Stefan Thurner, Stephan Böck and Georg Fröhlich, Freising,
as well as Angela Hagn, Elke Heyn, Michaela Schneider and Michael Erhard, München

RFID for Behavioural Studies with Minks

To automatically register activity patterns of American minks, an electronic registration system for the entrance tunnel (ETR) of the nest boxes was developed and tested. With an average identification reliability of 93.7 %, this system makes it possible to exactly record data about individuals over long time spans with low labour input. As a result specific time intervals for further behavioural observations can be chosen and activity rhythms in different housing systems can be compared.

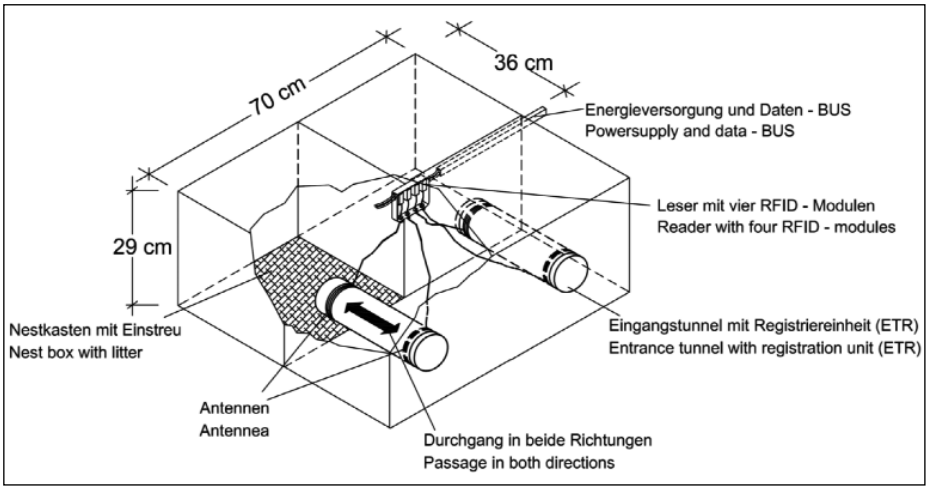

Fig. 1: Sketch of a nest box divided into two parts with two entrance tunnels with registration unit (ETR) and one fourfold reading unit

M.Sc. Stefan Thurner, Dr.-Ing. Georg Fröhlich and Stephan Böck are staff members of the Institute for Agricultural Engineering and Animal Husbandry of the Bavarian State Research Centre for Agriculture, Vöttinger Str. 36, D-85354 Freising; e-mail: *Stefan.Thurner@LfL.bayern.de*
Veterinarian Angela Hagn, Dr. vet.med. Elke Heyn and Dr. vet.met. Michaela Schneider are staff members of the Chair of Animal Welfare, Ethology, Animal Hygiene and Animal Housing (Head Prof. Dr. vet.med. Michael Erhard) of the Department of Veterinary Sciences of the Ludwig-Maximilians-University Munich.

Keywords

Electronic animal identification, activity patterns, minks, fur animals, automated data recording

Newly started operations for fur animal husbandry and therefore also for the husbandry of American minks in Germany are subject to minimum standards according to the 3rd revision of the directive "Farm Animal Protection (TierSchNutzV)" from 30th November 2006 [1]. Therefore for the husbandry of minks i.a. a minimum area (1 m^2 per animal in group housing systems; 3 m^2 base area per husbandry unit), a swimming basin and a nest box as well as tunnels are essential. Due to limited experience with the implementation of the afore mentioned regulation, the Chair of Animal Welfare, Ethology, Animal Hygiene and Animal Housing of the Department of Veterinary Sciences of the Ludwig-Maximilians-University of Munich conducts on behalf of the German Federal Ministry of Food, Agriculture and Consumer Protection a research project that should give information about the shape, depth and size of water basins for mink husbandry systems. Within the framework of the research project nest boxes with an electronic registration system at the entrance tunnels (ETR) were developed in order to evaluate the activity rhythm of all individual animals as exactly as possible over the whole cycle from weaning to pelting, without interfering animal behaviour and without high labour costs. The ETR allows to automatically registering the minks when they enter or leave a nest box. The aim of the investigation was to evaluate the reliability of the automatic registration of minks at the ETR and to show the activity rhythm of American minks exemplarily for a month.

Material and Methods

The developed registration system ETR is based on a RFID-system that was developed at the Institute for Agricultural Engineering and Animal Husbandry of the Bavarian State Research Centre for Agriculture for the registration of the behaviour of laying hens [2]. Similar to the laying hens, each mink was tagged with a 23 mm glass transponder (134.2 kHz, HDX). With the minks the transponder was subcutaneously injected between the shoulder blades, in the direction cranial, parallel to the centre line of the animals. The entrance tunnel to the nest box with a length of 40 cm was made from a drain pipe with a diameter of 100 mm (*Fig. 1*) in a way that the minks could pass the tunnel only individually one after the other. The registration unit consists of two antenna coils, which were wound around the tube at the tube ends in a distance of 30 cm. In total 20 nest boxes were equipped with a registration unit. Four antennas of two ETR were connected to a fourfold reader unit. The 10 fourfold reader units were connected via a BUS to a PC, which controlled them with specially programmed software. Therefore

Anteil richtig registrierter Durchgänge Share of corrcectly registered passages (%)	96,6	100,0	95,7	97,0	100,0	*	100,0	88,8	96,7	100,0
Anzahl ausgewerteter Durchgänge Number of evaluated passages (n)	29	52	47	101	36	*	16	143	91	39
Nestkastennummer || Nest box number	NK 20	NK 19	NK 18	NK 17	NK 16	NK 15	NK 14	NK 13	NK 12	NK 11
Lesernummer || Reader number	X		IX		VIII		VII		VI	

Lesernummer || Reader number	I		II		III		IV		V	
Nestkastennummer || Nest box number	NK 1	NK 2	NK 3	NK 4	NK 5	NK 6	NK 7	NK 8	NK 9	NK 10
Anzahl ausgewerteter Durchgänge Number of evaluated passages (n)	21	26	162	168	24	*	54	59	176	60
Anteil richtig registrierter Durchgänge Share of corrcectly registered passages (%)	76,2	88,5	88,3	91,1	100,0	*	92,6	93,2	96,0	100,0

* nicht ausgewertet || not evaluated

Fig. 2: Results about identification reliability at the entrance tunnel with registration unit (ETR) of the nest boxes (NK)

all 40 antennas could be powered synchronously 10 times per second. For each fourfold reader unit one dataset per second (with or without transponder number) was written into a data base. Data evaluation was carried out with two specially programmed software packages according to the routine described from [3]. The maximum allowed duration of a reading gap at an antenna was set to 60 s and the maximum allowed time span between the last registration at the first antenna of an ETR to the first registration at the second antenna at the same ETR was set to 300 s. The passage direction of a mink could be determined with the chronology of the registrations at the two antennas of an ETR.

The investigations were carried out in an outdoor enclosure with an area of approximately 300 m^2. The nest boxes were placed on the floor of the enclosure in a rectangular block with two rows, each with 10 nest boxes; with the ETR facing outwards alongside the block (see also *Fig. 2*). Evaluations were carried out with 18 American minks (9 male and 9 female) that were placed in the facility at an age of 13 weeks. Video recordings were taken on three days at an age of 25 weeks. From dawn to dusk the video recordings could be compared with the automatically registered data for 18 of 20 ETR, each for 26.5 hours.

Identification reliability of the minks at the entrance tunnel with registration unit (ETR)

In total 1,304 entrances and exits could be observed and evaluated at the 18 ETR. 93.7 % of the passages could be correctly registered with a maximum time difference of 5 seconds. For 10 passages (0.8 %) the time difference was larger than 5 seconds. The remaining incorrect passages resulted from longer stays of the minks in the ETR, where they were one time not read at the first antenna and one time not read at the second antenna, or because half of their body was hanging out of the ETR resulting in relatively large reading gaps. In 2.6 % of these cases a passage was not registered and in further 2.9 % of these cases a passage was additionally registered. Thereby the number of passages was not equally distributed over the single nest boxes. The share of correctly registered passages varied, depending on the nest box, from 76.2 % to 100.0 % (*Fig. 2*). Some of the incorrectly registered passages can result from technical problems, e.g. a not ideally wound antenna which has a lower reading distance. Furthermore, bad connections with the reader or the reader itself could cause errors. A noticeably amount of about 60 % of the incorrectly registered passages was caused by 6 minks of both sexes, and one female mink was involved in more than 20 % of the errors. In comparison with the electronic pop hole for the registration of the free range behaviour of laying hens (correctly registered passages: 96.5 %, n = 16,973 [4]) the ETR for minks shows a slightly lower identification reliability.

Activity rhythm of the minks

Exemplary the data of one month were evaluated regarding the whereabouts of the 18 minks. *Figure 3* shows the average number of minks in the different areas nest box, ETR and outdoor enclosure. Clearly visible is the higher number of minks in the outdoor enclosure during the twilight hours in the morning and evening. During the day the minks were mostly in the nest boxes, whereas more than a quarter of the minks were in the outdoor enclosure during the night hours. This result confirms the statement of [5], which found also a higher activity of the minks during the night hours. The higher activity during the night hours could possibly have positive effects for the identification reliability, because the minks use the ETR probably less for resting. Therefore further investigations about the identification reliability should be carried out during the night hours.

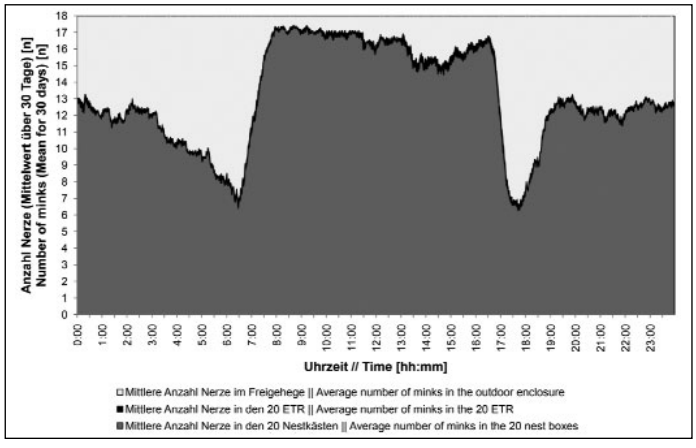

Fig. 3: Average activity rhythm for a month (26th to 30th week of live) for 18 minks

Conclusion and Prospects

The developed ETR for minks can be used for the registration of activity rhythms. The automatic data registration provides an inexpensive method with low staff input for long term studies. Over the further course of the research project nest boxes for the aviaries should also be equipped with the ETR in order to compare the activity patterns of minks in the outdoor enclosure with minks in the aviary.

Literature

[1] N.N.: Tierschutz-Nutztierhaltungsverordnung in der Fassung der Bekanntmachung vom 22. August 2006 (BGBl. I S. 2043), geändert durch die Verordnung vom 30. November 2006 (BGBl. I S. 2759), §§ 26 – 31

[2] *Fröhlich, G., S. Thurner, S. Böck, R. Weinfurtner und G. Wendl* : Elektronisches Identifikationssystem zur Erfassung des Verhaltens von Legehennen. In: Elektronische Zeitschrift für Agrarinformatik (eZAI) der Gesellschaft für Informatik in der Land-, Forst- und Ernährungswirtschaft e.V. (GIL), Band 2, Ausgabe 1/2007, 9 S., verfügbar unter der URL: http://www.ezai.org/index.php/eZAI/article/view/18/18

[3] *Thurner, S.*: Automatic registration and evaluation of the ranging behaviour of laying hens in group housing systems using RFID technology and electronic pop holes. Masterarbeit, Technische Universität München, Wissenschaftszentrum Weihenstephan, Forschungsdepartment Ingenieurwissenschaften für Lebensmittel und biogene Rohstoffe, Lehrstuhl für Agrarsystemtechnik, 71 S.

[4] *Thurner, S., und G. Wendl* : Tierindividuelles Auslaufverhalten von Legehennen - automatische Erfassung mit RFID-Technologie. LANDTECHNIK 60 (2005), H. 1, S. 30 – 31

[5] *Hansen, C.P.B., and L.L. Jeppesen* : The influence of temperature on the activity and water use of farmed mink (Mustela vison). Animal Science 76 (2003), pp. 111 – 118