

Comparison between the use of open and walled platforms by juvenile blue foxes (*Alopex lagopus*)

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The current European recommendations require that platforms in the cages of farm foxes should have solid sides. The present study aimed to clarify how such an obstructed view affects platform use in farmbred blue foxes (*Alopex lagopus*). Experimental groups with open (16 males, 14 females) and walled (16 males, 14 females) platforms were compared from weaning to pelting. Both platform types were 110 cm long x 30 cm wide. Walled platforms had 23 cm high walls at the ends and rear, but open ones were without walls. Data were collected by daytime scanning observations and 24-h video recordings. Results for both sexes were parallel, showing that foxes significantly ($p < 0.001$) prefer open platforms over walled types. Video recordings revealed a significantly ($p < 0.01$) greater use of open platforms for jumping and resting (short duration 1–10 min on platform) compared to walled platforms. A rather parallel conclusion was found for sleeping also. The only exception was in September when females given both platform types slept on them for the same amount of time on average. The disturbance test showed that foxes supplied with open type platforms jumped onto them significantly ($p < 0.05$) more often (62.5% of males, 85.7% of females) than those given the walled type (25.0% of males, 35.7% of females). It can be concluded that foxes avoid platforms with walls because such platforms prevent observation of the surroundings and therefore the possibility to adjust their distance to danger.

Key words: resting shelf, view, farm fox, animal welfare, environmental enrichment

Introduction

The Standing Committee of the European Convention currently has legislated that the cage of each weaned fox shall be equipped with a suitable nestbox, a platform, or preferably both. In addition, the equipment must be placed as high as possible in the cage and also enable the an-

imals to conceal themselves from people and animals in other cages. If no nestbox is available, then a platform with solid sides and a solid floor must be provided (European Convention 1991). However, results of recent platform experiments do not entirely support the European recommendation. For instance, the requirement for solid sides is problematic and the evidence from studies on farmbred silver foxes (*Vulpes vulpes*)

(Mononen et al. 1993a) and blue foxes (*Alopex lagopus*) (Harri et al. 1991, Mononen et al. 1993b) confirms that platforms offering a more unobstructed view of the surroundings are preferred over those with a more restricted view. The obvious explanation is that foxes would naturally want to survey the environment, yet solid sides prevent such observation. Use of platforms that offer the animals a view of their surroundings would therefore appear to be preferable. Non-preference for walls was further confirmed in another experiment in which half of a double cage was equipped with three nontransparent walls (Mononen et al. 1995). Both blue and silver foxes almost exclusively favoured the cage half without walls. The preference for resting was more pronounced than that for active behaviours.

Earlier experiments have been carried out employing mainly small-sized platforms. While it appears obvious, from the results of recent experiments (Korhonen and Niemelä 1993, 1995, Korhonen et al. 1995), that platforms to be used in the future will have to be considerably larger, it would be important to clarify to what extent solid sides influence amount of use for larger platform constructions. In addition, the previous silver and blue fox experiments (Harri et al. 1991, Mononen et al. 1993a,b) did not start until late September and thus there is no data on the effect of obstructed view on early platform use, i.e. already after weaning.

The purpose of this study was to quantify how platform use by juvenile blue foxes is affected by large solid sided platforms, which prevent observation of the environment and neighbors from weaning to pelting.

Material and methods

General managements

The present study was carried out at the Fur Farming Research Station of Kannus, in west-

ern Finland. The experimental animals originated from blue fox kits born in May 1994. After weaning, they were housed singly in a conventional farm cage measuring 107 cm wide x 110 cm long x 70 cm high. None of the animals had platform experience before weaning. Freshly mixed fox feed manufactured by the local feed kitchen was supplied twice a day at 9 am and 1 pm. Feed portions (from 650 to 800 g/animal/day) were adjusted according to the seasonal standards of the Finnish Fur Breeders' Association (Berg 1986). Water was freely available from an automatic dispenser system. All animals remained healthy throughout the study period.

Subjects and platforms

Two experimental groups were formed after weaning in August: (1) a group given platforms without walls (16 males, 14 females), and (2) a group given platforms constructed with solid walls of 23 cm high at the ends and rear, in which observation of neighbouring cages or the shed exterior was blocked (16 males, 14 females). Both experimental platforms were constructed of 125 mm board (22 mm thick) and measured 110 cm long x 30 cm wide (area 3300 cm²) with flat bottom. Platforms were placed 23 cm below the cage roof. A schematic picture of the platforms is presented in Fig.1. Both experimental groups were placed separately apart from each others in the same shed.

Monitoring of platform use

Platform use was monitored by two methods as follows: (1) continuous 24-h measurements by video camera equipment (CCD video camera 720, Bische UB-480 time-lapse tape recorder, Koyo monitor, Bische 12-300 infrared light: 500 W. A 24-h sample of each animal was recorded in September and November. The video tapes were analyzed by one investigator, using a video tape recorder and a TV monitor. Behavioural patterns were classified into the following cate-

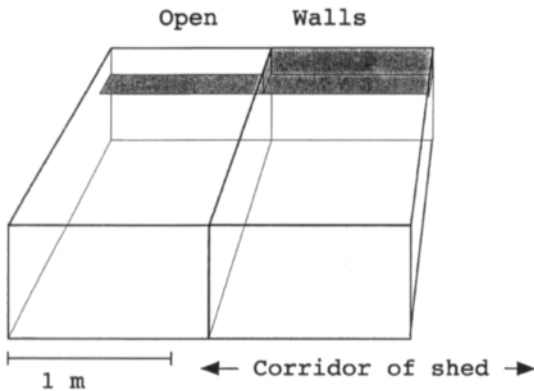


Fig. 1. Schematic picture of the platform types studied.

gories: jumping onto/off the platform (duration < 1 min; indicating an instant of a change in position), lying on the platform (1–10 min), and sleeping on platform (>10 min). (2) Daytime use by scanning observations carried out three times a day (8 a.m., 12 a.m. and 3 p.m.) on workdays. The only exception was on Fridays, when scanning observations were made at 8 a.m. and 12 a.m. only as farmwork ends at 2 p.m. For comparisons of the platform groups the daily scanning observations were summed up by month. Platform use was thus defined as the number of times a fox was recorded as on the platform each month out of the total number of observations for that month.

Disturbance test

The disturbance test was conducted in mid-October. The experimenter approached inside the shed the cage from the right side, struck the cage with a stick and made sudden movements towards the cage (Pedersen and Jeppesen 1993). Foxes' responses were then recorded, i.e. whether or not they jumped onto the platform.

Statistical methods

Repeated measurements of each fox were carried out during different months. The set of ob-

servations for one subject typically tended to be intercorrelated, i.e. the covariances between measurements within a subject tended to deviate from zero. These interdependencies should be taken into account when modelling the data. In the present study the mixed model approach was applied to the repeated measurements (Jones 1993).

Video and daily scanning data were analyzed separately. Video data was based on the following model:

$$Y_{ijk} = \mu + S_i + P_k + SP_{ik} + e_{ijk}$$

where

Y_{ijk} = time of platform use for fox i in platform group j during month k

μ = constant

S_i = effect of sex

P_k = effect of month

SP_{ik} = interaction of sex and month

e_{ijk} = residual, assumed to be independent and multivariate normal with the means 0 and arbitrary covariance matrices Σ .

Scan sampling data was analyzed similarly, but here Y_{ijk} = the percentage of platform use for fox i in platform group j during month k .

The platform use, as a dependent variable in all analyses, was transformed with the common logarithm $\log(y + 1)$ to achieve normal distribution and homogeneity of variances. Parameters of the models were estimated by the residual maximum likelihood (REML) estimation method.

Several covariance structures of the repeated measurements were fitted and the best one chosen by comparing several potential structures by the likelihood ratio test (Jones 1993). Multivariate normality assumption of errors was assessed by graphic methods. Comparisons between means were made by contrast examination. Statistical analyses were performed with the MIXED procedure of the SAS statistical package (SAS 1992). In addition, UNIVARIATE (SAS 1990a) and GPLOT (SAS 1990b) procedures were used.

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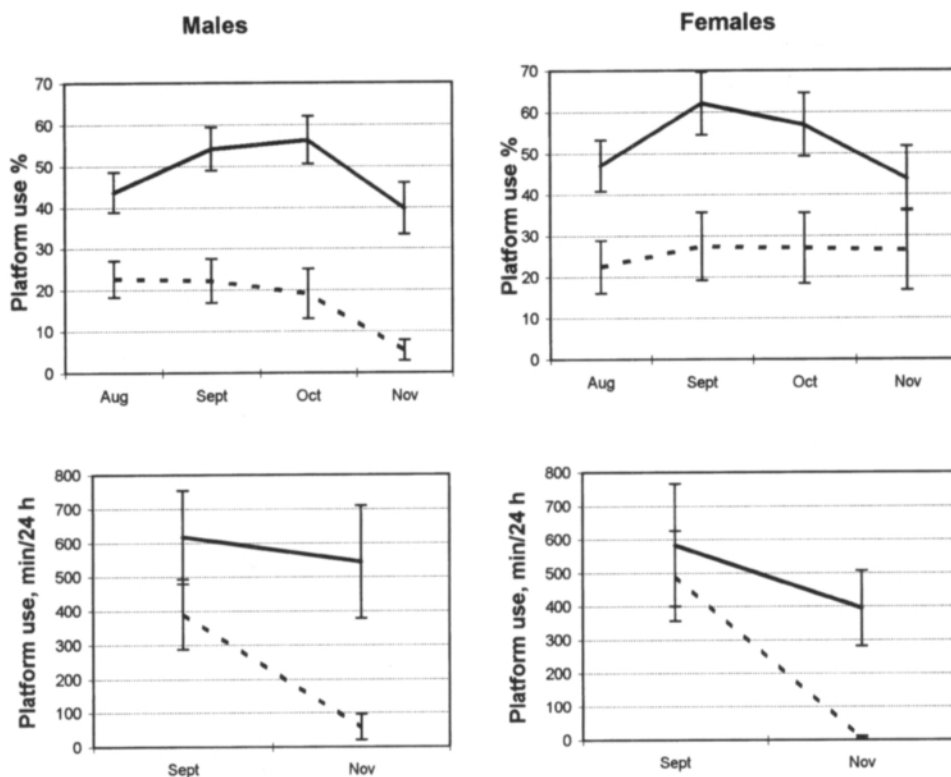


Fig. 2. Platform use of blue foxes by daytime scanning observations (% of observations of foxes on platforms) and 24-h video recordings (min/24 h). Solid line: open platforms. Broken line: walled platforms. Data are presented as mean \pm SE.

Results

Scan sampling data

Figure 2 shows the results of the scan sampling data. Already in August, use of the platforms with walls was significantly ($p < 0.001$) lower than that of open ones. The results were quite similar for males and females. Furthermore, the difference between studied platform groups increased with time, being highest in November for males (open platform use 39.7% vs. walled platform use 5.4%). For females the difference was greatest in September (open platform use 62.1% vs. walled platform use 27.4%). The difference was slightly less in November, i.e. 43.9% vs. 26.5%.

Video recording data

The general trend of the results was parallel in both the video and scan sampling material. Thus, a significantly ($p < 0.001$) greater use of open compared to walled platforms was also revealed by the video recordings (Fig. 2). In September, a clear difference between the platform types was apparent both in males (open 618 min/24 h vs. walled 390 min/24 h) and females (open 583 min/24 h vs. walled 491 min/24 h). In November, the difference even increased in both males (open 544 min/24 h vs. walled 59 min/24 h) and females (394 min/24 h vs. 7 min/24 h).

Figure 3 shows the main activities for which platforms were used. Open platforms were used significantly ($p < 0.001$) more than walled ones for jumping (use < 1 min) and resting (short du-

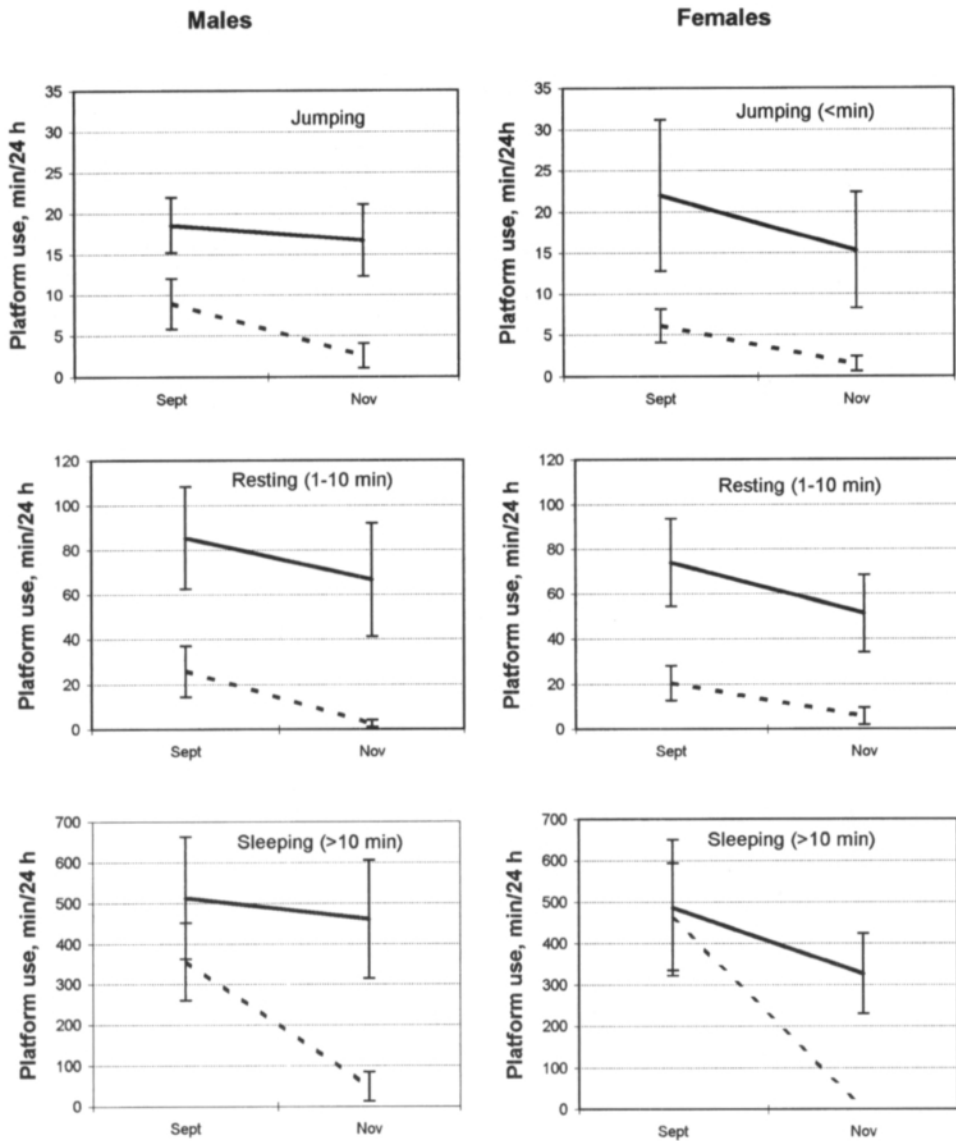


Fig. 3. Distribution of platform use for jumping (duration < 1 min), resting (duration 1-10 min) and sleeping (duration >10 min). Data are based on 24-h video recordings. Solid line: open platforms. Broken line: walled platforms.

ration from 1 to 10 min). The main result was also parallel in terms of their use for sleeping. The only exception was in September, however,

when females used both platform types about the same order of magnitude.

Reaction to acute disturbance

The percentage of animals that jumped onto the platforms during the disturbance test was significantly ($p < 0.05$) higher for open than walled types (males: open 62.5% vs. walled 25.0%, females: open 85.7% vs. walled 35.7%).

Discussion

It is known that wild foxes often choose higher places for their breeding dens (Garrott et al. 1984, Kaikusalo and Angerbjörn 1995). Elevated places, such as logs or boulders, outside the dens are also favoured by foxes for sleeping and resting. The surveillance of the environment is obviously easier from such places, thus enabling the animals to adjust their proximity to danger. A preference for nestboxes mounted at higher levels over those mounted at lower ones has also been observed in farm fox vixens during breeding season (Hoffmeyer 1986). In a complicated, highly-enriched housing environment, juvenile farm blue foxes most often occupied the higher places. Places offering good views were also preferred (Korhonen and Niemelä 1996). In some other experiments in which farmed foxes were allowed to choose between high and low housing levels, including earth and wire mesh materials, the overall preference was most typically for elevated places irrespective of the surface material (Harri et al. 1995, Korhonen and Niemelä 1994). Farmed foxes also display a tendency to avoid sections of the cage where the view is partially obstructed (Mononen et al. 1996). In addition, the present results clearly show that farmed blue foxes prefer the open platforms. This finding is in accordance with other platform studies (Harri et al. 1991, Mononen et al. 1993a,b) in which farmed foxes were similarly found to make use of platforms offering better views significantly more than those with obstructed views. Thus, it is quite obvious that,

like their wild relatives, farmed fox species prefer an elevated location which facilitates the observation of their surroundings.

According to Bakken et al. (1994), the fact that the farm fox is aware of the presence of a refuge can be of great importance even if the refuge is not used frequently. Particularly when clear disturbance occur, the platform would offer a fox a place of refuge or concealment. Moreover, the higher elevation may be important in offering a fox a better opportunity to exercise dominance and to self-defense (Pedersen and Jeppesen 1993). Elevation would be strategically advantageous, especially in a restricted environment, such as a small farm cage, from which escape is otherwise impossible. The disturbance test employed in the present study replicates a situation of high acute stress by pounding the animal's cage heavily with a stick. Thus, this test ought to reveal the maximum number of foxes that might use the platform for refuge during an unexpected situation. The present disturbance test results show that foxes more often jumped onto the open rather than the walled platforms. This can be considered to indicate clearly that during a disturbing situation foxes will actually avoid places from which they cannot survey the environment.

The recommendations of the European Convention (1991) suggest that the three main needs of the farmed fox, i.e. the needs for rest, observation and hiding would be satisfied by equipping cages with a platform or a nestbox, or preferably both. Based on the results of this study, the walled platforms should not be used for farm foxes: firstly, because the need for observation cannot be fulfilled, and secondly, because foxes dislike using them as a hiding place when disturbed. Thus, the current recommendations can be reformulated so that the requirement for platforms with solid walls could be withdrawn. However, it is possible that farm foxes have a need for some kind of a secluded area. The high frequency of the use of nestboxes shown in Danish studies (Jeppesen and Pedersen 1991, Pedersen and Jeppesen 1993) suggests that nestboxes may serve the fox better as hiding places. Further studies will be needed in order to resolve this hypothesis.

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References

- Bakken, M., Braastad, B., Harri, M., Jeppesen, L.L. & Pedersen, V.** 1994. Production conditions, behaviour and welfare of farm foxes. *Scientifur* 18: 233–248.
- Berg, H.** 1986. Rehutietoutta Turkiseläinkasvatijalle. (Feeding Guide for Farmers). Turkiseläintutkimuksia 23. Suomen Turkiseläinten Kasvattajain Liitto ry. Vaasa. Painopinta Ky. 99 p.
- European Convention** 1991. European Convention for the protection of animals kept for farming purposes. Strasbourg 1976, ETS 87. Recommendation Concerning Fur Animals, 25 June 1991. 19 p.
- Garrott, R.A., Eberhardt, L.E. & Hanson, W.C.** 1984. Arctic fox denning behaviour in north Alaska. *Canadian Journal of Zoology* 62: 1636–1640.
- Harri, M., Ahola, L., Mononen, J. & Rekilä, T.** 1995. Key features of housing design in farm foxes. NJF:s subsektion för pälsdjur. Höstmöte 4–6 Oktober, Göteborg, Sverige 1995. 13 p.
- , **Mononen, J., Korhonen, H. & Haapanen, K.** 1991. A study of the use of resting platforms by farmed blue foxes. *Applied Animal Behaviour Science* 30: 125–139.
- Hoffmeyer, L.** 1986. Preliminary experiments to improve the cage- and nest systems of farm foxes (short communication). *Scientifur* 10: 163–166.
- Jeppesen, L.L. & Pedersen, V.** 1991. Effects of whole-year nest boxes on cortisol, circulating leucocytes, exploration and agonistic behaviour in the silver fox (*Vulpes vulpes*). *Behavioural Processes* 25: 171–177.
- Jones, R.H.** 1993. Longitudinal Data with Serial Correlation: a State-space Approach. London, Chapman & Hall. 225 p.
- Kaikusalo, A. & Angerbjörn, A.** 1995. The arctic fox population in Finnish Lapland during 30 years, 1964–93. *Annales Zoology Fennici* 32: 69–77.
- Korhonen, H., Ketoja, E. & Niemelä, P.** 1995. Comparison of daytime use between different platform types, materials, ceilings and pre-weaning experiences in juvenile blue foxes (*Alopex lagopus*). *Applied Animal Behaviour Science* 45: 125–138.
- & **Niemelä, P.** 1993. Use of resting platforms by growing blue foxes. *Scientifur* 17: 271–276.
- & **Niemelä, P.** 1994. Preferences of silver and blue foxes for farm cage and pen. Resultater af de Seneste Års Nordisk Pelsdyrforskning, NJF-Seminar nr. 253, Rebild, Denmark 28–30 September 1994. 16 p.
- & **Niemelä, P.** 1995. Comparison of production results between blue foxes housed with and without platforms. *Agricultural Science in Finland* 4: 351–361.
- & **Niemelä, P.** 1996. Effect of environmental and social enrichment on some welfare variables in farm blue foxes (*Alopex lagopus*). *Scientifur* 20: 26–34.
- Mononen, J., Harri, M. & Rekilä, T.** 1995. Foxes do not like nontransparent walls. NJF:s subsektion för pälsdjur, Höstmöte 4–6 Oktober, Göteborg, Sverige 1995. 1 p.
- , **Harri, M., Rouvinen, K. & Niemelä, P.** 1993a. The use of resting platforms by young silver foxes (*Vulpes vulpes*). *Applied Animal Behaviour Science* 38: 301–310.
- , **Rekilä, T. & Harri, M.** 1993b. Young blue foxes (*Alopex lagopus*) prefer resting platforms with an unobstructed view. In: Nichelmann, M., Wierenga, H.K. & Braun, S. (eds.). Proceedings of the International Congress on Applied Ethology. Humboldt University, Berlin. p. 532–534.
- , **Rekilä, T. & Harri, M.** 1996. Farmed foxes prefer a cage with an unobstructed view. *Scandinavian Journal of Laboratory Animal Science* (in press).
- Pedersen, V. & Jeppesen, L.L.** 1993. Daytime use of various types of whole-year shelters in farmed silver foxes (*Vulpes vulpes*) and blue foxes (*Alopex lagopus*). *Applied Animal Behaviour Science* 36: 259–273.
- SAS** 1990a. SAS Procedures Guide, Version 6, Third Edition. SAS Institute Inc. Cary NC. 705 p.
- SAS** 1990b. SAS/GRAPH Software: Reference, Version 6, First Edition, Volume 2. SAS Institute Inc. Cary NC. 1342 p.
- SAS** 1992. SAS Technical Report P-229, SAS/STAT Software; Changes and Enhancements, Release 6.07. SAS Institute Inc. Cary NC. 620 p.

SELOSTUS

Näköesteen vaikutus sinikettujen hyllynkäyttöön

Hannu Korhonen ja Paavo Niemelä
Maatalouden tutkimuskeskus

Tutkimuksessa selvitettiin, missä määrin kettujen hyllynkäyttöön vaikuttaa se, onko näkyvyys ympäristöön estetty seinien avulla. Hyllynkäyttöä mitattiin videokameralaitteiston ja otoshavainnoinnin avulla vieroituksesta nahkontaan. Kokeessa oli kaksi hyllytyyppiä: toinen seinällinen ja toinen seinätön (molemmissa 16 urosta ja 14 naarasta). Tulokset olivat samansuuntaiset molemmilla sukupuolilla ja osoittivat, että ketut käyttävät seinättömiä hyllyjä merkitsevästi ($p < 0,01$) enemmän kuin seinällisiä hyllyjä sekä hyllylle hyppelyyn (kesto < 1 min) että lyhytaikai-

seen lepäilyyn (kesto 1–10 min). Myös nukkumisen (kesto > 10 min) osalta tulos oli pääosin samansuuntainen. Ainut poikkeus oli syyskuu, jolloin naaraat nukkuivat molemmissa hyllytyypeissä yhtä paljon. Häiriötesti osoitti, että akuutissa voimakkaassa häiriötilanteessa ketut välttävät hyppäämistä seinällisiin hyllyihin, koska ne eivät näe niistä ympäristöön. Tulosten perusteella voidaan todeta, että ympäristön tarkkailun mahdollisuus on ketuille tärkeä, ja siksi ne suosivat seinättömiä hyllyjä. Euroopan neuvoston (1991) määräyksiä on näiltä osin syytä muuttaa.