Development of a Protective Fence for Wildcats (*Felis silvestris silvestris*) at Roads based on Behavioural Studies. A Contribution to Species Conservation of Mammals

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Summary

Up to 50% of the total mortality of Wildcats (Felis silvestris silvestris) is due to accidents with traffic on roads. In order to effectively protect this and other migrating species, it is necessary to develop a highly effective protective fence along roads, - beneath efforts to reestablish permeability of motorways for migrating cats. This paper describes experiments on the behaviour of wildcats being confronted with different types of protective fences. The ideal fence, which fulfilled criteria such as unclimbability for the wildcat, low risk of injury and low costs best was of a total height of 180 cm (wire netting distance of 4.0 cm). On top of that fence an L-shaped metal plate of a height of 20 cm on one side and 30 cm on the other, angled 45° downwards, was installed.

1 Introduction

Many wildcats are killed on roads in Germany (VOGT 1985, KLAUS 1993). Despite a lack of empirical material, there is the risk that populations are suffering large losses on busy roads and are being greatly destabilized in conjunction with barrier and fragmentation effects. Usually game protection fences, which have been installed on roads to reduce collisions, are 160 cm tall and aim to protect hoofed game (red deer, roe deer, wild boar) but pose no barrier to wildcats. Appropriate protective fences must therefore urgently be developed to protect significant wildcat areas in Germany. Additionally, passages across roads in the form of overpasses and underpasses, “green bridges”, etc. (UECKERMANN & OLBRICHT 1984, ROTH & KLATT 1991) must maintain contact between the divided populations in selected areas.

The following contains a report on studies in which different fence types were reviewed in terms of wildcat safety during a field test based on behavioural observations. The contractor of the 1994 study was Landesbetrieb Straßen und Verkehrswesen Rheinland-Pfalz (Rhineland-Palatinate State Roads and Traffic Organisation).

2 Methodology

In a test enclosure, it was observed how fast and how the wildcats climbed over the differently constructed test fences and what behaviour they demonstrated (see 2.1 Field test). The behaviour shown at the fence was classified into behaviour groups and behaviour instances (see 2.2 Analysis) and evaluated by type, duration and frequency of occurrence.

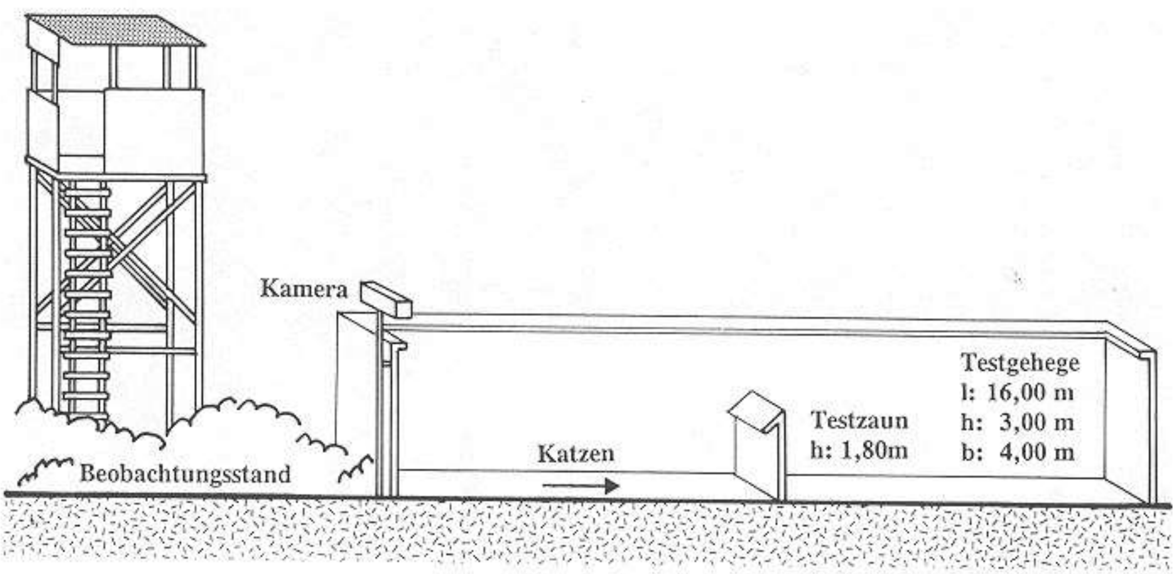
2.1 Field test

2.1.1 Testing enclosure

The field test was conducted on young reared wildcats, which were being prepared for life in the wild in a special enclosure as part of the Spessart Return to Nature Project by BUND Naturschutz (Conservation Union) in Bavaria. This phase of the enclosure rearing, which serves as a transition between the rearing station and "the outdoors", was used for the test series. The wildcats (2 males and 5 females) were about 6-8 months old – the age when they separate from their family and start searching for new territory. This phase of the territory search is characterized by increased activity and an increased motivation to climb over the test fences. Further motivations arise from the daily routine typical for this species (searching for sleeping places, feeding and maintaining the individual distances).

The existing enclosure for the return to nature was modified for the test series. Specifications for the design of the enclosure and the fence were obtained through expert interviews at wildlife research institutes, zoos, etc. as well as through literature evaluation. The enclosure was divided into two equal parts (4 x 8 m each), taking into account the jump height of up to 160 cm, by a double, 160 cm or 180 cm tall wire-mesh fence (mesh width 4 cm), see Fig. 1. This fence was modified several times during the test (see 2.1.2 Fence versions) by putting differently shaped fence ends (end plates) on top of the fence.

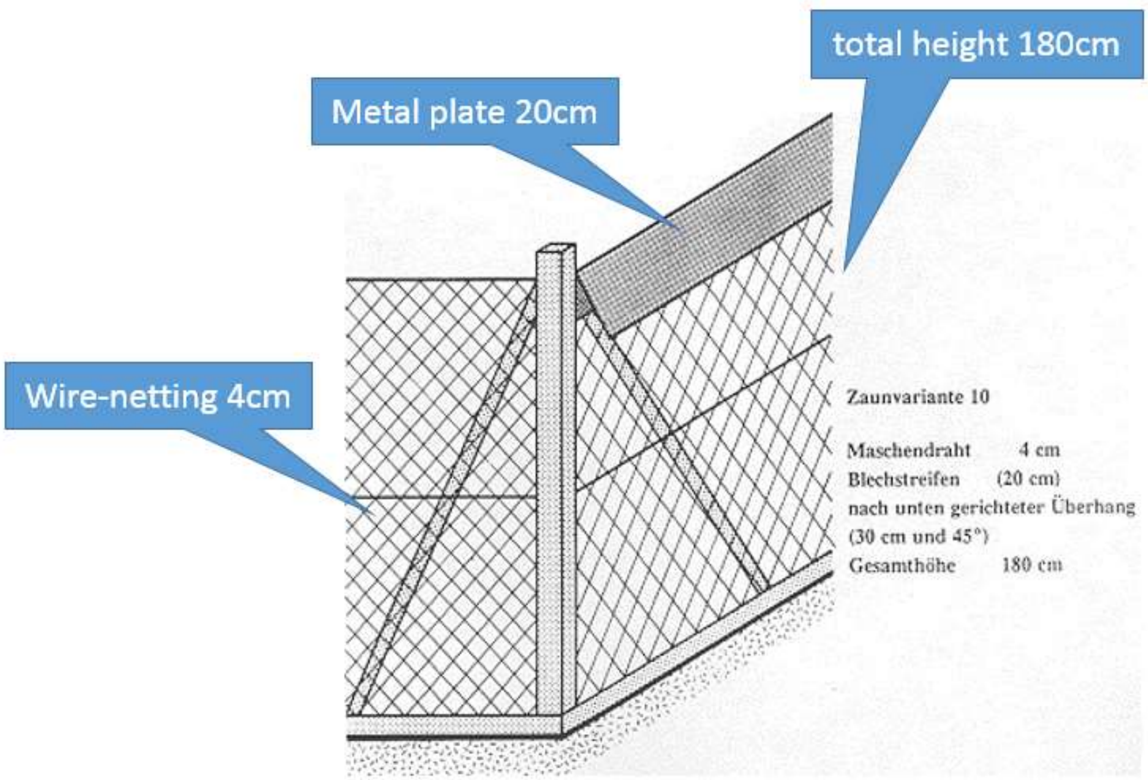
Figure 1: *Prinzipskizze des Versuchsgeheges* - principle sketch of the experimental enclosure (*Beobachtungsstand* = observation post; *Katzen* = cats; *Testzaun* = experimental fence; *Testgehege* = testing enclosure; l = length; h = height; b = width)



2.1.2 Fence versions

Ten different fence designs or end plates were used for the test (see Tab. 1); exemplary graphic representation of fence design 10, see Fig. 2. Generally, a 4 cm wide chain mesh was used for the fence; the final fence height was 160 cm (fence designs 1 - 3) or 180 cm (designs 4 -10).

Figure 2: ***Exemplarische Abbildung der Zaunvariante 10*** **- Exemplary illustration of fence variation No. 10**



2.1.3 Technical equipment for the documentation of behaviour

The behaviour of the animals in the testing enclosure was recorded with a low light video camera (manufactured by Proxitronic, Bensheim) and a mobile video recorder. The camera was installed above the enclosure fence in order to trace the behaviour of animals in front of the experimental fences.

2.1.4 Experimental setup

Fence types 1, 2, 3 and 4 were tested from 14/9/1993 to 26/9/1993; three test animals (1 male and 2 females) were available for this first test series (fences 1-4). Fence types 5-10 (second test series) were tested from 6/10/1993 to 27/10/1993 (1 male and 3 females). The animals had been able to familiarize themselves with the enclosure for five days prior to the start of the test. The cats were given a break for a day or two between the individual tests in order to recover them from possibly stressful situations (while maintaining the security fence but without the plates).

At the beginning of the test (for each fence type), the cats were randomly distributed on both sides of the test fence according to the individual distance maintained by the animals. The motivation to climb over the test fence resulted from the daily routines and behavioural patterns mentioned in chapter 2.1.1. Repositioning of all animals in front of the test fence before the start of a new test series would not have created any additional incentives, but would have resulted in disturbances and changes in behaviour and would have also affected the goal of returning the animals to nature.
The external conditions were kept as constant as possible through fixed feeding and enclosure cleaning times, the food being equally distributed on both sides of the fence, building the test fences in the afternoon and similar recording periods, etc.

Tab. 1: Untersuchte Zaunvarianten und Beschreibung des Zaunkopfes – examined fence types and head of the fences

Fence type	Height of metal plate/panel (cm)	Head / Modification of panel
1	20	none
2	30	none
3	50	none
4	60	projection of 10 cm
5	30	with wires
6	90	projection of 10 cm
7	50	downward projection (30 cm, 45°)
8	50	arched projection (gutters with Ø 10 cm)
9	50	upward projection (30 cm, 135°)
10	20	downward projection (30 cm, 45°)
reference	standard game fence	wire mesh, 180 cm tall

Based on the main activity phases of cats known from outdoor studies, the recording took place from approx. 6 pm until approx. 2 am, and from approx. 5 am to 9 am.

2.2 Analysis

The type and frequency of fence passes were documented. The behaviour of wildcats observed in front of the camera from start to finish of the activity (hereinafter referred to as “behaviour sequence”) was compared in terms of duration and frequency of occurrence in different behaviour groups. This should serve as an indicator of the effectiveness of each fence type and provide insight into their optimization. For analysis purposes, the behaviour of wildcats at the fence was divided into 18 behavioural instances, and these behavioural instances in turn were reclassified into 4 behaviour groups – “intention-driven behaviour”, "effort", "resignation-driven behaviour", and "other behaviour". "Intention-driven behaviour" includes behaviour instances such as "running to the fence" or "sitting on the fence". "Effort" includes behaviours associated with climbing over the fence such as "climbing", "jumping", "standing up on the fence", etc. "Resignation-driven behaviour" can be recognized by "turning away from the obstacle". The summary was necessary since no behavioural instance alone was suitable to serve as an eligibility criterion.

3 Results

3.1 Climbing over the fences

The simple chain-link fence installed between the individual tests (without special precautions) was regularly climbed over by the cats without much effort.
Fence types 1 to 5 also posed no obstacles to the test animals. The wildcats were able to jump to the top edge of fences 1 to 3 equipped with end plates without the cover, which were only 160 cm tall, and were able to jump onto and over the higher fence versions 4 and 5 with short rectangular covers.
Fence types 6 to 10 were not climbed over. The wildcats could not get a grip on the sloped roofing of these fences.

3.2 Behaviour in front of the fence or on the fence

Fence variations which were not climbed over triggered "fence-related" behaviour sequences (intention, effort, resignation) more frequently than fences which were (Fig. 3); the actions here were of shorter duration (Fig. 4) but were also discontinued more quickly. Fig. 5 shows the time taken by the behaviour groups pro rata compared to the overall behaviour (fence types 1 to 10). The proportion of intention-driven behaviour was roughly equal for all test fences with the exception of fences 2 and 5. This meets expectations, since wildcats have a strong intention-driven behaviour even in "normal" situations (without a test fence). The very low values for test fences 2 and 5 cannot be explained from the overall behaviour or the environment.
The proportion of resignation-driven behaviour was nearly the same (around 17%) at fence type 1 and fence types 6 to 10; resignation-driven behaviour was greatest (around 24%) at types 4 and 5 and lowest at types 2 and 3 (around 10%).
The "effort" behaviour group seems to be suited best as a value for the ability to climb over fences: big differences were demonstrated here (Fig. 5). The high proportion of behaviours grouped together in the "effort" behaviour group at fence types 1 to 5 correlates with the climbability of these fences. This behaviour group is very minor at fences 6 to 10, which were not climbed.

4 Discussion, planning recommendation

In principle, all fence versions that were not climbed over (6-10) are suitable as a wildcat-friendly wildlife protection fence. No cats were injured on the fences (also due to the good workmanship in one-off production of the end plates). However, there are still certain differences that can be used to select the best version from fence types 6 to 10. Selection criteria are:

- Deterrent effect
- Easy installation without any construction weaknesses.

The best wildcat protection fence should trigger early resignation in wildcats by serving as a visual deterrent. Otherwise, numerous climbing and jumping attempts will be made, which are energy-intensive and pose a risk of injury. Since higher fences or wider end plates during the test resulted in an earlier termination of the attempts to surmount the fence by the cats, these have to be evaluated as more favourable. During the test, structural shortcomings at test fences (welds, bars and mounting rifts) allowed one of the cats to find a way to climb even the "unclimbable" fence. However, this danger should not be overestimated in practice since during the test only one cat demonstrated this learning ability despite the – compared to outdoor conditions – significantly greater motivation of the cats to leave the enclosure, e.g., as a result of stress caused by conflicts among the cats.
In addition to these wildcat-specific criteria ("unclimbability", deterrent effect, low risk of injury), the costs for the construction and the interference with the landscape caused by the fence (potential high transparency and low visibility) also influence fence selection. However, an analysis of these criteria will not be conducted here.
The connections of the fence to other structures (road overpasses and underpasses, etc.) are clear deficiencies in the overall "wildcat protection fence" solution. For example, the wildcats could use the angle where the fence and the structure abut as a climbing chimney unless it is wider than approx. 120°. Further solutions must be developed to address these and other questions and problems arising from the installation on the premises.

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Annex: *Abbildungen* / figures

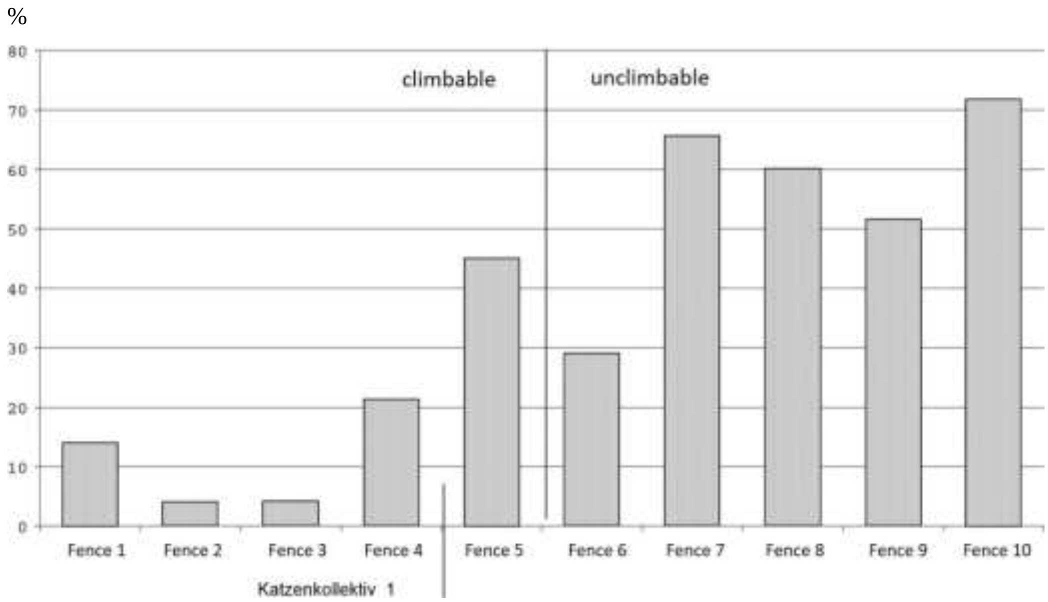

Figure 3: Häufigkeit der „zaunbezogenen“ Verhaltenssequenzen am Gesamtverhalten - ***Frequency of "fence-related" behavioural sequences in overall behavior on fences 1 - 10***

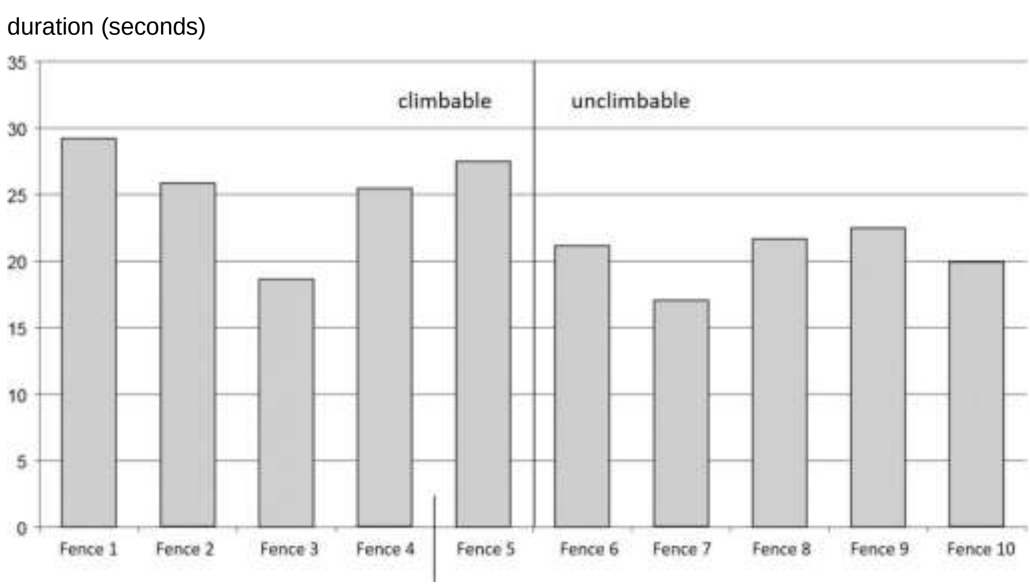

Figure 4: Dauer der „zaunbezogenen“ Verhaltenssequenzen am Gesamtverhalten - ***Duration of "fence-related" behavioral sequences on fences 1 - 10***

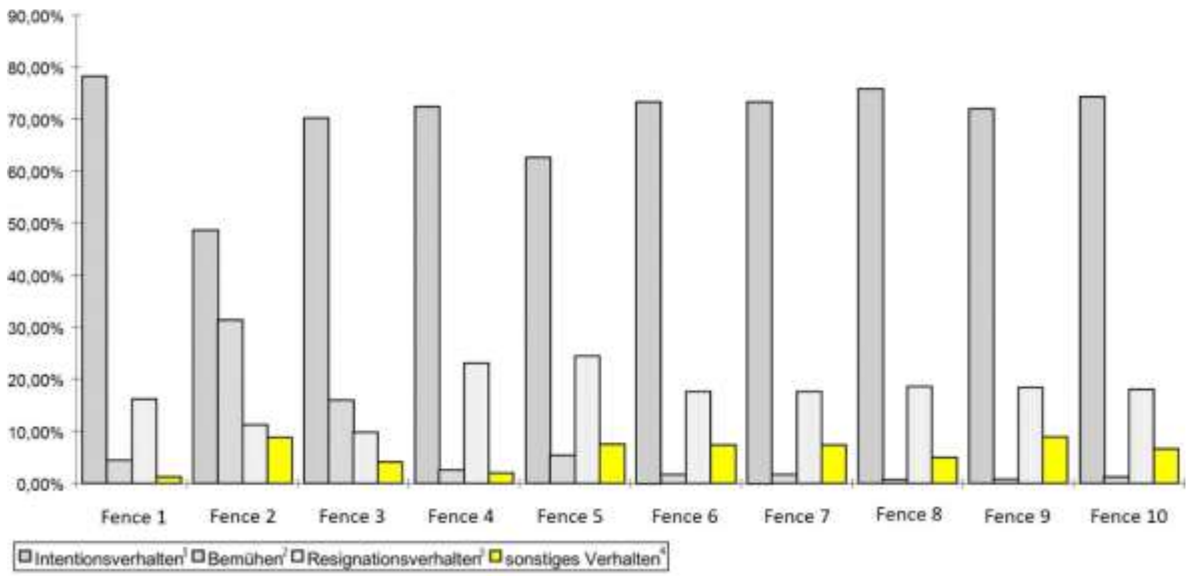

Figure 5: Relativer Zeitanteil der Verhaltensgruppen Intentionsverhalten, Bemühen, Resignationsverhalten und Sonstiges Verhalten am Gesamtverhalten am Zaun - ***Relative time proportion of the behavioral groups „intentional behavior“ (1), „effort“ (2), „resignation driven behavior“ (3) and „other behavior“ (4) in the overall behavior in front of the fence***

Figure 6: An der Autobahn A60 in der Eifel errichteter Wildkatzenschutzzaun - Wildcat fence built alongside the A60 motorway in the Eifel (Rhineland-Palatinate)