# A case of winter reproduction in the stoat (*Mustela erminea*). An effect of artificial light?

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Most of the northern hemisphere's mustelid species (18 out of 27), including the stoat (*Mustela erminea*), exhibit delayed implantation (Mead 1989) in which after mating and successful fertilisation in spring or summer, the development of the embryo stops at the blastocyst stage after approximately two weeks. The blastocyst remains free-floating in the uterus until implantation, which occurs nine to ten months later (King & Powell 2007). The moment of implantation is strictly governed by the increasing ratio of natural light-to-dark hours in spring, which is hormonally controlled by the *Leukemia Inhibitory Factor* (LIF), in a complex feedback process. Ambient temperature changes have not been shown to affect the cycle. After implantation the embryo develops to the birth stage in 28 days. Delayed implantation in stoats is fixed and shows no apparent variation (King & Powell 2007). In north western Europe, the birth of stoats occurs between mid-April and mid-May. This means that the implantation of the blastocysts occurs around the first of April. There are no records in the literature of births occurring at other times of the year. At the end of June and the beginning of July female stoats can be seen travelling around with their almost full grown young in tow, which soon after become independent (Mulder 1990, King & Powell 2007).

On 26 January 2017 several photographs of a stoat were taken by Gert Stegeman in the Netherlands (published on https://waarneming.nl/waarneming/view/134097323). The animal was crossing the ice over a ditch to the south of the town of Steenwijk (52.7638 N, 6.1184 E). The stoat was carrying a light-coloured, short-haired, juvenile mammal dangling from its mouth. The photographs aroused our attention, because the juvenile animal appeared not to be a prey animal (e.g. a young rat) but clearly a baby stoat of about three weeks old (figure 1 and 2). Its characteristics were as follows: 1. a relatively long neck and distally placed front legs; 2. relatively short ears and toes (compared to those of true mice and rats); 3. a subtly visible demarcation line on the flank, which separates the brown dorsal pelage from the white to crème belly fur, and; 4. a patch with dense and longer hairs on the back of the neck, known as the transitory 'mane', which, among mustelids, is only found in stoats.

The transitory mane of juvenile stoats (figure 3) starts to develop at an age of about three weeks. It apparently plays a role in stoats'

Figure 1. Female stoat with only very partial winter fur (ermine) on a frozen ditch, carrying a juvenile stoat of approximately three weeks old, 26 January 2017. *Photo: Gert Stegeman*.

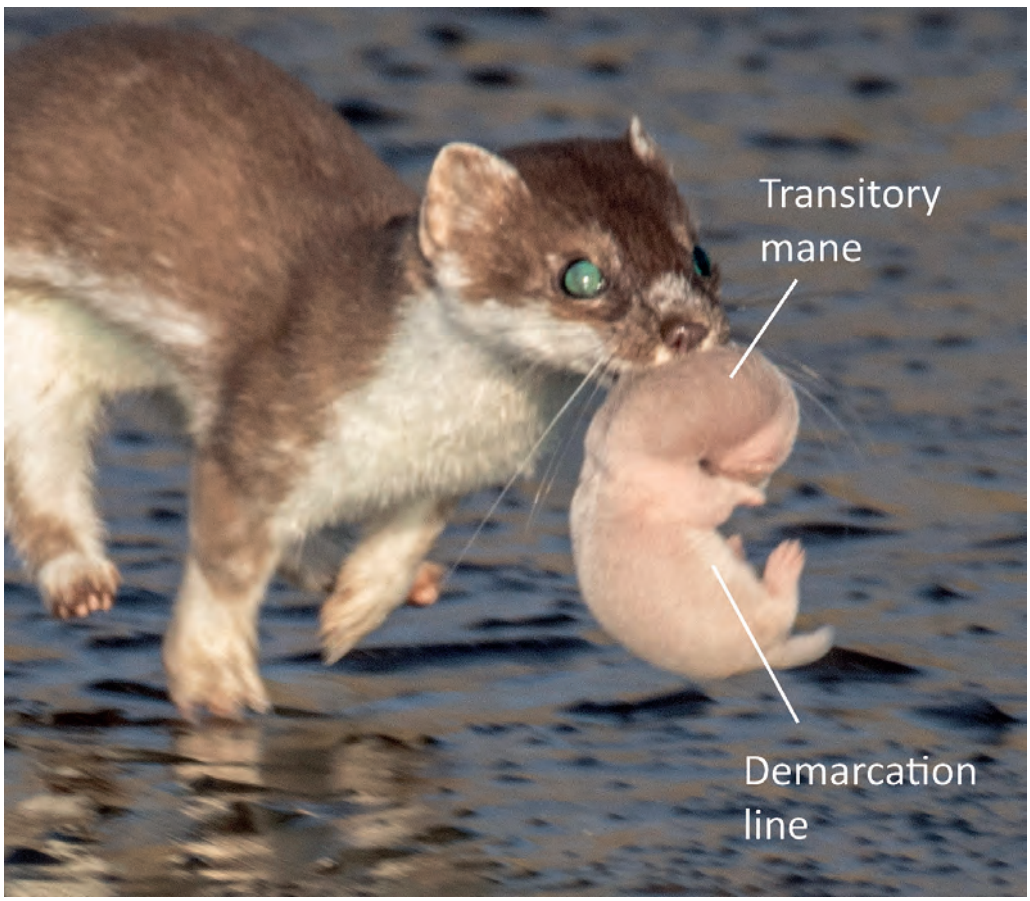


Figure 2. Close up of the juvenile stoat, showing the patch of dense transitory mane on the back of neck and the lateral demarcation line. *Photo: Gert Stegeman*.

Figure 3. Litter of young stoats of about 6 weeks old. The animal most to the right clearly shows the distinctive transitory mane on the back of the neck. *Photo: Erwin van Maanen.*

unique mating system. Adult male stoats visit nests with juvenile stoats to mate with the females (even at the blind stage) by grabbing the mane to get a hold. When they grab a male juvenile, they release it immediately; the mane apparently holds a clue for gender distinction. Fertilising juvenile females guarantees that virtually all females will have a litter the following calendar-year, which is a considerable advantage for such a short-lived species and allows the colonisation of new territory without the presence of a resident male (King & Powell 2007).

Deducing backwards in time on the approximate age of the juvenile stoat gives an embryo implantation date of around 8 December 2016. The photograph was taken on 26 January 2017 and the approximated age of the juvenile was 21 days. On average 28 days pass between embryo implantation and birth. From this we can infer that the current natural daylight regime, shortening toward midwinter, could not have triggered the implantation of the blastocysts in this case, as the required regime only occurs in spring (March-April).

We can only speculate as to the primary cause of this aberrant winter birth. The simplest explanation may be a rare disruption of the natural hormonal birth control in the female, hence a freak occurrence of out-of-phase reproduction. Other explanations are even more speculative, but should be proposed in light of environmental changes. Disruption of the endocrine system has been linked to chemical compounds used in the modern agrarian environment, including herbicides and pesticides. However, whether such compounds or their derivatives have an

Figure 4. Stable block with permanent light, near the town of Blokzijl in the same region of Northwest Overijssel. *Photo: Erwin van Maanen.*

effect on reproduction is currently unknown (N. van den Brink and M. Elmeros, personal communication).

A more plausible unnatural cause is prolonged exposure to artificial light in the immediate area of the place where the female stoat may have lived around the start of December. Milk cattle stations with nocturnal lighting are wide-spread in the Netherlands (figure 4) and in the region where the stoats were photographed. Stoats could very well live inside these illuminated stables or in their immediate vicinity. It is known through radio-tracking studies that the related polecat (*Mustela putorius*) seeks out farms during winter (Birks 2015), probably attracted by the provision of food (rodents) and thermal cover. Considerable artificial light is also emitted by greenhouses used for flower and vegetable production, with the aim of lengthening the days. One of the most intensive areas with such irradiation lighting, Luttelgeest, is only 16 km from the place of observation (figures 5 and 6). It is possible that this female stoat lived near this source of artificial light in December and later dispersed to the area where it was photographed. In the few studies with data on dispersal in stoats, most young females did not disperse further than 6 km, but in one case a dispersal distance of 65 km was recorded (studies cited in King & Powell 2007).

A clear cause-and-effect relationship for the aberrant reproduction in this particular female stoat cannot be given. But given the strictly regulated reproduction in the stoat and the uniqueness of this case, of which no other example could be found in the literature, we question whether it is an extreme rarity or a more common occurrence driven by anthropogenic interference. We therefore appeal to the scientific and the citizen-scientist communities to keep an eye out for more such cases.


Figure 5. The amount of artificial light in the wide surroundings of the place of observation (white star), showing the intensive light of the greenhouses around the small village of Luttelgeest. Map constructed with data from the NASA, by the late Ed Stevenhagen. Source: https://nl.wikipedia.org/wiki/Lichtvervuiling.

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## Samenvatting

### Een geval van winterreproductie bij hermelijn - een effect van kunstmatig licht?

Op 26 januari 2017 fotografeerde Gert Stegeman een hermelijn (*Mustela erminea*) op het ijs van een sloot in de buurt van Steen-

Figure 6. Nightly view of the light effect of the greenhouses of Luttelgeest, 6 December 2015, from a distance of 7 km. Source: https://nl.wikipedia.org/wiki/Lichtvervuiling. *Photo: IIVQ / Tijmen Stam*.

wijk, Overijssel. Het dier droeg een jong in de bek dat begin januari geboren moest zijn. Dit was zeer uitzonderlijk, omdat hermelijnen hun jongen altijd rond 1 mei werpen. Hermelijnen vertonen uitgestelde implantatie: eitjes worden in voorjaar of zomer bevrucht, ontwikkelen zich tot vrij zwevende blastocysten, die zich pas begin april van het jaar daarop in de baarmoederwand nestelen en zich verder gaan ontwikkelen. Het innestelen gebeurt onder invloed van de toenemende daglengte en is daarmee een in de tijd gefixeerd proces. Over de oorzaken achter het sterk afwijkende geboortetijdstip bij deze waarneming wordt gespeculeerd, waarbij kunstmatige lichtbronnen de meeste aandacht krijgen als factor die het normale reproductiepatroon in dit geval kan hebben verstoord.

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