WORLD RABBIT SCIENCE, VOL 10 (2), 77-84

FREQUENCY AND TIME OF NURSING IN WILD AND DOMESTIC RABBITS HOUSED OUTDOORS IN FREE RANGE

HOY ST., SELZER D.

Department of Animal Breeding and Genetics, Justus Liebig University of Giessen, GIESSEN, Germany.

ABSTRACT: Investigations were carried out during 104, 24-hours intervals in wild rabbits and 257, 24-hours intervals in domestic rabbits kept in two enclosures measuring 150 m² each. Both wild and domestic rabbit does nurse their pups more than once a day (wild rabbits: 1.28 per 24 h; domestic rabbits: 1.12 per 24 h) with the highest frequency in the 2nd week of lactation (wild rabbits: 1.48 per 24 h; domestic rabbits: 1.27 per 24 h). During the night, 84% and 86% (wild, domestic rabbits, respectively) of all nursing took place. Light-dark change influences the time of nursing in both wild and domestic rabbits. The highest frequency of nursing in domestic rabbits was found in the first two hours after onset of dusk, whereas the peak in nursing activity in wild rabbit does was postponed after midnight.

RÉSUMÉ: Fréquence et moment de l'allaitement chez des lapines de garenne et des lapines domestiques élevées à l'extérieur en liberté.
L'étude a porté sur l'observation de 104 cycles de 24 heures pour les lapines de garenne, et de 257 cycles pour les lapines domestiques, entretenues dans deux enclos de 150 m² chacun. Les lapines des deux types allaitent leurs lapereaux plus d'une fois par jour : en moyenne 1,28 fois par 24 heures pour les lapines de garenne et 1,12 fois par 24 h pour les lapines domestiques. La fréquence la plus élevée est observée au cours de la 2ème semaine de lactation avec 1,48 et 1,27 allaitements par 24 heures pour les lapines de garenne et domestiques respectivement. L'allaitement est situé en période nocturne dans 84% et 86% des cas pour les deux types de lapine toujours dans le même ordre. Chez les lapines de garenne, les allaitements ont lieu principalement dans les 2 heures suivant le coucher du soleil, tandis que chez les lapines domestiques les allaitements sont situés le plus souvent après minuit.

INTRODUCTION

Previous work suggests that rabbit does nurse their kits only once a day (CROSS, 1951; VENGE, 1963; ZARROW *et al.*, 1965; FINDLAY and TALL, 1971; HUDSON and DISTEL, 1982; BIGLER, 1986; JILGE, 1994). DAVIS (1957) and BERNARD (1962) observed two nursings a day only during the first two or three days of life. But, in the last few years some investigations, using infrared video techniques and time lapse recording, indicate that rabbit does kept in cages nurse more than once a day (SEITZ *et al.*, 1998; HOY, 2000). The discussion up to now is whether more than one nursing a day is a species-specific behaviour or a behavioural disturbance of rabbit does kept in too small cages. The aims of our studies were to investigate and to compare nursing behaviour of wild and domestic rabbits kept in two free-range areas measuring the of frequency and timing of nursing events.

Correspondence: S. Hoy. E-mail: Steffen.Hoy@agrar.uni-giessen.de

MATERIAL AND METHODS

The investigations were carried out on the research station Oberer Hardthof of the Department of Animal Breeding and Genetics, Justus Liebig University of Giessen. Two enclosures were built on a pasture measuring about 150 m² each enclosed by a wood fence 2 m high. A wire screen was installed 50 cm high and 60 cm deep in the soil to prevent escape of rabbits. Plastic tubes with a length of 150 cm and a dieter of 10 cm were provided in the area for wild rabbits as hiding-places. Additionally, half tubes of ceramic were placed into enclosures both for wild and domestic rabbits. Wood boxes were used as hiding-places for domestic rabbits.

Two artificial nestboxes per area measuring 50 x 50 x 25 cm (width, depth, height) for wild rabbits and 65 x 65 x 50 cm for domestic rabbits. The nest boxes consisted of wooden walls with one tube as entrance per box and were filled with straw as bedding material.

Outlets of tubes end in a heap of soil outside the nestbox with a distance of approximately 3 m between both outlets. Wooden walls were built around the nestboxes for wild rabbits to guarantee fully darkness in the boxes.

Rabbits were fed pellets, hay from grass and water ad lib at a roofed feeding place. The chemical composition of the pelleted basal diet was 17 % crude protein, 17 % crude fibre, 1.5 % crude fat and 9 % ash. Two does and one buck with their offspring were kept in the enclosures at the same time. The kits were weaned at an age of 28 days and were taken away from the free-range area. The wild rabbits were bought from a private breeder. New Zealand White (NZW) and ZIKA (Zimmermann-Kaninchen) hybrids were used as domestic rabbits. After several kindlings both the wild and domestic rabbit does and bucks were exchanged to prevent individual influence of does on nursing frequency.

Eleven litters of 6 wild rabbit does and 15 litters of 8 domestic rabbit does were included in the investigations.

Infrared video technique and time lapse recording was used in all experiments as described by HOY (2000). Infrared cameras with aspheric lens (WV-BP 500 or WV-CD 810, Panasonic) were installed above the nestboxes together with an infrared lamp (WFL-I-LED 30 W) emitting infrared light with a wavelength of 880 nm. Using a time-lapse video recorder (VCR) (AG 6024 HE, Panasonic) 180 min videotapes can be prolonged to 24 hours recording time without having to change the cassette. A monitor (WV-BM 80, Panasonic) was used to position the cameras. Video recordings of nursing behaviour took place on two consecutive days per week of lactation.

Videotapes were analysed on a Metz 9875 HiFi VCR with jog/shuttle function. The following parameters were recorded: frequency of nursing in 24 hours, time of nursing, duration of nursing event, interval between two nursings, time of nursing after onset of dusk. Nursing was defined as time between the beginning and ending of does stay above the nest with kits laying on the back. The doe shows in this moment a characteristic body position for nursing (PETERSEN *et al.*, 1988; SEITZ *et al.*, 1998). After nursing the doe leaves the nest very quickly, mostly with a jump. In total 104, 24 h-intervals in wild rabbits and 257 intervals with the same length in domestic rabbits were analysed.

Differences in percentages (e.g. of days with 0, 1, 2 or 3 nursings) were tested with χ^2 test in contingency tables. Means were compared by Student-t-test or multiple Student-Newman-Keuls-test. Data were statistically analysed by SPSS 8.0 for Windows.

RESULTS

In wild rabbits, the average daily nursing events recorded of 11 litters from 6 does was 1.28. The average frequency of nursing in domestic rabbits (8 does, 15 litters, 257 x 24 hours) was 1.12. The differences between the means of all 24 hour intervals and the means based on the data of 6 and 8 does were small both in wild as in domestic rabbit does.

One nursing a day occurred at 68.3 % of all 24-hour intervals in wild rabbits and at 86.8 % in domestic rabbits. Two nursings a day were observed at 26.9 % and 11.2 % of all days in wild and domestic rabbit does, respectively. The frequency of three nursings a day was 1.9 % in wild rabbits and 0.8 % in domestic rabbits.

Both wild and domestic rabbit does showed the highest frequency of nursing in the second week of lactation and the lowest number of nursings a day in the fourth week (Table 2).

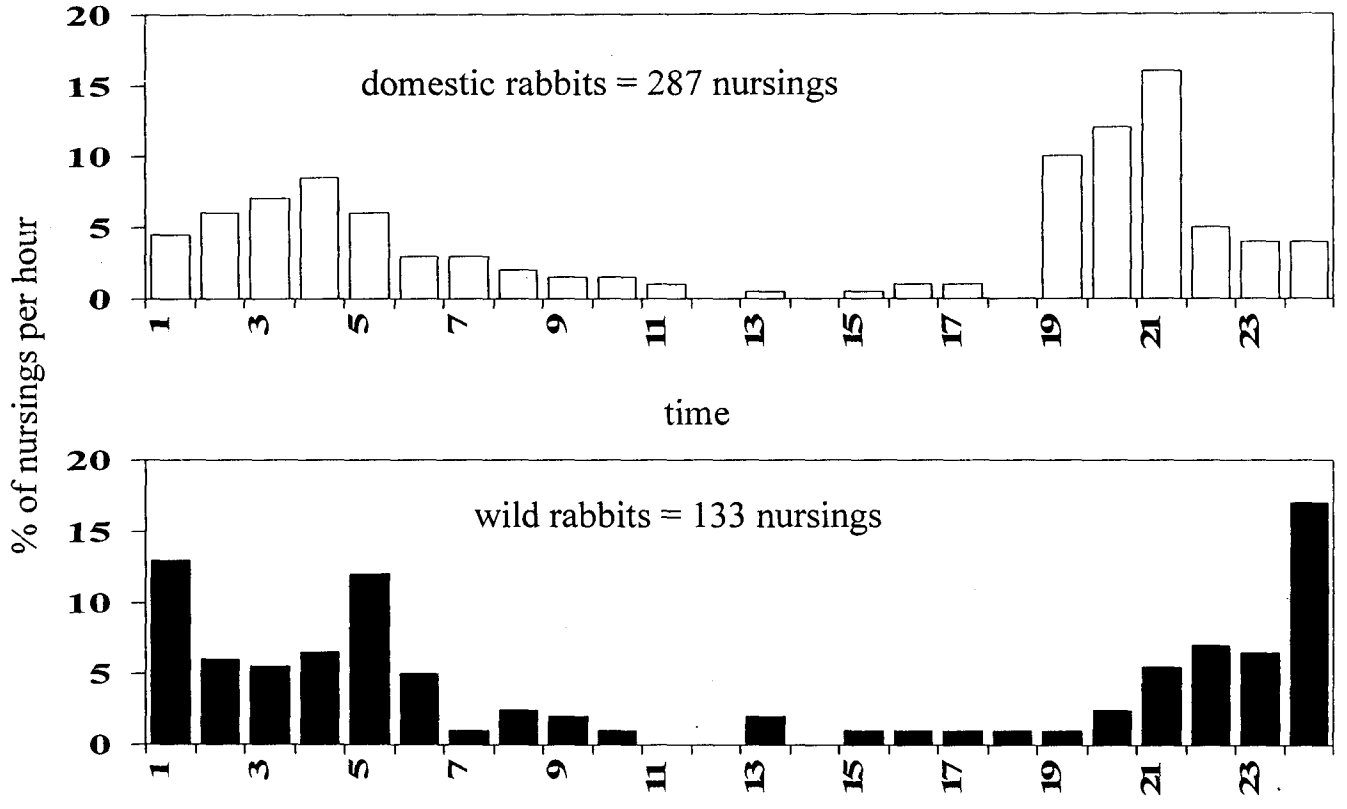

Figure 1: Percentages of nursings in domestic and wild rabbits during 24 hours under free range conditions

There was a negative correlation between frequency of nursings a day and the mean duration of a nursing event. With increasing number of nursings in 24 hours, the mean duration of a nursing event decreased. Total duration of nursing a day (= result from number of nursing events a day x mean duration of a nursing event) was nearly the same both in wild and domestic rabbits – 228 s, 237 s, respectively. However, the mean duration of a nursing event was higher in domestic rabbit does (211 s) compared with wild rabbits (178 s, $P < 0.05$) (Table 2).

The mean interval between two nursings was 16.5 hours in wild rabbits and 20.5 hours in domestic rabbits. Nineteen percent of all observed intervals had a duration of 24 hours in wild rabbits. That represents one nursing a day. Further peaks were seen at intervals of 4 and 19 hours. In domestic rabbits 39.2 % of all intervals were at 24 hours.

Wild rabbit does nursed their kits 84.0 % of the time during dusk and night. Domestic rabbits, kept under free-range conditions, showed 85.8 % of all nursing events from dusk to dawn. But, there was a difference between wild and domestic rabbit does regarding the time with the highest nursing activity. The peak in nursing activity in domestic rabbits was between 7 and 9 p.m. whereas the wild rabbit does mostly nursed their kits after midnight (1 to 2 a.m.) (Figure 1).

Because of the different onset of darkness during spring and summer months the time of nursing was classified based on time interval between dusk and nursing.

Most of the nightly nursing events in wild rabbits took place between the 3rd and 6th hour after the onset of dusk. Fifty percent of all nightly nursings occurred in these 4 hours. On the opposite, the highest nursing frequency in domestic rabbit does was found in 2nd hour after the beginning of dusk. Fifty percent of all nursing events that happened during the night were found in the first three hours after onset of dusk (Figure 2).

DISCUSSION

Both wild and domestic rabbits kept in outdoor enclosures nurse their kits more than once a day. In approximately 30 % (wild rabbit does), and 12 % (domestic rabbit does, respectively) of all observed 24 hours intervals, more than one nursing was found. SEITZ *et al.*, (1998) also found, that domestic rabbits kept in different cages nurse kits more than once a day. In 39 % of all observed 24 h intervals, more than one nursing event per day occurred. New Hungarian investigations have shown the same tendency. Twentyfive percent of the does nursed more then once a day (MATICZ *et al.*, 2001 a,b).

This is in opposition to many other authors who reported only one nursing event a day (e.g. CROSS, 1951; ZARROW *et al.*, 1965; HUDSON and DISTEL, 1982; JILGE, 1994). Direct visual observation was mainly used in those investigations. In this report, infrared video technique in combination with time-lapse video recording was used to observe rabbits in darkness continuously, while not being influenced by persons or artificial light.

SEITZ (1997) has shown that the frequency of nursing a day (≤ 1, 1 to ≤ 2, > 2) did not influence the weaning weight of kits.

By this technique it was possible to demonstrate that nursing is not only a constant value, but influenced by different factors. One factor is the change from light to dark.

It was shown that most of nursing events (84.0 % in wild rabbits and 85.8 % in domestic rabbits) took place in darkness. Only a small rise in nursing activity was seen in the early morning. These results correspond with data in domestic rabbits kept in different cages (SEITZ *et al.*, 1998; SELZER, 2000). The use of different methods in behavioural studies (direct visual observation with presence of observer versus infrared video technique and time lapse video recording) is probably the explanation for different results existing in literature and presenting in this paper.

Mean duration of nursing event was 179 seconds in wild rabbit does. No information has been found up till now considering duration of nursing in wild rabbits. According to ZARROW *et al.*, (1965), DREWETT *et al.*, (1982), PETERSEN *et al.*, (1988), SEITZ (1997) and SCHULTE (1998), the average duration of nursing event in domestic rabbit does ranged between 3 and 3.5 minutes. The mean duration of nursing event in wild rabbit does was shorter than in domestic rabbit does. SELZER (2000) reported that small rabbit breeds nurse their kits shorter (approximately 192 s) than

Table 1: Means of frequency of nursing in 24 hours in wild and domestic rabbits kept in two free range areas (standard deviation between brackets).

	number of 24 h intervals	FNE24[1]	number of does	FNE24[2]
Wild rabbits	104	1.28 (0.54)	6	1.26 (0.20)
Domestic rabbits	257	1.12 (0.49)	8	1.16 (0.12)
		P<0.05		Non significative

FNE24: Frequency of nursing events in 24 h.
[1]means on the basis of all 24 h-intervals (n = 104, 257 respectively); [2]means on the basis of average nursing frequency of does (n = 6 and 8 does, respectively).

larger pet rabbit does (up to 230 s on average). It could be that the milk yield of smaller breeds and in wild rabbits is lower and so the duration of nursing is shorter than in larger breeds like NZW and ZIKA hybrids used in these investigations.

A diametrically opposed dynamics of frequency and duration of nursing was shown during lactation both in wild and domestic rabbits. The highest nursing frequency combined with the lowest mean duration of a nursing event took place in the second week nursing after kindling. The same results were obtained by SEITZ (1997) and SCHULTE and HOY (1997) in investigations with domestic rabbits of different breeds kept in different cages. This dynamic was also found by SELZER (2000) in domestic rabbit does housed in get-away-cages of different size and structure and in traditional concrete cages.

HUDSON and DISTEL (1989) postulated a fixed time interval of 24 hours between two nursing events. But, they have kept rabbits (only a small number) in sound-isolated laboratories not comparable with practical conditions. In this work, mean time intervals of 16.5, 20.5 hours were found in wild and domestic rabbits. This corresponds to a higher nursing frequency than once a day. Also, SEITZ (1997) reported a mean time interval between two nursings of 16.5 hours, but the individual nursing frequency per doe ranged from 0.8 to 2.2 nursings during 24 hours (SEITZ *et al.*, 1998).

A circadian rhythm of nursing activity with a peak after midnight (3 to 6 hours after onset of dusk) in wild rabbits and in the first two hours after dusk in domestic rabbits was found. Light-dark change is a significant timer for nursing behaviour, especially for domestic rabbit does. More than 25 percent of 1534 nursing events took place in the first two hours of darkness if rabbit does were kept under artificial lighting conditions (SEITZ, 1997). If light-dark rhythm (12 Light : 12 Dark) was put off by one hour (from 5 a.m. to 5 p.m. to 6 a.m. to 6 p.m.) the peak in nursing activity was postponed simultaneously by one hour (SEITZ, 1997). It was found by SEITZ *et al.*, (1998) that nursing behaviour is related to dusk also under natural lighting conditions. SEITZ (1997) found in three rounds from March/April to July a peak in nursing activity soon after dusk. In contrast, the morning dark-light-change under artificial light conditions or the onset of dawn under natural lighting caused no or only a

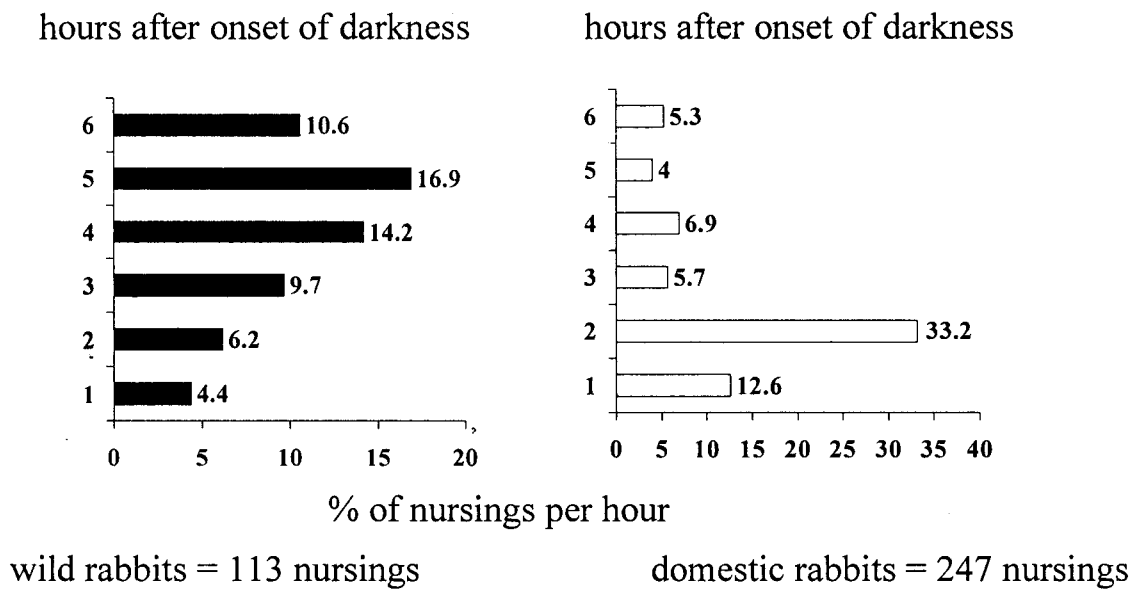

Figure 2: Percentages of nursings in the first 6 hours after onset of dusk in wild and domestic rabbits under free range conditions.

Table 2: Frequency and duration of nursing events in wild and domestic rabbits depending on week of lactation. Standard deviation between brackets.

Week of lactation	Wild Rabbits			Domestic rabbits		
	DNE (s)	DN2 (%)	FNE24	DNE (s)	DN2 (%)	FNE24
1	184.4[a] (30.3)	21.2	1.24	229.9[b] (56.9)	9.2	1.09
2	169.2[a] (35.2)	44.8	1.48	200.5[b] (32.0)	22.2	1.27
3	185.0 (42.0)	34.8	1.35	205.8 (36.3)	15.1	1.15
4	186.3 (21.2)	10.5	0.95	211.9 (30.4)	2.8	0.99
Average	178.5[a] (34.4)		1.28[A]	211.8[a] (41.6)		1.12[A]

DNE: Duration of nursing event; DN2: Percentage of days with ≥ 2 nursing events; FNE24: Frequency of nursing events in 24 h. Means in the same row with different letters (a, b) and (A) are significantly different ($P < 0.05$).

small increase in nursing activity.

Using an intermittent light regime with 6 h light : 6 h darkness : 6 h light : 6 h darkness, two peaks in nursing activity were found after switching off the light twice a day (HOY, 2000 – unpublished results).

A delayed peak of nursing behaviour in wild rabbits compared with domestic rabbits was found. Wild rabbits spend the time between dawn and dusk mainly in the nestbox without food and water and without possibility of urination and defecation. They leave the nestboxes with the beginning of dusk. SELZER (2000) reported that the wild rabbits started with food intake and elimination soon after leaving the boxes. After this period, they nursed their kits. In contrast, domestic rabbits eat, urinate and defecate also during day time. So, the light-dark-change during dusk influences the onset of nursing activity as a timer comparing conditions under artificial light regime.

CONCLUSIONS

Wild and domestic rabbit does nurse kits on average more than once a day with the highest frequency in the 2nd week of lactation. Nursing more than once a day can not be considered as a behaviour disturbance. Light-dark-change influences onset of nursing as a timer for biorhythm. Approximately 85 percent of all nursing events both in wild and domestic rabbits take place from dusk to dawn. Therefore nursing mainly in the night belongs to the species-specific behaviour of rabbit does.

REFERENCES

BERNARD E., 1962. Methods and problems concerned with hand-rearing rabbits. *J. Anim. Tech. Ass., 13, 35–40.*

BIGLER L., 1986. Mutter–Kind–Beziehung beim Hauskaninchen. *Lizentiatsarbeit Univ. Bern.*

CROSS B., 1951. Nursing behaviour and the milk ejection reflex in rabbits. *J. Endocr., 8, Proc. XIII–XIV.*

DAVIS J., 1957. Some observations on lactation and food intakes in a colony of Chinchilla-Giganta rabbit. *J. Anim. Tech. Ass., 7, 62–63.*

DREWETT R., KENDRICK K., SANDERS D., TREW A., 1982. A quantitative analysis of the feeding behaviour of suckling rabbits. *Anim. Behav., 32, 501–507.*

FINDLAY A., TALLAL A., 1971. Effect of reduced suckling stimulation on the duration of nursing

in the rabbit. *J. Comp. Physiol. Psychol., 76 (II), 341–346.*

HOY ST., 2000. The use of infrared video technique and computer supported analysis in investigations of rabbit behaviour. *Proc. 7th World Rabbit Congress, Valencia, July 2000, 531-536.*

HUDSON R., DISTEL H., 1982. The pattern of behaviour of rabbit pups in the nest. *Behav., 79, 255–271.*

HUDSON R., DISTEL H., 1989. Temporal pattern of suckling in the rabbit pups: a model of circadian synchrony between mother and young. *Research in Perinatal Medicine, Vol. IX, Development of Circadian Rhythmicity and Photoperiodism in Mammals, 5, 83–102.*

JILGE B., 1994. Ontogeny of the rabbits circadian rhythms in the rabbit. *J. Biol. Rhythms, 8, 247–260.*

MATICZ Z., SZENDRÖ Z., HOY ST., RADNAI I., BIRO-NEMETH E., NAGY I., GYOVAI M., 2001a. Hazinyul szoptatasi viselkede senek vizsgalata. *13th Hungarian Conference on Rabbit Production. Kaposvar May 2001, 55-61.*

MATICZ Z., SZENDRÖ Z., HOY ST., RADNAI I., BIRO-NEMETH E., NAGY I., GYOVAI M., 2001b. Untersuchung zum Säugeverhalten von Hauskaninchen. *Proc. 12. Arbeitstagung über Haltung und Krankheiten der Kaninchen, Pelztiere und Heimtiere. Celle May 2001, 115-124.*

PETERSEN J., BÜSCHER K., LAMMERS H., 1988. Das Säuge- und Saugverhalten von Kaninchen. *DGS, 30, 864–867.*

SCHULTE I., 1998. Untersuchungen zum Säuge- und Saugverhalten und zur Mutter-Kind-Beziehung bei Kaninchen der Rasse Weiße Neuseeländer unter Nutzung der Infrarot-Videotechnik. *Thesis Univ. Leipzig.*

SCHULTE I., HOY ST., 1997. Untersuchungen zum Säuge- und Saugverhalten und zur Mutter–Kind–Beziehung bei Hauskaninchen. *Berl. Münch. Tierärztl. Wschr., 110, 134–138.*

SEITZ K., 1997. Untersuchungen zum Säugeverhalten von Hauskaninchen-Zibben sowie zu Milchaufnahme, Lebendmasseentwicklung und Verlustgeschehen der Jungtiere. *Thesis Univ. Gießen.*

SEITZ K., HOY ST., LANGE K., 1998. Untersuchungen zum Einfluss verschiedener Faktoren auf das Säugeverhalten bei Hauskaninchen. *Berl. Münch. Tierärztl. Wschr., 111, 48-52.*

SELZER D., 2000. Vergleichende Untersuchungen zum Verhalten von Wild- und Hauskaninchen unter verschiedenen Haltungsbedingungen. *Thesis Univ. Gießen.*

SELZER D., JAUKER F., HOY ST., 2000. Vergleichende Untersuchungen zum Säugeverhalten von Wild- und Hauskaninchen. *Proc. Aktuelle Arbeiten zur artgemäßen Tierhaltung. KTBL-Schrift 391, 187-194.*

SELZER D., LANGE K., HOY ST., 2001. Untersuchungen zur Mutter-Kind-Beziehung bei Hauskaninchen unter Berücksichtigung verschiedener Haltungsbedingungen. *Proc. 12 Arbeitstagung über Haltung und Krankheiten der Kaninchen, Pelztiere und Heimtiere. Celle May 2001, 106-114.*

VENGE O., 1963. The influence of nursing behaviour and milk production on early growth in rabbits. *Anim. Behav. 11, 500–506.*

ZARROW M., DENENBERG V., ANDERSON C., 1965. Rabbit: frequency of suckling in the pup. *Science 150, 1835–1836.*