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Testing a sustainable coconut coir cat litter: Cat versus owner

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Abstract

Effective management of indoor cats' elimination needs is necessary to prevent the development of behavioural and physiological problems that can result in their relinquishment by owners. Feline toileting is based upon a series of complex behaviours, which, if not completed adequately, result in persistence of behaviours associated with toileting, such as scratching and sniffing in the litter box. In a cattery environment, a new sustainable coconut coir litter of dirt consistency, and pelletised wood litter were offered to individually housed cats over a four-day period. The coconut coir litter was found to promote appropriate toileting behaviour by reducing inappropriate elimination behaviours such as perseveration in interacting (scratching at the litter and surrounding areas), lingering (sniffing in and around the litter), and defecation or urination outside the box within a few days. In comparison, inappropriate behaviour continued with the use of basic pelletised wood litter, indicating it may not provide an ideal toileting environment. While the coir improved the opportunity for appropriate cat behaviour, as it is similar to the substrate they use when eliminating outdoors, it also increased the mess and maintenance workload for cattery staff. Convenience in managing the waste of indoor cats tends to be more important to owners than the capacity for a litter to fulfil cats' toileting needs. Accordingly, to promote positive relationships between owners and cats, future experimentation will focus on both how to minimise inconvenience for owners and on identifying a product that gives cats the opportunity to perform appropriate toileting behaviours.

Keywords

Cat behaviour, cat litter, cat toileting, inappropriate cat behaviour, coconut coir, animal welfare

Introduction

Domestic cats (*Felis catus*) are a free-roaming species in Aotearoa / New Zealand that causes significant harm to native wildlife. Here, 41% of households have a cat (Companion Animals New Zealand 2020), with 95% of cat owners allowing their cats to roam outdoors (Farnworth et al. 2010). Cats are the third most negatively impactful organism on global biodiversity – after rats (*Rattus* spp.) and the chytrid fungus that affects amphibians (Bellard et al. 2016) – through native wildlife predation, competition for resources and the spread of disease (Glen et al. 2023; Gow et al. 2021; Trouwborst et al. 2020). Cats are a major contributor to historical and ongoing decline of native fauna in Aotearoa / New Zealand (Bruce et al. 2019). The threat posed by cats is exacerbated by a number

of factors, including the 'fostering' of stray and feral cats, the exclusion of cats from predator management programmes under the Predator Free 2050 initiative, and low uptake of non-lethal management actions (e.g., confinement, Russell et al. 2015; Rouco et al. 2017; Glen et al. 2023). Guardians can keep companion cats inside the home to decrease their impact on the environment and lessen the chance of companion cats adding to the population of free-roaming, feral or stray cats that continue to cause damage.

There are challenges to owners keeping their cats inside the home, the most impactful issue being managing cat elimination using litter boxes (Foreman-Worsley & Farnworth 2019). The New Zealand Code of Welfare for Cats (Ministry for Primary Industries 2018) recommends daily checking and cleaning of litter boxes if required, and specifically mentions disposal methods of used litter. Furthermore, the code mentions provisions for the size and depth of the litter box, and types of suitable substrate. Although recent articles by Companion Animals New Zealand mention the need to offer advice on keeping cats inside and to ensure those cats have a good life, there were none on the most inconvenient task of cat guardianship – managing waste (Companion Animals New Zealand 2024; Lawson et al. 2020).

In a local study, an estimated 34% to 38% of companion cats were considered indoor cats and thus are most likely to require the provision of a litter box (Johnston et al. 2017). Populations globally have a higher estimation of closer to 50% of cats being indoor cats (e.g., Heidenberger 1997), with reports of up to 74% (e.g., Stella & Croney 2016). Persistent inappropriate house soiling is one of the main reasons for cat guardians to seek behavioural advice (Heath 2018; Herron 2010), and is the leading cause of relinquishment of cats, with rehoming made difficult and an increased likelihood of euthanasia (Frayne et al. 2019; Frayne et al. 2022; Salman et al. 2000). Common behaviours include urination and defecation outside the litter box, eliminating in the same spot, on objects or near the litter – behaviours that might also be caused by urinary tract infections (Tateo et al. 2022). These behaviours are here considered distinct from communication-driven behaviour such as spraying (Guy et al. 2014).

Medical issues are an important initial consideration for house soiling (Frayne et al. 2022). Toileting behaviour might have a physiological basis, such as issues in the lower urinary tract and gastrointestinal system, endocrine disease such as diabetes, or kidney problems (Herron 2010). It is vital to rule out medical problems before considering behavioural aversions in a diagnostic process of this nature (Herron 2010).

Behavioural aversions to litter boxes require tracking of elimination behaviour and characteristics of the litter box, the latter of which is managed by the guardian, and needs to be as appealing as possible to encourage use (Ellis et al. 2017). Aspects of appropriate toileting reflect the movement of outdoor cat behaviour to an indoor environment (Jongman 2007). These include litter location, substrate and litter box type, such as covered or uncovered (Grigg 2022), odour and changes to litter, and number, size and sharing of litter boxes, where mismanagement results in house-soiling (Frayne et al. 2022; Herron 2010; Heidenberger 1997; McGowan et al. 2017). Furthermore, the size of the litter box matters, with larger being preferred (Guy et al. 2014), especially with multiple cats (Neilson 2008). The depth of litter can also affect toileting, with deep litter preferred for defecation and shallow for urination (Ellis et al. 2017). In addition, household dynamics, home renovations, changes to routine or litter type, presence of outdoor cats (Amat et al. 2015; Frayne et al. 2022; Herron 2010), and dogs in the house have been reported to affect toileting (Tateo et al. 2023). The frequency of scooping and cleaning increases usage of the litter box (Ellis et al. 2017; Neilson 2004). To optimise the use of the litter box and mitigate house-soiling behaviours, it is important that cat litter management is convenient for guardians to ensure continued cat ownership.

An early study by Heidenberger (1997) found that in a sample of 550 owners with 1177 cats, 29% were inside cats allowed outside with supervision, 51% of cats shared a litter box with other cats, and 58% of owners located the litter box in the bathroom. Most owners cleaned the litter box daily (61%) with the rest spot-cleaning at least daily (31%). 57% had a complete clean at least every two days. This is consistent with more recent studies, for example, Tateo et al. (2022), that found, for 3000 Italian cat owners, most owned a single cat or small clowder (group) and would once or twice a day clean (scooping out litter and urine or faeces) litter boxes, located most often in the bathroom. It is evident that guardians need to monitor the physiology and behavioural needs of cats and be mindful of changes that may need to be implemented to mitigate the development of problem behaviours. The resulting litter box set-up also must be simple, convenient and easy to clean to ensure good welfare and continued cat ownership.

The litter box needs to be a sufficient approximation

of the outdoor environment to ensure cats can perform normal behaviours. McGowan et al. (2017) identified 39 behaviours associated with urination and defecation, concluding that cats required more space than expected to perform typical behaviours, and that cats will linger around the litter box and create mess if the litter is of suboptimal consistency (McGowan et al. 2017). Furthermore, Frayne et al. (2022) identified similar behaviours in group-housed cats that were offered different ratios of clay to plant-based litters, both resulting in investigative behaviours, such as sniffing and scratching, rather than stress-related behaviours, such as persistent scratching of litter and surrounding areas, digging and upending the litter box. This suggests that toileting behaviours can be consistent across a range of litter presentations, including during transition between litters, but the litter must fulfil qualities of the environment cats would normally prefer when toileting outside to mitigate perseveration of behaviour, and therefore, abnormal amounts of time and energy spent performing these behaviours. Qualities that are important to a cat to toilet effectively, that is, providing litter that satisfies behavioural needs, such as dirt or sand, are unfortunately secondary to human convenience. Qualities of 'good' litter are usually presented to guardians from a human perspective, such as having reliable absorbency or the capacity to control odour.

There are many cat litters available on the market, which are commonly promoted as being renewable, sustainable, biodegradable, absorbent, odour controlling and easy to manage. Litter can contain crystals made from silica gel beads, bentonite clay, wood and natural plants (e.g., such as pine or soya bean). Products such as pelletised pine or sawdust can be considered natural, renewable and sustainable, as they are biodegradable forestry waste-products that can be introduced back into the environment via compost. Products using sand-based silica and mined bentonite clay might be natural, but they are not renewable and are reported to damage the environment during extraction (Sanavada et al. 2023). Biobased cat litters are being tested with the aim to identify a sustainable and renewable litter that has comparable efficacy in clumping, and dust and odour control as commercial product.

A new product on the market is a renewable, biodegradable and cheap litter made from ground coconut coir (*Cocos nucifera* spp.), ordinarily used in gardening. A waste product from coconut harvesting in Indonesia, it has a neutral pH, absorbs urine well, and can be disposed of in the garden. Furthermore, coconut coir has been reported to significantly reduce ammonia levels found in cat faeces compared to wood shavings (Linhares et al. 2022), and due to its fibrous texture, coconut coir is naturally absorbent, clumps and does not produce dust (Macquoid & Keane 2003). In terms of consistency, the ground coir most closely approximates the substrate cats tend to use when toileting outside (i.e., sand or dirt). However, it has been noted that pelletising the coir results in fewer particles tracking via cat feet outside of the litter box (Macquoid & Keane 2003). The current study tested unpelletised coir only; it is unknown whether in pelletised form it would be adequate in providing for the behavioural needs of cats or be easier for owners to manage.

The objective in this study was to measure the utility of coconut coir cat litter for both cats and guardians. It used behavioural observation to measure the responses of individually housed cats in a cattery when presented with typical and coconut coir-based litters, and surveyed cattery workers for their assessment of the coir product in terms of ease of use and cleaning, odour control, dust and tracking, and absorbency. It was expected that cats would perform more natural toileting behaviours with the ground coir due to its similarity to a normal outdoor toileting material. The perception of the cattery workers and guardians will be informative for the future development of this product to inform holistic advice for conveniently keeping cats indoors, while ensuring 'a good life' by meeting the behavioural and physiological needs of cats.

Method

Participants

Six cats temporarily housed at a local cattery participated in brief testing of the sustainable coconut coir product. All cats had been housed individually at the cattery for at least 24 hours prior to testing and were regulars at the cattery. We were unable to determine the cats' previous experience with litters, if they used a litter box at home, or if they had pre-existing toileting issues. It is acknowledged that this is a limitation of the study.

The ethics of this animal research were approved by the AgResearch Animal Ethics Committee, protocol 1891.

Cage size and description

The enclosures were each 210 cm high, 58 cm wide and 100 cm deep, with a 70 cm ledge jutting out from

the back wall. The door was opposite a small cat house provided, with a gap of 30 cm between the door and the ledge where there was space for the cat to jump to the ground. The door was made of tight wire mesh and braced in the middle. The sides of the enclosure where wood up to the ledge and Perspex to the ceiling. Food and water bowls were placed on the ledge with a cat house of 30 cm^3 containing a cushion. Cats were able to sit on top of the cat house or on the stool located at the front of the enclosure, which also functioned as a step. The litter trays were 31 cm wide, 44 cm long and 8 cm deep, and two fitted side by side underneath the ledge at the back of the enclosure.

Litter

The coconut coir is sourced from Bali, Indonesia. It is certified as organic by OMRI and has a neutral pH (between pH 5.8 and 6.2). The coir is 100% renewable as a waste product from coconut harvesting. The cat litter being used already at the cattery – a sustainable pelletised domestic natural pine product by Freshco – was used as a baseline for cat defecation behaviour.

The typical provision of litter by the cattery was continued during testing to minimise extra effort on behalf of cattery staff. This consisted of two cups of litter in a tray with a tablespoon of baking soda. This covered the bottom of the tray up to 2.5 cm deep. The coir was placed in the trays to an even 2.5 cm deep to appear similar to the cattery's normal litter provision.

Procedure

The daily routine of the cattery was maintained, and the cattery manager agreed to two short runs of testing over four days due to the increased load on staff to conduct the study. Cats were fed and water replaced between 7 am and 8 am, and again at 4 pm. The litter boxes were either replaced or spot-cleaned of wet litter or faeces between 8.30 am and 9 am. The first condition for all cats was 24 hours of the cattery litter either on the right or left side of the enclosure. For the first four cats, the litter box was located on the right side of the enclosure as the cattery staff maintained their routine. After the first 24 hours, and for the remaining conditions for all cats, the location of the cattery litter and/or coir litter was counterbalanced (Table 1). The second condition functioned as the first exposure to the coir and was provided at the same time as the cattery litter. As Wendland (2011) notes, two days of new litter is required for transition and it was noted that the cats all used the coir for either urination or defecation in the first presentation, thus the third condition of only coir litter being offered was implemented. The fourth day was a preference test where both litters were presented to the cats.

Cat behaviour was recorded using Eufy outdoor security cameras (Anker Innovations, China) that were screwed to the wooden brace in the middle of the door, and controlled via the Eufy smartphone app. The cameras were set to record for 90 seconds after detecting motion about the litter boxes. There was an unavoidable gap of five seconds before motion-activated recording again. All videos were saved to the cloud, and videos of the cats engaging with the litter boxes were downloaded to a OneDrive account. Videos were deleted after 28 days of recording.

Table 1. Order of presentation of cattery 'litter' and 'coir' litter to the cats.

	Day 1: Litter only	**Day 2: Coir + Litter**	**Day 3: Coir only**	**Day 4: Coir + Litter**
Cat	**Litter side of cage**	**Litter side of cage**	**Coir side of cage**	**Litter side of cage**
Chilli	Right	Right	Left	Right
Blackie	Right	Left	Right	Left
Mabel	Right	Right	Left	Right
Luna	Right	Left	Right	Left
Scooter	Left	Right	Left	Right
Honey	Right	Left	Right	Left

Behavioural assessment

The ethogram used was developed by the authors to note behaviours associated with the base litter and the coir (Table 2). Each behaviour was then counted as either 'toileting', including behaviours of urination, defecation and scratching dirt over the top; 'interacting', including behaviours such as scratching the litter with one foot while in or outside the litter box; and 'lingering', including behaviours such as sniffing in or around the litter box and at the urination or defection site, but not immediately after toileting. Each occurrence and duration of behaviour was recorded when the cat was in view of the camera and the litter box (Figure 1). Recording stopped when the cat left the floor by the litter boxes or when the recording timed out.

Figure 1. Video capture of the litter trays on Day 3 when the coir was on the left and litter on the right side of the enclosure.

Data analysis

Focal sampling and continuous recording were used to analyse the videos. Data files were created in Microsoft Excel, where the count and duration of each behaviour was recorded according to a custom ethogram of cat defecation and urination and associated behaviours (Table 2). The study was designed to provide a baseline of behaviour using the cattery litter, which was compared with Day 3, which involved provision of the coir litter only. Day 2 was the first preference test (and first presentation of the coir litter) and was compared to the second preference test on Day 4. The data was analysed for each cat using a within-subjects design across conditions and aggregated for behaviours that were related to engagement with the coir and the litter, and other non-specific behaviours. Repeated measures ANOVA tests were used to measure the effect of litter type on the average frequency and duration of engagements with the litter types across time on Day 2 and Day 4. Paired t-tests were used to determine the relationship between condition and litter type on the average frequency and average duration of engagements with the coir and cattery litter between Day 1 and Day 3.

Survey

At the conclusion of the experiment, the manager and cattery staff were asked to fill in a survey approved by the Unitec Human Research Ethics Committee, protocol 2024-1006. This was voluntary and anonymous, with surveys completed and left in a folder in the office to be collected by the researcher a week after the experiment.

The survey asked respondents about their experience on a 7-point Likert scale regarding absorbency and smell control, ease of preparation and cleaning, mess, texture, usage, and perception of sustainability, cost effectiveness and satisfaction. Due to the small sample size, the survey results are reported briefly.

Table 2. Ethogram detailing the behaviour groups, codes and definitions. Where there is an 'x' in the table, the behaviour applies to both the C = coir litter, and L = cattery litter.

Coir or litter	Behaviour category	Code	Description
C/L	Toileting	D-x	Defecating in coir/litter tray. Body in a seated position with front legs straight and back legs bent. Weight forward and lifting posterior.
		S-fx-d	Scratching with front leg over defecation in coir/litter tray. Back feet may be in or outside the tray.
		Sn-D/Ux	Nose at the same point of defecation/urination in coir/litter tray.
		U-x	Defecating in coir/litter tray. Body in a seated position with front legs straight and back legs bent. Weight forward and lifting posterior. Faecal matter evident after movement. Urine stain evident after movement.
	Lingering	Ap-x	Approaches coir/litter tray.
		G-ix	Moving so whole body (four feet) is in coir/litter tray. The starting point can be from either four feet on the floor or two feet in the tray and two on the floor.
		G-ox	Moving so whole body (four feet) is outside coir/litter tray in one continuous movement.
		L-x	Lingering around coir/litter tray (sniffing, then moving head toward and away from tray).
		L-otherx	Lingering around coir/litter tray and doing other behaviours (turning to face the other way, licking/sniffing wall, etc.).
		L-Tx	Lingering (sniffing) with all feet in coir/litter tray.
		L-Tx2	Lingering (sniffing) with two feet in coir/litter tray, two feet remaining in the other tray or on the floor.
	Interacting	S-ar-x	Scratching with one foot outside the coir/litter tray and three feet inside.
		S-bx	Scratching with back feet in coir/litter tray, front feet remaining stationary.
		S-fx	Scratching with front feet in coir/litter tray, back feet remaining stationary.
		S-ox	Scratching with front leg in coir/litter tray with back feet outside of the tray.
Non-specified		F	Cat on floor but not near coir/litter.
		J	Jumping from tray to floor.
		Tu	Turning in either tray (<1 s duration).

Results

The number of occurrences engaging with the coir and litter, and undirected behaviours within 4-hourly bins starting at 7 am were aggregated across the cats (Figure 2). The number of engagements with the litter during Day 1, the baseline, was variable across hourly bins and showed the most variation across cats indicated by the standard error bars. On Day 3, the number of engagements was initially high, followed by a low count, then increased up until 11 pm and again between 3 am and 7 am. On Day 2 and Day 4, behaviour associated with the coir was higher and more variable than for the litter across time. The cats were more active between 11 pm and 7 am for coir but not for the litter. The amount of non-specified behaviour, such as being on the floor but not engaging with the coir, was similar across time.

A repeated measures ANOVA revealed a significant difference in the average number of occurrences of behaviour on Day 2 and Day 4 when divided by the 4-hourly bins: $F(5, 15) = 3.49$, $p = 0.027$. More behaviour occurred between 11 pm and 3 am across litter types (M = 16.1) and between 3 am and 5am (M = 10.8). Few behaviours occurred between 11 am and 3 pm (M = 1.3).

The duration of engagement with the coir and litter,

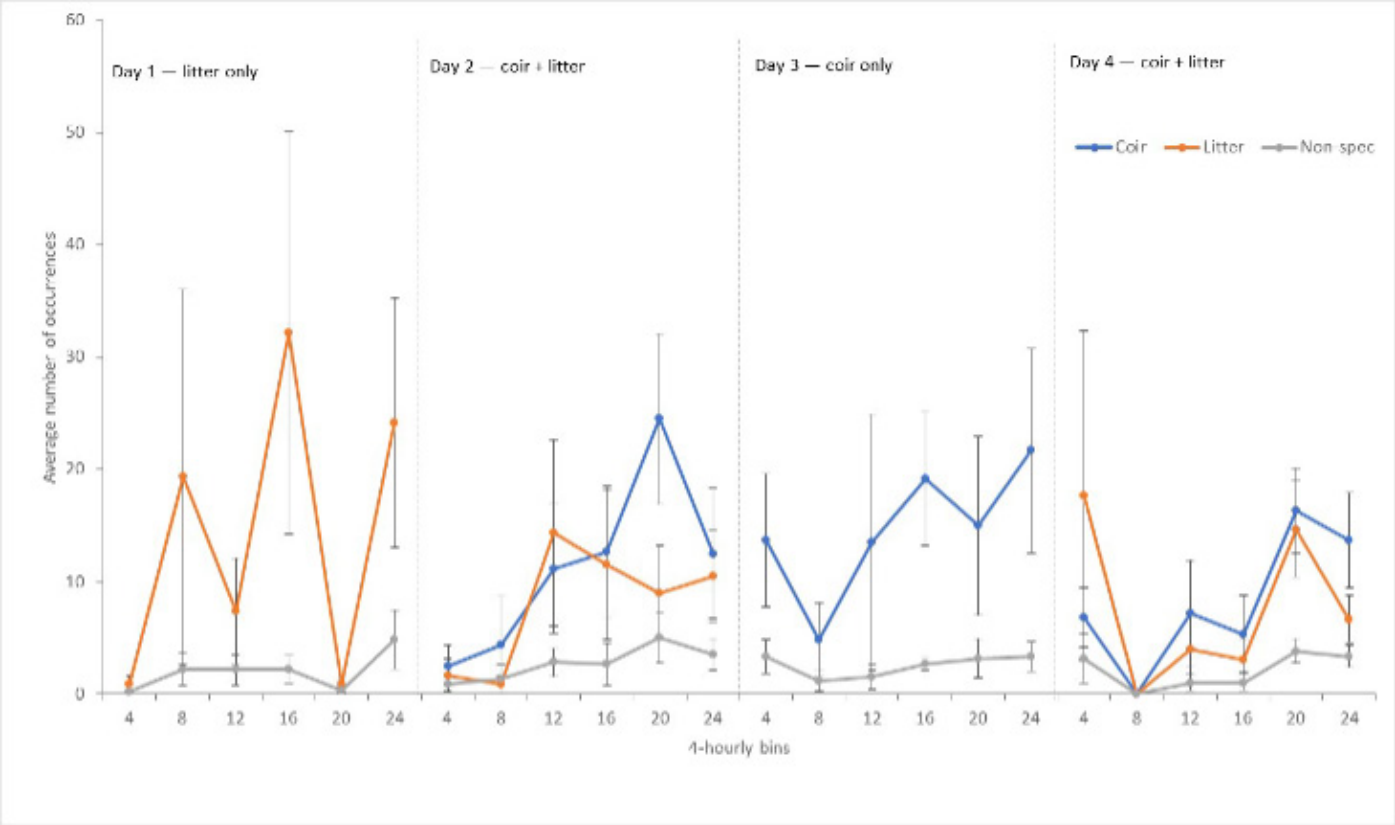

Figure 2. Average number of occurrences within 4-hourly bins directed at the coir, cattery litter and unspecified behaviour across cats across conditions from Day 1 to Day 4. Error bars represent the standard error of the mean.

and undirected behaviours within 4-hourly bins starting at 7 am were aggregated across the cats (Figure 3). On Day 1, the duration of engagement with the litter was variable across cats, with the highest duration between 11 pm and 3 am, and the lowest between 7 am and 11 am, and 3 am and 7 am. On Day 3, the duration of engagement with the coir increased across time from early afternoon to the next morning (3 pm–7 am) in contrast to the Day 1 engagement with litter. The number of occurrences of engagement decreased between 11 pm and 3 am; however, the duration of those occurrences was longer.

On Day 2, the time spent engaging with the coir increased throughout the day to peak between 11 pm and 3 am. The engagement with the cattery litter was more variable, with more time spent engaging with

cattery litter between 3 pm and 7 pm, then with the coir more than the cattery litter between 7 pm and 7 am the next day. On Day 4, initial durations of engagement were longer with the cattery litter (possibly as it was absent the day prior). Between 11 am and 11 pm the duration of occurrences was similar between the coir and cattery litter, but longer durations were spent engaging with the coir between 11 pm and 7 am. The unspecified behaviour remained the same across time and conditions.

A repeated measures ANOVA revealed no significant difference in the average duration of behaviour on Day 2 and Day 4 when divided by the 4-hourly bins: F (5, 15) = 2.63, p = 0.067. The average duration of behaviour during the 4-hourly bins was 44.94 seconds. Longer stints occurred between 11 pm and 3 am (M = 78.1 s), 3 pm and 7 pm (M = 51.0 s), and 3 am and 5 am (M = 50.6 s). The shortest duration occurred between 11 am and 3 pm (M = 8.4 s).

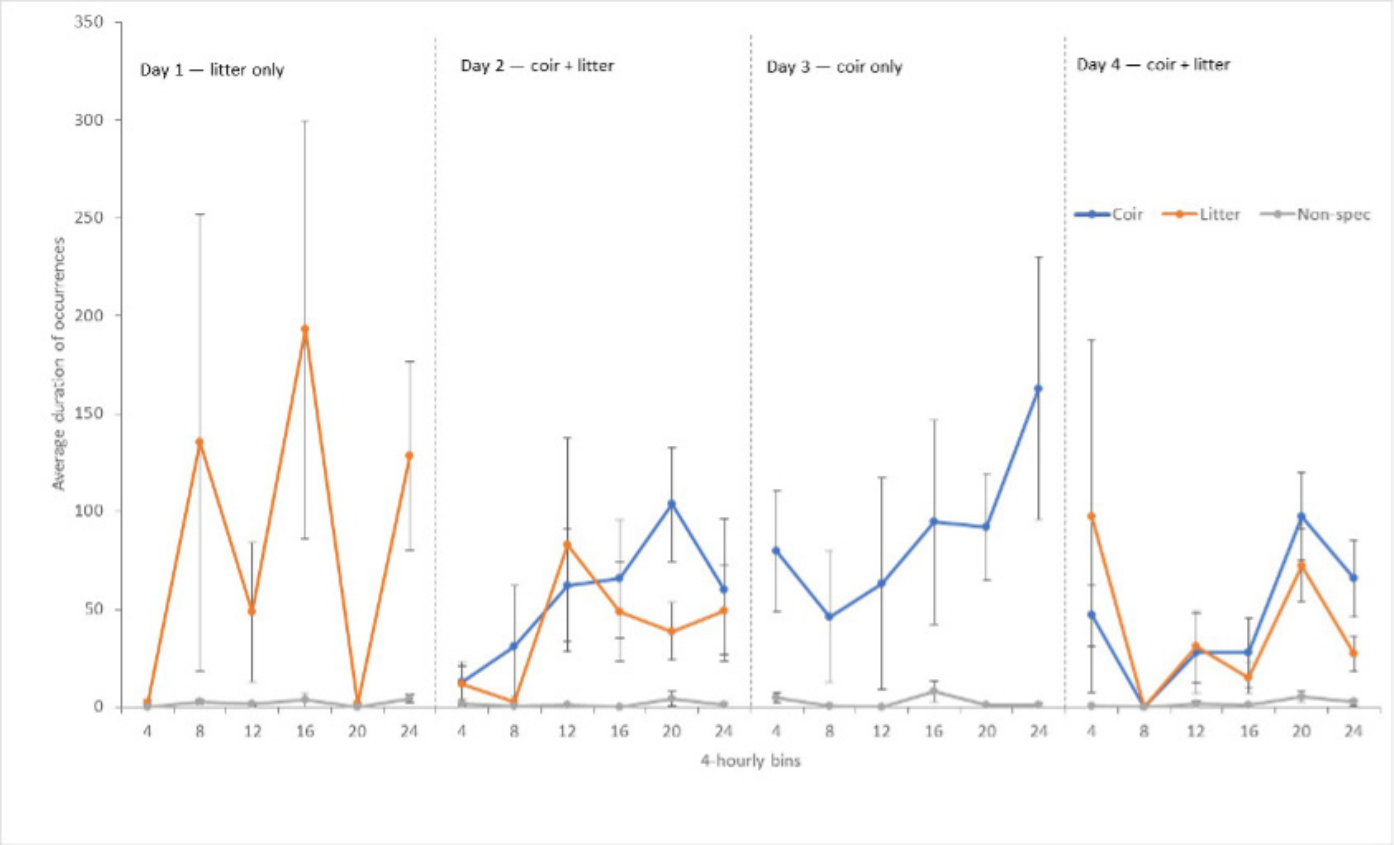

Figure 3. Average duration of engagement within 4-hourly bins directed at the coir, cattery litter and unspecified behaviour across the cats across conditions from Day 1 to Day 4. Error bars represent the standard error of the mean.

Figure 4 shows the average number of toileting, interacting and lingering behaviours over 24 hours. In a comparison of Day 1 and Day 3, the cats performed similar frequencies of toileting, interacting and lingering behaviours in the cattery litter and the coir.

On Day 2, the cats toileted in the cattery litter more than the coir and interacted with, and lingered by, the coir slightly more than the cattery litter, but still performed interaction and lingering behaviours with the cattery litter. On Day 4, there were similar numbers of toileting, interacting and lingering behaviours (all p's > .05). A repeated measures ANOVA revealed significant differences between the number of toileting, interacting and lingering occurrences to the litter types: F (2, 6) = 95.3, p < .001, but no significant difference in the average number of occurrences directed to the coir versus the litter: F (3, 6) = 4.46, p = .057. The effect size between the behaviour categories was medium (η^2 = 0.064) and the partial effect size of the number of engagements between the coir and cattery litter was medium (η_p^2 = 0.69).

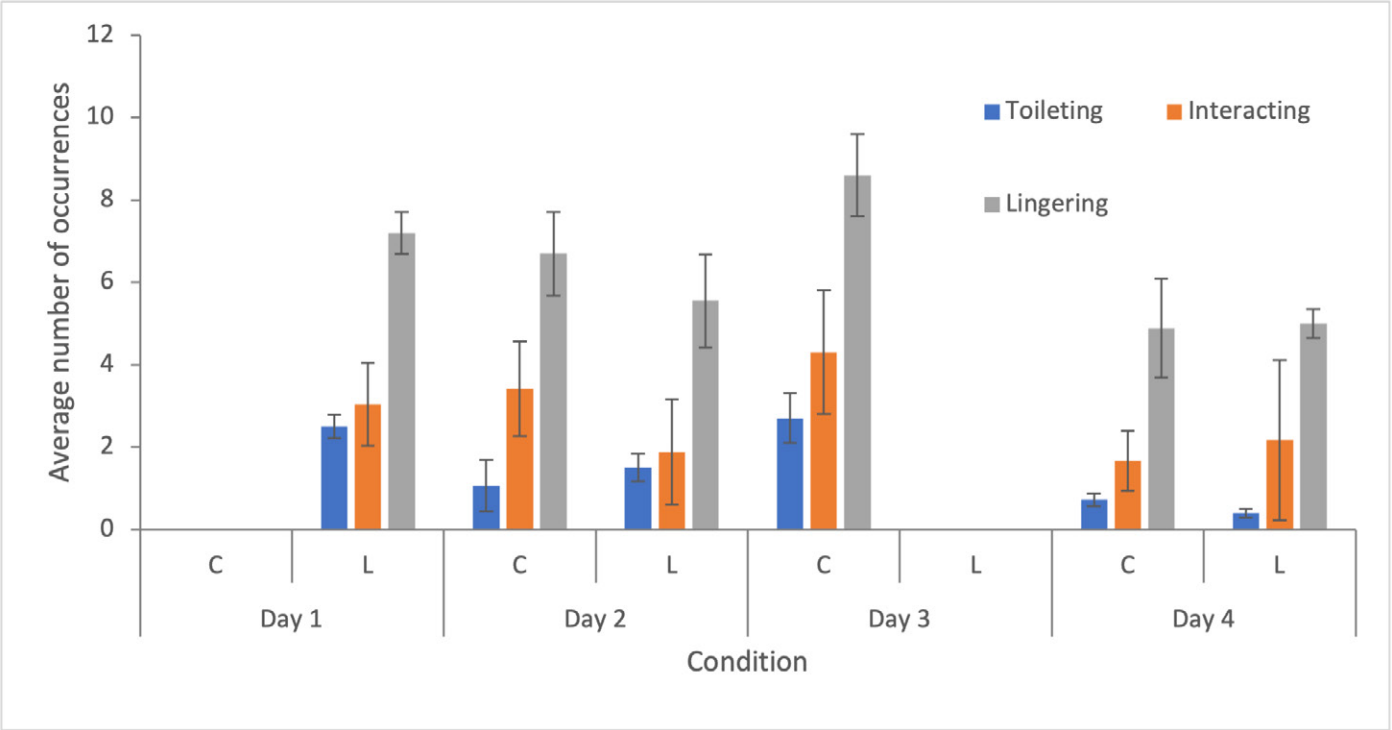

Figure 4. Average number of occurrences of behaviours classed as 'toileting', 'interacting' and 'lingering' around the coir and cattery litter across the cats and conditions from Day 1 to Day 4.

Figure 5 shows the average duration of behaviour towards the coir and litter for each condition. In a comparison between Day 1 and Day 3, the cats spent a similar amount of time toileting and interacting with the litter boxes, but spent more time on average lingering in the environment around the litter boxes on Day 3: t (4, N = 3) = 0.68, p = .536.

During Day 2, the cats toileted in, interacted with, and lingered by the coir more than the cattery litter, but still maintained engagement with the litter, especially spending time lingering around the cattery litter box. A repeated measures ANOVA revealed a significant difference between the time spent performing the behaviours of toileting, interacting and lingering on Day 2 compared to Day 4: F (2, 6) = 7.2, p = .025, but there was no significant difference across average time spent engaging with each litter type: F (1.4, 2.8) = 9.2, p = .062 (Greenhouse Geisser correction ε = .46). Multiple comparisons using the Bonferroni correction indicated that significantly more time was spent engaging with the coir (M = 24.9) on Day 2 than on Day 4 (M = 14.3, p = .048). The effect size (η^2 =0.57) of the average time spent engaging with the coir over litter was large. Similarly, the partial effect size (η_p^2 = 0.81) indicates that time spent lingering was impactful, although not significantly greater than toileting and interacting across litter types.

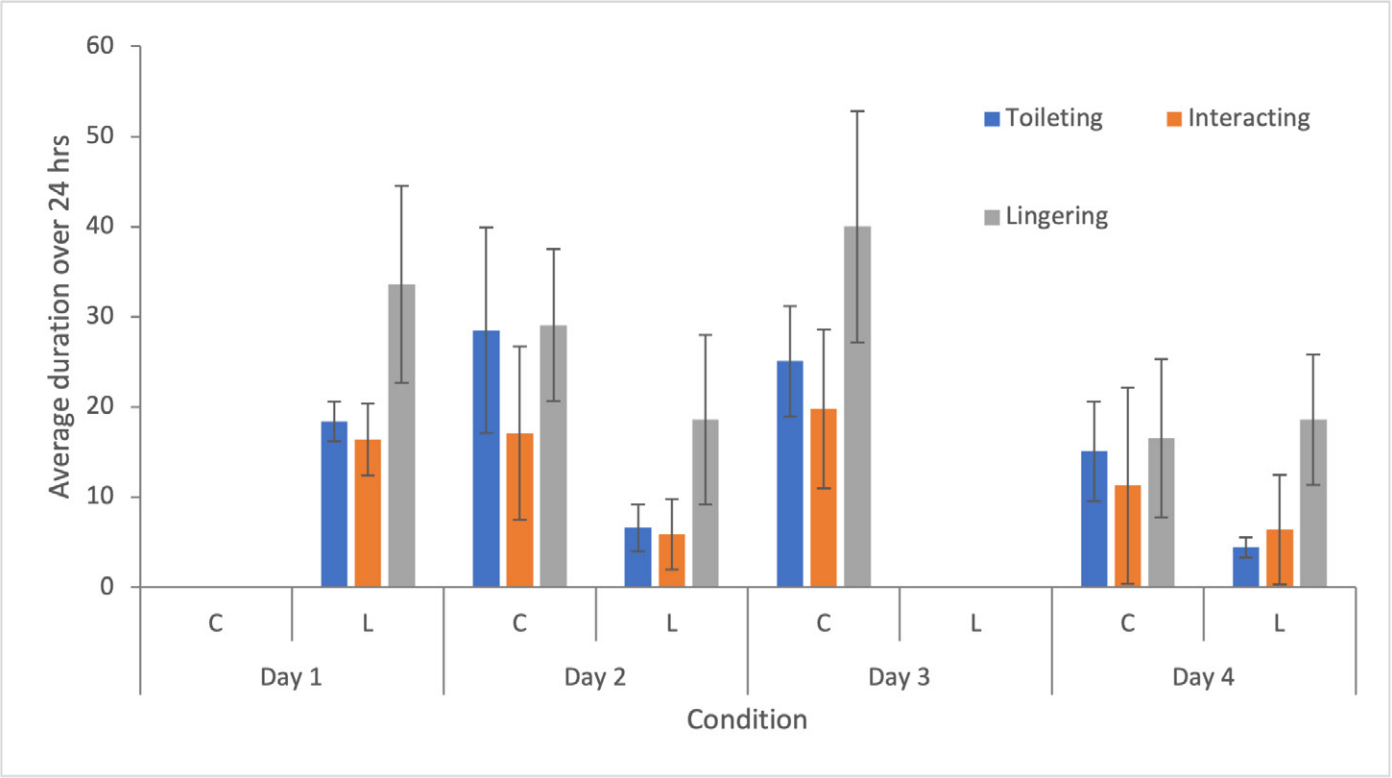

Figure 5. Average duration of engagement of behaviours classed as 'toileting', 'interacting' and 'lingering' around the coir and cattery litter across the cats and conditions from Day 1 to Day 4.

Survey

The survey was completed by the three staff. They all responded that the coir was messier and required considerably more time and effort by cattery staff to manage on a daily basis. In addition, every surface in the individual cat areas was covered in dust and needed to be wiped down after the coir conditions. One response suggested that it did not clump when wet and became 'like mud'.

Discussion

In this experiment a coconut coir litter was presented to cattery cats over a series of conditions to measure toileting. The coir was the consistency of dirt, similar to natural substrates used for toileting, and was presented alongside pelletised wood cattery litter. Both litters functioned similarly for toileting with a similar number of engagements. However, the cats spent longer toileting in the coir compared with the cattery litter, with similar durations of interacting and lingering, by Day 4.

In the current experiment, 'toileting' consisted of behaviour such as urinating and defecating. There were no differences in the number of toileting occurrences; however, they were longer in duration using the coir compared to the cattery litter on Days 2 and 4. Associated appropriate behaviours with toileting included scratching substrate over and sniffing their eliminations. We categorised sniffing and scratching behaviours outside of, or immediately before or after, elimination, as 'lingering' and 'interacting'. Interacting included scratching while all feet, or two feet, were in the litter box, and scratching with back or front feet while the whole body was in the litter tray, or scratching the floor, litter or surrounding walls. Lingering included sniffing around the outside of the litter tray, in the litter tray while two or four feet were in the tray, and movement into the litter tray. McGowan et al. (2017) found that in a comparison of toileting behaviours in a clinic (using polypropylene beads) versus an enriched environment (using loose clay litter), cats would interact with their environment by pawing at the litter more and for longer, and lingered by sniffing the area in and around the litter, more and for longer in the clinic environment. The authors concluded that the clinic environment provided a substandard environment for toileting and that more negative toileting behaviours, such as perseverated

lingering and interacting with the litter indicated that the behavioural sequence of toileting – that is, completely covering the urination/defecation – was incomplete and that the cats returned repeatedly to complete the behaviour, resulting in 'frustration' (McGowan et al. 2017).

The cats in the current experiment spent a similar amount of time toileting, interacting and lingering around the coir and litter, with toileting involving the smallest proportion of time, and lingering and interacting with the litter types exceeding the time spend urinating or defecating. Perseveration at these behaviours is considered negative as it indicates that the environment is inadequate in some way and the cat is not 'content' to have performed toileting efficiently and move on to other behaviour. In the current testing it was evident that engagement with the coir and cattery litter was variable in the number and duration of occurrences when presented with a single option. On Day 1, cats spent twice as long lingering and the same amount of time interacting with the cattery litter as toileting. When compared with McGowan et al. (2017) and the inadequacies of clinic litter resulting in greater lingering and interacting with the litter, we can draw comparisons that the cattery litter was not providing an optimal toileting environment. On Day 3, the same pattern of behaviour was observed with longer durations overall in engagement with considerably more lingering about the coir, but with similar durations for interacting as for the cattery litter. The increase in engagement with the coir could be due to the novelty of the coir to the cats, or neither litter allowing for behavioural needs to be met, or the litter being the only enrichment available to the cats (except for one cat, who had a scratching post) – or, most likely, a combination of all three.

The cats in the experiment had been housed at the cattery for at least 24 hours prior to the experiment starting – and were regulars at the cattery. When introducing the coir, we offered both litters at the same time, resulting in more use and attention given to the coir than the cattery litter. However, the litter was not completely ignored as there was perseveration of toileting-associated behaviour to the cattery litter. Foreman-Worsley & Farnworth (2019) make the point that preference tests, as used in this study, can present a novelty effect, which was evident on Day 2. They also state that any positive effects might decrease over time, and no longer be of benefit. In the current study, the novelty effect of the coir was diminished by Day 4, with fewer associated toileting behaviours allocated to the coir than on Day 2. Frayne et al. (2022) also found that sniffing behaviour decreased over time after introductions of new litters. In the current experiment, the level of interaction and lingering with the coir and cattery litter was apparent in all presentations, but decreased considerably for the coir and would likely decrease with further presentations.

McGowan et al. (2017) identified that continued behaviour outside of toileting was part of a perpetuating cycle of incomplete toileting. Where lingering and interacting with the coir decreased over time, the allocation of that behaviour to the cattery litter did not. This might reflect that the cats were able to complete a toileting routine with the coir more successfully than with the cattery litter. This is speculative, as we were only able to perform a four-day experiment due to the mess and extra effort created by the coir for the cattery workers, but we surmise that because the coir litter is the consistency of dirt, cats adapt to it quickly and are able to fulfil their toileting behavioural needs – perhaps because they can adequately cover their eliminations and control odours (Frayne et al. 2022; McGowan et al. 2017). In contrast, the cats were seemingly unable to fulfil their behavioural needs using the cattery litter, evidenced by the lack of change in lingering or interacting behaviours associated with its use.

The cats in this study were housed in an environment with a hide. They were able to see their neighbour through the window, use their stool to sit on, and step down to the lower level to access the litter box. One out of six of the cats had a scratching post. The authors propose that to some extent the litter box also functioned as a stimulus. It is not surprising that without another activity, bar sleeping and eating, there was perseveration of lingering and interacting with litter material, which remained constant for either litter. In addition, this likely led to the increased mess identified by the cattery workers when the coir litter was implemented. A number of research papers offer strategies for environmental enrichment within a cattery to mitigate development of abnormal behaviours such as interacting with dirty litter, including housing cats in a clowder offering social interaction, human interaction, use of toys, creative feeding methods, enhanced physical environments such as increased heights and structures, and sensory enrichment incorporating novel visual, olfactory and auditory stimulation (Houser & Vitale 2022; Ellis 2009; Ellis et al. 2022).

There were several limitations to this study. The most impactful was the cattery shortening the study due

to the increased workload involved. We were not able to measure whether the novelty of the coir would decrease over a longer period; however, the marked decreases between Day 2 and Day 4 do indicate acclimation to the new substrate. As a result of the recommendations of the authors, the producer has begun to pelletise the coir litter to decrease dust and mess (Macquoid & Keane 2003), and this will be tested over a longer period of time in another series of experiments. We were also unable to ascertain whether the cats in the experiment used litter boxes at home, due to incomplete information sheets; however, we know that they are regular users of the cattery and had also been staying in the cattery for at least 24 hours prior to the experiment starting. Finally, the video recording system had an inbuilt unavoidable interval of five seconds between motion-activated recordings. In some instances, this would have resulted in missed behaviour; however, the authors do not think that this would change the overall conclusions of the research.

Effective management of indoor cats' elimination needs is important in preventing the development of behavioural problems and physiological issues such as lower urinary tract problems, gastrointestinal disturbances, and even more serious conditions such as diabetes or kidney disease (Herron 2010). Furthermore, inappropriate elimination can also lead to cats being relinquished by their owners (Frayne et al. 2019; Frayne et al. 2022; Salman et al. 2000). In this study, the coconut coir litter was found to promote positive toileting behaviours, by reducing inappropriate elimination behaviours within a few days. Conversely, basic pelletised wood litter did not show the same improvement, indicating it may not provide an ideal toileting environment. However, while the coir litter improved the opportunity for appropriate behaviour, it also increased the mess and maintenance workload for cattery staff. To address this, a new experiment is planned to test a pelletised version of the coir litter. This version aims to reduce mess while maintaining the positive effects on toileting behaviour observed with the coir product. Ultimately, balancing the wellbeing of cats with owner convenience is essential for effective toileting management and a long-lasting positive human–animal relationship.

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