape of M 56, though he had been enclosed in the pen for a period of only three weeks, in the hope that he would re-establish contact with M 56. During the first three days he did not leave the pen, but later he started to explore his surroundings. On day seven he was found resting in a rabbit burrow 3 km south-west of pen 2, just south of the home range of M 42 and M 44. The following night we tracked him while he gradually moved into their home range. At 04:11 a.m. it was noticed that M 42 was not far away, and ten minutes later their signals seemed to come from the same location. Apparently a chase ensued, since the signals of both badgers rapidly moved to the south together: in 52 minutes they moved 2 km, after which the resident male returned to his range. Soon afterwards M 55 went to sleep in a rabbit burrow. The next night we immediately lost track of him, but the following day he was found again, sleeping in a culvert within the home range of the resident males. From there he gradually moved north and after a few days settled along the river Vecht, 3 km north of the release pen, where he lived until he ran into a car more than three months later, in the beginning of February.

#### Mortality at the end of winter

In February the other solitary male, M 56, started to wander again. He tried to swim a canal, could not get out because of the steep timbering of the sides, but had the luck to be noticed and rescued by someone letting out a dog in the middle of the night. Unfortunately, this badger was killed by a car three days later, more or less under our eyes.

A remarkable thing was that a wild badger, a subadult female, was found freshly killed by a car on 19 February, within the home range of the eastern badgers, M 44 and F 43.

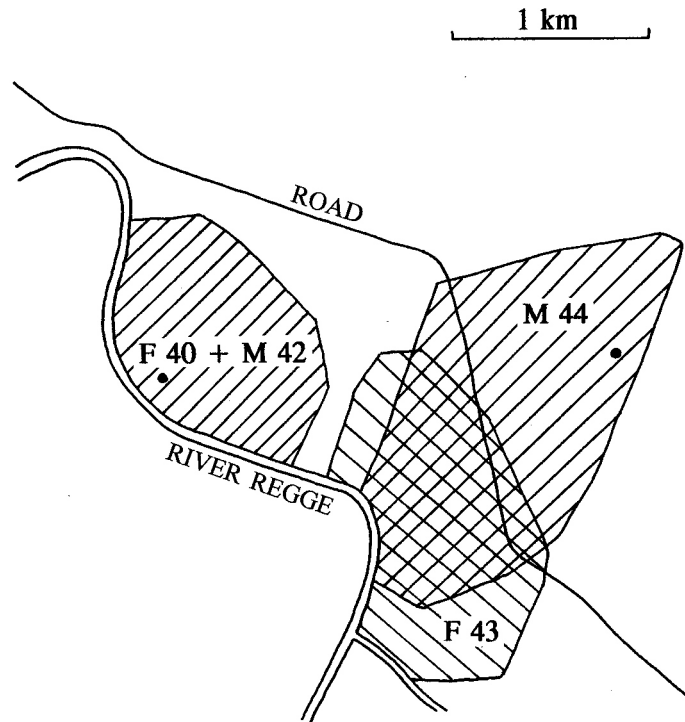


Fig. 5. Home ranges of the reintroduced badgers in Overijssel at the end of the winter 1992/93. The position of release pens 1 and 2 is indicated with a dot.

Since the disappearance of badgers from the area in the fifties the presence of wild badgers had never been noticed on the estate 'Eerde'.

After one year and the reintroduction of eight badgers the balance in early spring 1993 was: one female associated with wild badgers at a distance of 7 km and two badger pairs in adjacent home ranges on the site of release (fig. 5).

#### The third stage: adding a solitary female

The next stage in the reintroduction scheme in Overijssel was to try to 'add' a second female to M 44. A one year old female, F 51, was placed in pen 2 in April 1993. This pen was now clearly situated within the radius of action of M 44. Female 43, with which M 44 shared his sett, never visited the pen. In the sixth night of her presence, F 51 was discovered by M 44. From our observations and from the signs he left around the pen (photo 8) it soon became clear that he spent many hours running around the pen almost every night. On May 1st (day 16 after the arrival of F 51) we installed an automatic recording system to record the presence of M 44 near the pen. He visited her during at least eight out of the ten following nights, staying at the pen from about 1.5 to a

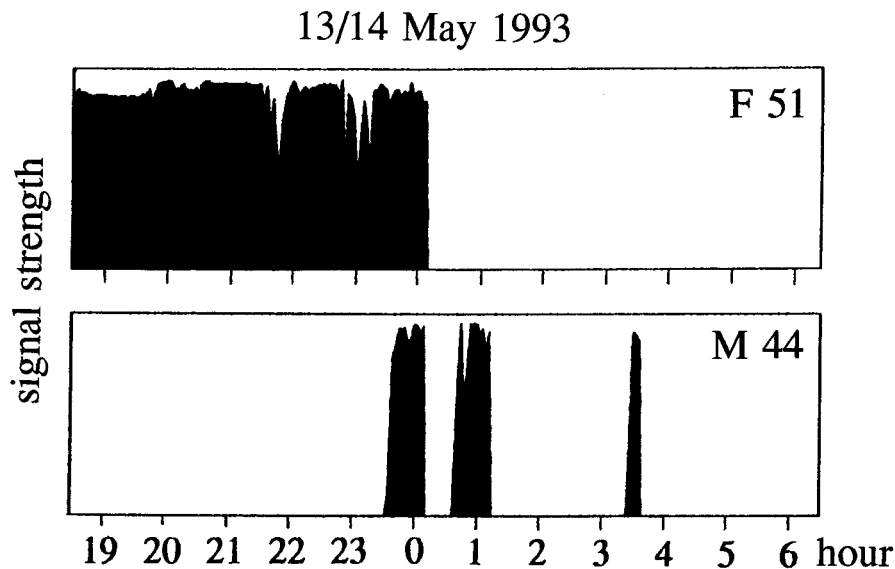


Fig. 6. Recordings at pen 2 of the signal strength of the transmitters of F 51 and M 44, showing three visits of the latter, in the last night of F 51's presence here.

maximum of 4.8 hours per night; there were about seven hours of darkness each night at that time of the year. Most of the time M 44 was running back and forth along the fence, accompanied by F 51 on the inside. It was not clear whether or not their behaviour was friendly towards each other. Every day he returned to his main sett at a distance of 1.5 km, crossing the road through one of the badger tunnels.

When holes were cut in the fence on May 12th, four weeks after the arrival of F 51, both badgers were initially unaware of the openings. From 23:25 hrs. to 00:45 hrs. the badgers mainly ran back and forth, each on their own side of the fence. Then M 44 discovered a hole when F 51 was somewhere in another corner of the pen. He entered slowly, sniffing the ground carefully, came upon a latrine, urinated in it, and one metre further met F 51. There was one moment of hesitation, noses almost touched, and then a terrific fight ensued. Loudly screaming, the badgers tumbled through the entire pen as one hairy ball for minutes on end. Next moment there was dead silence, except for the heavy panting of M 44, which slowly left the pen, leaving F 51 in the artificial sett. His panting could be heard for minutes, while he was moving away through the woodland.

Half an hour later F 51 was walking through her pen as usual, seemingly unhurt. She did not leave the pen that night, nor the following night, when M 44 did not show up. The next night, 13/14 May, M 44 arrived at the pen at 11:38 p.m., according to the recordings (fig. 6). He stayed for an hour, after which both badgers left the pen simultaneously. M 44 revisited the pen twice that same night, but F 51 never came back to it. She started to explore her surroundings rather thoroughly during the next seven nights, visiting the home ranges of both resident badger pairs several times, sleeping in

three different culverts, three different overgrown ditches and an enlarged rabbit burrow. We never had an indication that she met another badger while wandering around, not even M 44. From his behaviour it became clear that he did not follow her, but he continued to visit pen 2 for at least five nights (recording was stopped then) after the departure of F 51. After having spent the first seven nights more or less in the vicinity of the release site, F 51 slowly shifted her activities southwards, leaving the area of reintroduction for good (Mulder, in prep.).

The last stages: adding a pair and a solitary female

In June 1993 a male and a female badger (M 52 and F 54, respectively) were placed in pen 3, as far as we knew outside the range of the resident male M 44. However, M 44 appeared to range further than we thought and discovered the pen already in the second night after the arrival of its inmates. He visited the pen four nights in a row, and after that intermittently.

Although the new badgers had formed a more or less inseparable couple during their stay in the badger asylum, they split up on the first night after their release, 40 days after their arrival. F 54 wandered southwards and was killed on a motorway, only eight nights after her release, while being radiotracked by us. M 52 stayed four days in the vicinity of the pen, but never returned to it after the night of release. He also wandered to the south, leaving the area of reintroduction for good.

In the meantime one of the resident badgers, F 43 of the eastern pair, was killed on the road, east of the protective provisions for badgers. Fortunately, this seemed to have no influence on the behaviour of her mate, M 44. The following winter we tried to provide him with a new mate: F 72, born in the preceding spring, was placed in pen 2. Contrary to our expectations, M 44 did not visit the pen, staying at the other side of the road all the time. At first this was attributed to the temporary obstruction of the badger tunnel, which was filled with water as a result of unusually heavy rainfall, but M 44 appeared to be not very active at all. In February 1994 he was found dead near the sett, having died from the consequences of tissue-growth around the transmitter (see 3.4).

Now only one pair of resident badgers remained, M 42 and F 40. Male 42 extended his range to the east and probably also visited pen 2, but at the same time signs of the



Photo 8. The most important reason for leaving the area of reintroduction probably is the presence of other badgers. Pens with newly introduced badgers, waiting to be released, may be 'besieged' by the badgers already living there, which dig fresh holes and latrines along the outside of the fence almost every night. Photograph: J.L. Mulder.

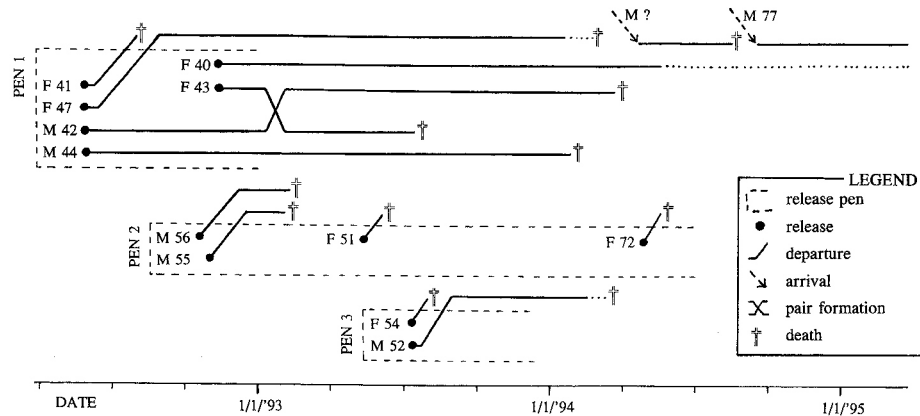


Fig. 7. Schematic chronological overview of badger releases and the results in Overijssel.

presence of a wild badger were noticed in the north-eastern part of the release area. This badger dug a small sett in the vicinity of pen 3. The next development was the death of M 42 on April 4th, killed while crossing the road when the badger tunnel was still blocked by water. Now only F 40 and the wild badger mentioned above, whose signs were found 3 km to the east of the range of F 40, remained in the area. However, observations at the sett of F 40, on the evening of April 23rd, led to a surprise: F 40 was accompanied by a strange, large badger, perhaps the same individual of which we had found the sett and tracks before. Having appeared from the sett, the badgers mated for 45 minutes, in front of the observer.

Female 72 was released on May 3rd. She stayed for two days, but then ran off to the east and drowned in the canal from which M 56 had been rescued about one year earlier.

#### Last developments in the Overijssel project

Until 5 July 1994, two badgers were observed at the only occupied sett left. The transmitter of the last remaining reintroduced badger, F 40, had ceased operation by then. At the end of August a wild male badger was found dead on the road, probably the mate of F 40. Within weeks he had apparently been replaced: from the sett came the transmitter signal of a subadult male (M 77), born the previous year in the nearest sett of wild badgers, 7 km to the north-east. At the time he was accidentally captured and given a transmitter, during attempts to recapture F 47 for transmitter replacement. The latter had joined these wild badgers in 1992 already, had reproduced for the first time in 1994, but was then killed on the road.

At the beginning of 1995, the overall result of the reintroduction project in Overijssel, after three years and twelve badgers released, was that at most only one released badger (F 40) still lived, accompanied by a wild male, her third partner within a period of one year. In June 1995 she reproduced: two cubs were seen at the sett. Fig. 7 schematically shows the successive releases and their results in the Overijssel reintroduction area.

#### Adding a solitary female to established badgers in Friesland

Although reintroduction in successive stages was not the aim in the Friesland project, a two year old female (F 70) was released in a pen in mid-October 1994, after five animals had settled around the site of release one year before (see below). This female was released in a badger pen (fig. 3, pen 6) at the edge of the range of at least one of the resident males (M 63). It took him twelve days to discover her. After his first visit to the pen, he most probably returned there only once again, two nights later. It is not known if the resident female visited this pen, because her transmitter had ceased operation. When F 70 was released after a period of five and a half weeks, she showed very little activity, spending almost all her time within or in close vicinity to the pen. Winter set in, reducing her activity still further, and at the end of February 1995, three months after her release, she still lived in the same woodland, resting in the artificial sett in the pen or in one or two other setts in the vicinity. We never were aware of meetings between her and the resident badgers.

#### 4.2. One-attempt reintroduction

##### General set-up of the release scheme

In south-eastern Friesland eight badgers were released within a short period of time. First, two males were placed in each of two pens, 1.2 km apart at either side of the river Tjonger (fig. 3, pens nrs 4 and 5). These males were released simultaneously, at the beginning of January 1994. The males of pen 4 quickly discovered the remains of an old, large badger sett which was situated 100 m from their pen. Seven days after their release they slept in this sett for the first time, and subsequently slept there every third day on average. The pen was closed again 18 days after the release of the males while these slept in the old sett, and two females were placed inside.

It took the males of pen 5 somewhat more time to leave their pen. A fox earth and a rabbit warren were sometimes used as a day rest site in the first three weeks after their release, but the artificial sett in the pen remained their favourite sleeping place. Fifteen days after their release, M 78, an adult male, left the area of reintroduction. In the 36th night we closed pen 5 while the other male, M 67, was absent foraging. The next day two females (an adult and a subadult) were introduced into the pen. At this stage, three males were roaming freely in two home ranges and four females were kept in two pens, each pen within one of the home ranges of the males.

##### Wandering female

F 79, the adult female of pen 5, escaped in the night of 4-5 March after 23 days of captivity, through a hole dug under the fence. Two days later she was discovered in an enlarged rabbit burrow 8 km from the pen, at the other side of the river Tjonger. For the next five days and nights she stayed in that burrow, probably leaving it for defecation only: during both of the first two days a fresh dropping was found a few metres from the entrance. She left the burrow in the fifth night after her discovery at 19:20 and started to wander about, returning to the burrow one day later. The next night she left again, to return ten days later. The only possible explanation for the lack of mobility between



her escape and the start of her wanderings seems to be that she had given birth to a litter in the rabbit burrow, which must have perished some days later. She might even have escaped for this reason, not wanting to have her litter inside the pen which she shared with the other female. Technically it is possible that she was pregnant. She had been captured on December 3rd, after having been injured in a collision with a car. As an adult female she might have carried blastocysts at the time, which subsequently must have been implanted in the uterus at about January 15th, i.e. during her stay in the badger asylum.

This female wandered in an area of about 220 km<sup>2</sup> for a period of 33 days, sometimes visiting the area of reintroduction during the night but never sleeping there (Mulder, in prep.). During this period, the other three females were not released from their respective pens. One day we found that M 67 had climbed into pen 5 and locked himself in again; the electric fence at the outside of the pen did not function properly. One of the males of pen 4 started to visit pen 5 after M 67 had climbed in.

#### Releasing the females

On April 12th, both pens were opened again. The situation in and around pen 5 developed smoothly. The newly formed pair, F 73 and the sneaker-in M 67, stayed together until the end of the project (February 1995), steadily enlarging the sett in the pen and making it into a real main sett. This 'artificial' sett differed from all other artificial setts in that it did not contain a wooden case and PVC or concrete pipes. It had been made out of a rabbit warren by digging a vertical shaft into it and by widening the rabbit burrows from within the shaft and from the surface. The shaft was covered by a wooden board, the only artificial item in the sett. The badgers in this sett could dig in to all directions without obstruction, which may explain the prolonged use of this sett. M 65 from pen 4 soon refrained from visiting the vicinity of pen 5 and stayed on his side of the Tjonger.

The two females of pen 4 (F 74 and F 68) started their explorations, but right then, i.e. in the second night after their release, the wandering adult F 79 decided to settle in the old sett near pen 4. While we were tracking F 74 and F 68 on the night of 13/14 April, at 03:45 a.m., F 79 arrived in the area of reintroduction. She moved around slowly and finally entered the old sett, where she was found resting at 05:30 a.m. Ten minutes later the two resident males 63 and 65 arrived. By day we found out that these three badgers were sleeping in the same part of the sett. F 68 appeared to sleep in a separate part of the sett, whereas F 74 rested in the artificial sett in the pen, 100 m distant. What would happen next, with three 'new' females and two resident males so close to each other?

Within days things became clear. F 79 stayed for good. F 74 drowned in the Tjonger two nights later, having extended her explorations beyond the stretch where the steep sides of timbering had been removed. She appeared to have fresh bite wounds on her face and thighs, suggesting that she had had a clash with another badger, probably F 79. The other female, F 68, left the home range of the resident males and moved gradually away from the area of reintroduction. We rescued her when she was swimming in the river Tjonger, trapped between the steep sides at the same place where F 74 had drowned three nights before. Eventually, after three weeks of wandering she settled, alone, in an old, disused badger sett 16 km away.

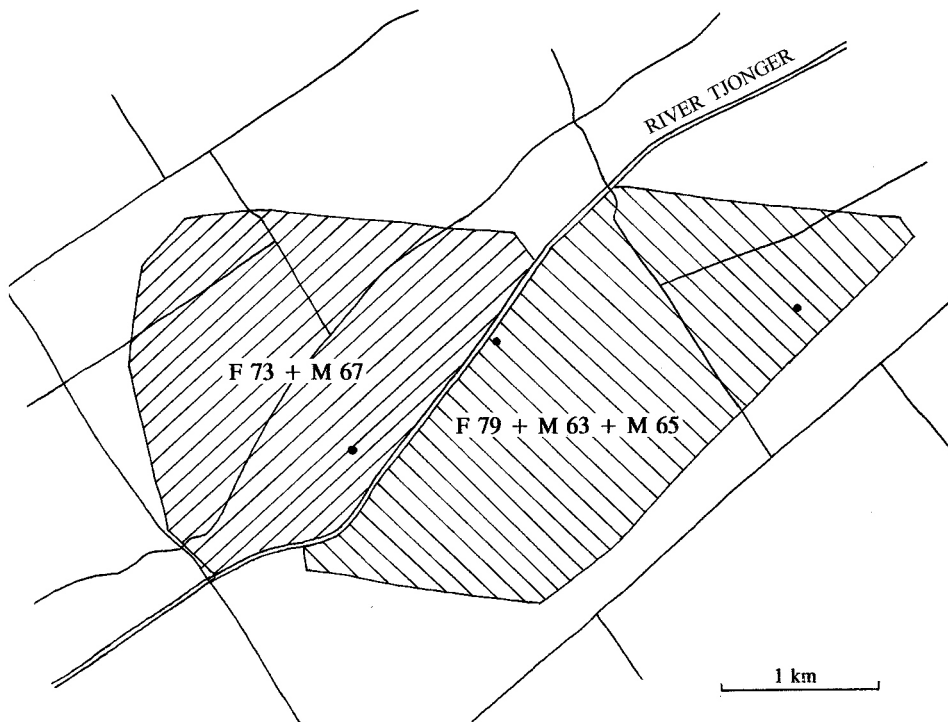


Fig. 8. Approximate home ranges (April-December 1994) of the five badgers which settled in the Friesland reintroduction area, showing the positions of the three release pens.

The balance after releasing eight badgers in a single reintroduction attempt was rather positive: five animals settled in the area of reintroduction, forming two stable groups (fig. 8); one female settled elsewhere.

## 5. Factors affecting the outcome of the release

### 5.1. General set-up

From the results of the two release schemes, it would seem that releasing a relatively large number of badgers in an 'empty' area at about the same time is more successful than releasing small numbers in succession. Adding animals to badgers already resident in the area hardly succeeded in our experiments. Out of nine badgers (six females, three males), only three females stayed where they were released: two females placed in the centre of the home range of two 'bachelor' males in the Overijssel area, and a female in Friesland released next to a home range with three established badgers (a female and two males). The reasons for the departure of the other six animals are not clear (see below), but may well be connected with the visits of the resident badgers to their pens, and/or later contacts between the newly released and already established badgers. Many badger experts have warned against releasing badgers within the home

range of other badgers (Harris et al., 1990; Kruuk, 1989; T. Roper, pers. comm.). We observed a ferocious fight between a resident male and a newly released female, upon which the female left the area for good, and we witnessed a long chase between a resident and an itinerant male. Furthermore, we obtained evidence of a fight between a resident and a newly released female, after which the latter drowned; when found, she had fresh wounds in her face and on her thighs. Roper (1988) mentions the death of two or three out of 15 translocated badgers on the release sett, supposedly killed by resident badgers.

When dealing with an area devoid of badgers, there seem to be two ways of avoiding problems: either release as many badgers as possible at the same time, thus giving them equal chances (the one-attempt approach), or release badgers in successive stages, but at localities far enough apart to ensure that the different groups do not meet each other during the first few months or so. According to our results, the release pens in that case should be at least 4 km distant from each other, preferably more.

### 5.2. Staying or leaving?

The two main problems that we observed were the high proportion of badgers leaving the areas of release and the high mortality. The factors influencing the decision of badgers to stay or to leave remain unclear. The duration of captivity in the release pen was not different between badgers staying ( $7.7 \pm 2.3$  weeks) or leaving ( $7.5 \pm 3.0$  weeks). It is not known whether the use of pens is at all necessary to release badgers successfully. In the past a few reintroductions of badgers in the Netherlands (for instance near Stap-horst) and elsewhere had been successful, even though the animals were simply released at a disused sett (R. Hoeve, pers. comm.; J. Vink, pers. comm.; Murray, 1970; Ratcliffe, 1973).

When a badger left the area of reintroduction, it always did so within 15 days after its release. Times of departure were 2, 6, 7, 7, 8, 10 and 15 days after the release, respectively. The two badgers which forced their own release, i.e. escaped, left the vicinity of the pen in the same night. Kruuk et al. (1986) mention that their badgers, released after years of captivity, departed after a week and a month, respectively, upon opening of the gate.

As other authors have found (for instance Kruuk et al., 1986), badgers show an astonishing capacity to find natural food after having been fed in captivity, sometimes for years. In most cases our badgers discarded their food bowls within days after their release; some animals, for instance the escapees, apparently did not need their food bowls right from their first day of freedom. Clearly, to a newly released badger food is not an important factor in the decision to leave or to stay.

### 5.3. Sex

Males tended to stay more often at the site of release (5 out of 9) than females (4 out of 11), though the difference is not significant. To establish new populations it is, however, more important that female badgers settle at the site of release than males. Data from 526 wild badgers, collected as road victims in the Netherlands, show that more females than males are found at distances of more than 3 km from the nearest sett (20 vs 5,  $\chi^2 = 9.0$ ,  $p < 0.01$ ). Out of 15 drowned badgers, twelve were found further than 3 km from the nearest sett; and eleven of these were females. Twenty individuals among the

sample of road victims and drowned badgers had been caught before, as juveniles at the sett; they had been tattooed and released the same day. All of these were found within 3 km of a badger sett, although eleven of them (5 out of 13 males, 6 out of 7 females;  $\chi^2 = 1.85$ ,  $p > 0.10$ ) were collected at more than 3 km from their natal sett (Müskens & Broekhuizen, 1993). These results with wild badgers suggest that females tend to disperse more often and over longer distances than males.

#### 5.4. Season

The season may be an important factor in the decision to stay or leave. Harris et al. (1990) suggest that releasing badgers in late autumn may be more successful than in spring or summer, due to the decreasing activity of both resident and released badgers in the former season. Overend (1993b) relates that the badgers she raised at her home chose to settle with wild groups in January or February (the females) or April or May (the males). This season of 'dispersal' supports the results obtained by Müskens & Broekhuizen (1993), who found that 19 out of 20 females which had dispersed over more than 3 km, were collected in spring (February to June inclusive).

Of the 21 badgers released in this project, nine were released in autumn and winter (September-February) and twelve in spring and summer (March-August). Of these animals, three and eight respectively, left the area of release. Therefore it seems that badgers released in autumn and winter tend to stay more often in the area of release (6 out of 9) than those released in spring and summer (4 out of 12), though the difference is statistically not significant ( $\chi^2 = 1.09$ ,  $p > 0.10$ ). If we restrict the analysis to those animals released in the neighbourhood of established badgers ( $n = 9$ ), the effect of season seems to be stronger. Four badgers were released in spring and summer, and five in autumn. Of these, only three, all females released in autumn, stayed ( $\chi^2 = 2.40$ ,  $p > 0.10$ ). These results suggest that releasing badgers in autumn and winter may be more successful than setting them free in spring and summer, but a larger sample size is needed to confirm this.

#### 5.5. Individual history

Another factor of importance in a badger's decision to leave or to stay, may be the history of that individual. In the badger asylum it was customary to form small groups of young badgers as soon as they arrived, to be released together later. Siblings were separated, to avoid future inbreeding in these release groups. However, while growing up together, the young badgers in a group probably start to consider each other as siblings. The result might be that they do not regard their group members as potential sexual partners after having been released in the wild as (sub-)adults, which may lead to the departure of one of the sexes. Exactly this happened at the very first release of four badgers in the Overijssel project: both females left after about a week, both males stayed. From then on real siblings were kept together in the asylum, to be formed into release groups at a much more advanced age, thus preventing a possible effect of growing up together. The existence of inbreeding avoidance by littermates is well known from studies on other mammals. In Barbary macaques *Macaca sylvanus* it is apparently familiarity during early life that causes mutual sexual indifference, not genetic relatedness (Kuester et al., 1994).

Cohesion in the group of badgers to be released together, which is seen as a necessa-

ry prerequisite for a successful release (Cresswell, 1993), apparently does not guarantee that the members stay together after being released. A couple of badgers that had shown much affection and cohesion in captivity, split up from the first day after their release from pen 3, and both animals dispersed.

#### 5.6. Resident badgers

The most important factor probably is the presence of other badgers. Of all our attempts to 'add' badgers to already established ones, only attempts with females (but not all females) succeeded: two females in the centre of a home range shared by two bachelor males; two females in the two home ranges of three males, very soon after these males had been released themselves; and finally one female in the periphery of the home range of two males and a female, already established for almost a year. The three remaining attempts to add badgers to resident groups led to the departure of the newly released badgers: two males together, two individual females, and a couple, respectively. Their pens had invariably been visited by one or two resident males during their captivity.

Before these reintroduction projects started, the badgers from the asylum were released, mostly after having spent some time in a release pen, near populations of wild badgers, to reinforce these. The fate of most of these badgers could not be followed, but some were found dead sooner or later. The overall success of these releases does not seem to have been great, probably as a result of interference by resident badgers, although usually an increase in badger activity over the years was noticed (J. Dirkmaat, pers. comm.). Out of 26 released badgers, seven were known to have lived longer than six months and five died within six months. The fate of the other 14 badgers remains unknown (Anonymus, 1992).

On the other hand, the presence of badgers apparently may attract other badgers, according to our observations in the Overijssel reintroduction area. A female released in the first reintroduction attempt left after seven days and found the wild badgers living 7 km away; she stayed there for good. At least three wild badgers (one female, two males) turned up in the reintroduction area within a period of one and a half year, and associated with the released animals. Before the start of our reintroduction attempts, badgers had never been observed in that region. This phenomenon may be important for future reintroductions: if badgers are released not too far from existing populations, the new population may intercept badgers straying from the existing one.

#### 5.7. Sett quality

Another factor likely to improve the chance of settling of released badgers, is the quality of the available (artificial) sett. Only recently has the sett received some attention as being an important 'resource' for badgers, and even as a possible reason for the existence of sociality in badgers (Roper, 1993). One of the indications that sett quality was important in our experiments is that the only 'artificial' sett remaining in use for more than a year, was the one made out of a rabbit warren, without wooden walls and concrete or PVC pipes, giving ample opportunity for digging. Furthermore, a large, old badger sett in the vicinity of one of the release pens was quickly occupied by the badgers and was still in use as a main sett one year later. In this same sett a female badger took up residence after having wandered for forty days, sleeping in small fox earths and rab-

bit burrows. Another female left the area of reintroduction and eventually settled, without other badgers in the neighbourhood, in a disused fox earth which, in view of its size and shape, had been dug by a straying badger some years earlier.

To increase the success of badger reintroductions, it may therefore be advisable to provide the animals with a large and not too artificial sett, for instance by digging several trenches towards two or three interconnected chambers, not reinforcing the burrows and chambers with wood, leaving earth walls, covering everything with wooden boards (as the only artificial elements) and covering these in turn with a thick layer of soil. One of the entrances should be situated higher than the others, to ensure a good airflow (Cresswell & Lewns, 1992).

#### 5.8. Mortality

In attempts to establish a new badger population by releasing young animals, it is of vital importance to prevent mortality, since it takes one or two years before reproduction is possible (Cresswell, 1993). Female badgers do not generally have their first litter until the spring of their third year (see the review by Broekhuizen et al., 1994). During their first years of sexual maturity only 40% of the females actually give birth, whereas 80% of the older females have litters (Broekhuizen et al., 1994). Taking the relatively small litter size into account (3.3 cubs per litter in the Netherlands; Broekhuizen et al., 1994), population growth in badgers is very slow, stressing the point that mortality prevention in the initial stage of a population is important.

The reintroduction project in Overijssel was hampered by three road kills of established released badgers as well as two road kills of wild badgers which apparently had settled in the reintroduction area (photo 11). Four of these accidents took place on the same road running right through the centre of the area. The three badger underpasses and their accompanying fences did not prevent these road kills, because from time to time the badgers crossed the road in between these provisions. The reintroduction area in Friesland lacked busy roads, but nevertheless a badger was killed on a road a few days before the end of the research period.

The other cause of mortality was drowning (photo 9). Only one badger drowned in a reintroduction area, but a second one was rescued in time from the same canal. Two other badgers drowned while wandering away from the site of reintroduction, whereas two more dispersing badgers were rescued. So, altogether six out of the 21 released badgers had been trapped in water with sides too steep to enable them to clamber out. Drowning must be a much more important mortality factor among badgers in the Netherlands than has always been assumed. The badgers followed in this research project readily took to water, crossing ditches and streams of various widths. The practice of reinforcing the banks of streams and canals with steep timbering results in the presence of deadly traps everywhere in the Netherlands. Out of 555 dead badgers inspected between 1981 and 1990 by Müskens & Broekhuizen (1993), only 15 (2.7%) had drowned, while the remaining 540 had been killed on the road. Of the badgers released in this project six might have drowned (if not rescued), whereas six others were killed on the road. Most probably a very high proportion of traffic-killed badgers is reported, because the badger is rather rare in the Netherlands and a dead badger on the roadside is a conspicuous sight. A drowned badger, on the other hand, is much less easily seen and probably remains floating for a short time only. The proportion reported must be very low indeed.



Photo 9. The number of badgers in the Netherlands drowning in canals with steep sides is probably grossly underestimated, because the chances of finding a drowned badger are small. Photograph: J.L. Mulder.



Photo 10. In summer badgers sometimes slept above ground, preferably in maize fields. Photograph: J.L. Mulder.

In conclusion, an area selected for reintroduction of badgers should be free of (busy) roads within a circle of about 5 km around the site(s) of release, or the roads should be sufficiently fenced and tunnelled. The area should also be devoid of water with steep, timbered sides.

#### 5.9. Some further practical suggestions

If badgers have to be released in the wild, because they have been rescued as orphaned cubs, their stay in the asylum should be as short as possible. As soon as they are able to eat solid food from a bowl, they may be kept in a pen erected at the site of capture. Such cubs may be accepted by the remaining resident badgers (Woodroffe, 1993), and this should be confirmed by observation before the pen is opened. If it is not possible to release rehabilitated cubs on the site of capture, i.e. within their own group territory, it might be possible to release them near another occupied sett, since strange cubs may be more readily accepted by adult badgers than strange adults (Overend, 1993a). At the same time, cubs are less likely to desert the site of release (Cresswell, 1993). Releasing cubs may thus be a relatively simple way to reinforce small, isolated badger populations.

If the aim is to establish a new badger population in an area where no badgers lived before, it is doubtful whether it is worthwhile to use badgers which have been brought to the asylum as (wild) adults, or badgers which have been caught in the wild. They may be more liable to escaping from the release pens (Cresswell, 1993) and may also have a greater urge to disperse, in search for their home territory. Of the two adult badgers reintroduced during this research, one escaped prematurely and both left the site of release and wandered widely, although one of them eventually returned and settled in the area of release. On the other hand, if adult badgers can be persuaded to stay in the vicinity, the new population may reproduce much earlier than if only subadults are set free.

#### 6. Concluding remarks

In the preceding section many suggestions have been made how to establish new badger populations in empty areas. However, these suggestions are based on limited material. Successful reintroductions are obviously feasible, but require a high degree of effort and luck, and at the same time a low degree of expectation. We feel that more different reintroduction situations should have been tried, with accompanying research, to arrive at more clearly defined 'reintroduction procedures' than has been possible on the basis of our present experience. However, in the light of our experience with wandering badgers (Mulder, in prep.), the usefulness of badger reintroductions seems questionable: if deadly barriers (canals with steep sides, main roads) are 'removed', badgers are capable of reaching every corner of the land by themselves. On the other hand, to persuade straying badgers to settle somewhere probably requires the presence of other badgers or of a suitable sett. The artificial construction of large setts, as natural as possible in terms of architecture and siting, may be enough to attract wandering badgers to suitable areas. That will, however, take time, which is a limited resource in politics...



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## SUMMARY

We attempted to reintroduce badgers in two areas in the Netherlands, with the aim of improving the connections between small, isolated populations. The badgers were mostly orphaned juveniles, obtained from a badger asylum. After implantation of a transmitter they were initially kept in pens and released after several weeks. In one area twelve badgers were released in five successive stages; after three years only one reintroduced badger, a female, remained, accompanied by a wild male which apparently was attracted to the reintroduction area. Many badgers left the area of reintroduction and died sooner or later. In another location eight badgers were released more or less simultaneously (the males some weeks before the females), followed by one female some months later. After one year five badgers still lived in the area.

The observations are reported in detail. The small sample sizes allow only tentative conclusions. The badgers which left the area of reintroduction always did so within 15 days after having been set free. Females tended to leave more often than males and males never stayed when released in areas where other males had already settled. When reintroducing badgers, the best results may be obtained by releasing many badgers at about the same time, releasing them in autumn or winter and by offering large artificial setts with ample opportunity for digging.

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## SAMENVATTING

Het uitzetten van dassen *Meles meles* in Overijssel en Friesland

In het kader van het 'Dassenbeheersbeleid', zoals dat in 1985 door de Tweede Kamer is vastgesteld, werd in 1992 begonnen met het uitzetten van de das in enkele gebieden waar hij lang geleden voorkwam. De twee gebieden, Midden-Overijssel en Zuidoost-Friesland, waren zo gekozen, dat de nieuwe populaties een schakel zouden kunnen vormen tussen enkele nog bestaande kleine, geïsoleerde populaties (fig. 1). De uitgezette dassen kwamen alle uit het Dassenopvangcentrum en waren, op twee volwassen dieren na, jongen van wie de moeder was doodgereden. Na implantatie van een zender werden ze losgelaten in uitzetrennen, waar ze enkele weken de tijd kregen om te wennen voordat er gaten in het gaas werden gemaakt.

In Overijssel werden op het landgoed Eerde, gemeente Ommen, in vijf achtereenvolgende fasen in totaal twaalf dassen uitgezet. Begonnen werd met twee mannetjes en twee vrouwtjes in één ren. De twee vrouwtjes verlieten kort nadat ze waren losgelaten het uitzetgebied, de mannetjes bleven. Eén van de vrouwtjes sloot zich aan bij wilde dassen in een burcht op 7 km afstand van de plaats waar ze was uitgezet. Twee jaar later wierp ze jongen. Kort daarna werd ze echter door een auto overreden en belandden haar jongen eveneens in het Dassenopvangcentrum. Van de acht dassen die tijdens de volgende vier fasen werden uitgezet, bleven slechts de eerste twee vrouwtjes in het ge-

bied; de andere zes dieren vertrokken (wellicht als gevolg van de contacten met de reeds gevestigde dassen) en werden vroeger of later doodgereden of verdrinken gevonden. Ook twee van de dassen die zich ter plekke hadden gevestigd werden doodgereden, ondanks de aangebrachte voorzieningen in de vorm van dassentunnels en das-senkerende rasters. Drie jaar na het uitzetten van de eerste dassen leefde er in het gebied nog slechts één uitgezette das, een vrouwtje, in gezelschap van een wild mannetje, dat vanuit bovengenoemde dassenburcht de 7 km afstand naar Eerde had overbrugd. In juni 1995 werd het vrouwtje met twee jongen gezien.

In Friesland, in de buurt van Oldeberkoop, werd een ander uitzetschema gevolgd. Hier werden zo veel mogelijk dassen min of meer in één keer uitgezet, zodat ze elkaar onder vergelijkbare omstandigheden ontmoetten. Begonnen werd met vier mannetjes, verdeeld over twee uitzetrennen. Kort na het loslaten van deze mannetjes werden vier vrouwtjes in dezelfde, weer afgesloten rennen geplaatst, op een dag dat de mannetjes erbuiten sliepen. Het idee achter deze opzet was dat de vrouwtjes, die zo belangrijk zijn voor het vestigen van een populatie die zich voortplant, wellicht meer geneigd zouden zijn in het terrein te blijven als de mannetjes er hun geuren al verspreid en wissels naar de voedselgebieden gemaakt zouden hebben.

Van de acht dassen verlieten één mannetje en één vrouwtje het uitzetgebied. De eerste verdrong, de laatste vestigde zich net over de provinciegrens in Drenthe. Een tweede vrouwtje verdrong, kort nadat ze was losgelaten, in de Tjonger, net buiten de 2 km lange zone waar de steile beschoeiing was vervangen door een glooiende helling van steenslag.

Enkele maanden later werd er in dit gebied nog een vrouwtje 'bijgezet', in een derde ren. In de drie maanden dat ze nog gevolgd kon worden, bleef ze het terrein rond de uitzetren bewonen. Ruim een jaar na het loslaten van de eerste dassen bij Oldeberkoop leefden er nog vijf dieren in het uitzetgebied, plus één in Drenthe.

In dit artikel worden de gebeurtenissen en waarnemingen vrij uitvoerig beschreven. De omstandigheden waren onderling verschillend en het aantal dassen en uitzetschema's beperkt, waardoor slechts voorzichtige conclusies mogelijk zijn. De dassen die het uitzetgebied verlieten, deden dat alle binnen 15 dagen na vrijlating uit de uitzetrennen. Vrouwtjes verlieten het gebied vaker dan mannetjes en mannetjes bleven nooit, als ze waren uitgezet in een gebied waar zich reeds mannetjes hadden gevestigd. De beste resultaten worden wellicht bereikt als er veel dassen tegelijk worden uitgezet in een door dassen onbewoond gebied, maar toch niet al te ver (10-15 km) van bestaande populaties. De kans op het 'invangen' van zwervende dassen is dan groot. Dassen die in de herfst of de winter worden uitgezet en kunnen beschikken over een grote kunstburcht van waaruit ze zelf naar alle kanten kunnen graven, zijn wellicht wat meer geneigd om in het uitzetgebied te blijven.

Opvallend was het grote aantal dassen dat verdrong of bijna verdrong. Dassen kunnen goed zwemmen en gaan vrijwillig te water; de dassen van Eerde zwommen soms elke nacht meermalen de Regge over. Als ze echter te water gaan in een waterloop met gladde beschoeiingen, kunnen ze er niet meer uit. In totaal raakten zes dassen op die manier 'gevangen'; drie daarvan konden min of meer toevallig gered worden. Vermoedelijk wordt het aantal dassen dat jaarlijks verdrinkt in zulk beschoeid water sterk onderschat, doordat de kans dat zulke dieren gevonden worden, ongetwijfeld zeer veel lager is dan bij verkeersslachtoffers.

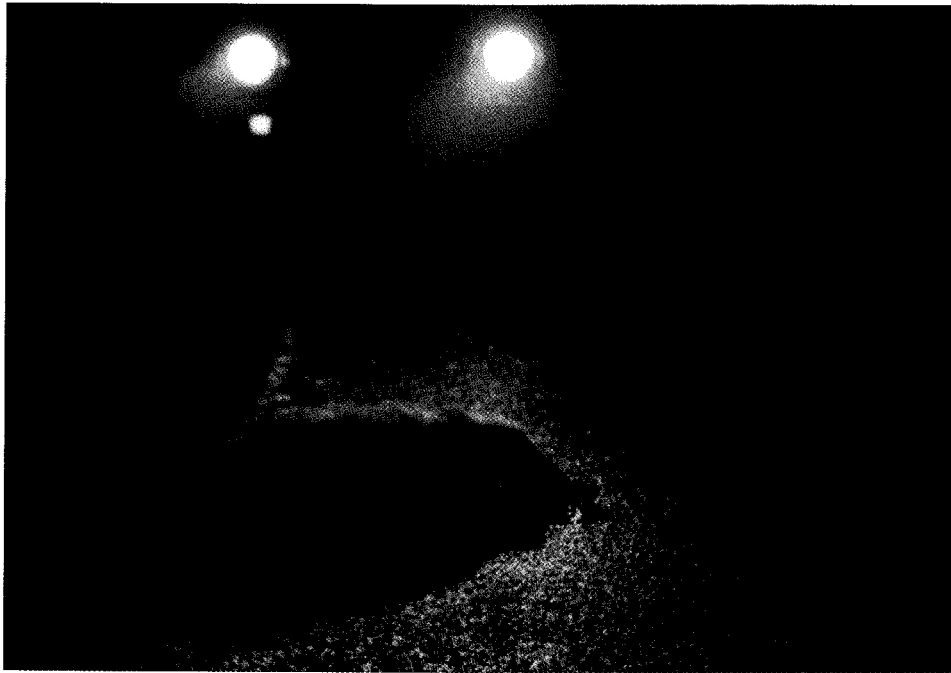


Photo 11. Every year, 300-400 badgers are killed on roads in the Netherlands. This animal is M 56, killed in the Overijssel reintroduction area (see p. 15).

Photograph: J. L. Mulder.

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