

Bekoff, M. (2001). Observations of scent-marking and discriminating self from others by a domestic dog (*Canis familiaris*): Tales of displaced yellow snow. *Behavioural Processes*, 55, 75-79. [https://doi.org/10.1016/S0376-6357\(01\)00142-5](https://doi.org/10.1016/S0376-6357(01)00142-5)

Article summary:

Scent-marking behaviour in dogs is characterized by sniffing a mark left by other dogs and immediately urinating over it. Although there were already multiple studies about the scent-marking behaviour of dogs, none of them examined the behaviour from different arrival times and how the canine behaves in response to its own scent. So, Bekoff (2001) investigated if dog scent-marking behaviour is also observed on the dog's own scent.

To do this, he scooped up chunks of Jethro's (a castrated domestic dog) and other dogs (females and males, castration status unknown) urine-soaked snow and placed them at different distances from 10m, 30m, and 50m away so that Jethro would arrive at each location at different times. (10 seconds, 10-120 seconds, and 120-150 seconds respectively). He eliminated any confounding variable by using clean gloves for each sample to prevent mixing scents, and by matting the snow after it was placed to minimize any visual cues.

He found that Jethro paid less attention – less sniffing, less urinating, and less scent-marking - to his own yellow snow than any of the others (At 10-120s, his sniffs lasted < 3s. $Z > 3.30$, $P < 0.001$). However, he was more attentive to the male's urine-soaked snow more than that of females. For example, at 120-150s, he marked male's scent 20.1% more than females. Although there was no statistically significant difference between the data from females and males, it was shown that on all occasions, he urinated over males' urine more than females.

Results from this study can be used in the future for the examination of sex differences or territorial marking instincts in canines that may be causing this behaviour, but further research is needed to support this. Future studies may also explore the question about the effect of castration status on scent-marking behaviour.

Article Contribution:

I chose this article as part of my literature review because it takes the dog's gender and own behaviour into account during the study of scent-marking behaviour. This article advanced the knowledge in the field because these data may be applied to wild canids as well. It supports previous findings such as Dunbar and Carmichael's (1981) study on beagles where they found that dogs pay more attention to male dogs' scent than females. It provides enough background, and it presents more questions that should be studied in the future such as the effects of castration on scent-marking behaviour.

*This article was cited 117 times.

McGuire, B. (2019). Effects of gonadectomy on scent-marking behavior of shelter dogs. *Journal of Veterinary Behaviour*, 30, 16-24.
<https://doi.org/10.1016/j.jveb.2018.11.002>

Article summary:

Dogs are castrated as part of routine and preventive care measures in shelters or veterinary clinics. Gonadectomy is required for dogs staying in a shelter. Gonadectomy is the removal of either testis in males or ovaries in females through surgery. For dogs staying in a household, owners may opt for surgery to decrease the amount of sexually dimorphic behaviours such as mounting and roaming. In this article, McGuire (2019) studies the effect of gonadectomy on the scent-marking behaviour of shelter dogs since there is less data that provides information on this topic.

Scent-marking behaviour (SMB) is characterized by urination, defecation, and ground scratching behaviours of dogs. McGuire (2019) compared these at the Tompkins County Society for the Prevention of Cruelty to Animals (SPCA) and Cortland Community SPCA. The reproductive status of the dogs included 89 intact and 269 castrated males and 91 intact and 213 spayed females. McGuire (2019) looked at the rate of SMB before and after the gonadectomy.

McGuire (2019) found that intact males had higher SMB rates than castrated males. The spayed and intact females show similar SMB indicating that this is not affected by the procedure. The likelihood of defecation and ground scratching wasn't affected by gonadectomy considering that the amount of both behaviours in both genders before and after the procedure showed no statistically significant difference.

Senior dogs had higher urination rates than younger dogs as the finding in McGuire's (2016) study. The SMB in castrated males is still higher than intact females indicating that this behaviour is more crucial to males than females.

Findings from this study shed light on hormonal causes of scent-marking behaviour. Since females are unaffected by gonadectomy, we can deduce that estrogen and progesterone don't play a role in scent-marking behaviour but testosterone in males does. The degree of which warrants further studies.

Article Contribution:

I chose this article for my literature review because it shows proximate causes of scent-marking behaviour. It also distinguishes whether female hormones (estrogen and progesterone) or male hormones (testosterone) are responsible for the behaviour. It is consistent with the study done by McGuire (2016), where senior dogs were also found to urinate more than younger counterparts. This article shows enough background information on the topic, but it begs the question of the extent of testosterone's effect on scent-marking behaviour.

*This article was cited 6 times.

Knol, B. W., & Egberink-Alink, S. T. (2011). Treatment of problem behaviour in dogs and cats by castration and progestagen administration: A review. *Veterinary Quarterly*, 11:2, 102- 107. <https://doi.org/10.1080/01652176.1989.9694206>

Article Summary:

Past studies have investigated the efficacy of castration, (procedure to lose function of the testicles) and progestagen (a steroid hormone that binds to progesterone receptors) therapy in male dogs to eliminate problem behaviour. This includes intermale aggression, mounting, roaming, excess barking, restlessness, unacceptable sexual activity, self-mutilation, tail chasing, and pickiness, and urine marking. Sexually dimorphic behaviours include sexual, scent-marking, and aggression. In this review, Knol and Egberink-Alink (2011) delve deeper into the subject hoping to decrease the frequency of euthanasia caused by these behaviours.

They did so by examining multiple studies on the subject. They first looked at the role of sexual dimorphism and found that both genders display the behaviours. They found that these behaviours differed between both genders and were found to be sex hormone-dependent.

To qualify for the progestagen treatment, dogs must show problem behaviours. Dogs that showed the same behaviour as above and mounting behaviours underwent the castration procedure.

After castration, 50-70% of the dogs showed a decline in these problem behaviours but territorial and fear aggression were unaffected. After progestagen treatment, non-sexually dimorphic behaviours were treated successfully. However, the efficacy depended on the individual and the dosage.

There were no adverse effects of castration other than weight gain. Contrarily, there were multiple adverse effects from progestagen. The least concerning is increased

appetite, while mammary hyperplasia (enlargement of mammary glands), penile and testicular hypoplasia (undeveloped testis) and hypofunction (decrease in function) were reported in higher dosages of the treatment. Serious side effects included the induction of mammary gland tumours and acromegaly (increased growth hormones due to over-functioning of pituitary glands), endometritis/pyometra (secondary infection in female dogs), and diabetes mellitus.

This review reveals that castration is the better option in treating these behaviours. The authors recommended further research to identify the factors that leads to differentiated results.

Article Contribution:

This article was chosen as part of my literature review because it discusses the management of scent-marking behaviour among others. This would be useful to eliminate odour and help keep the shelters clean and sanitary for animals. It supports previous studies on the subject. It advances knowledge in the field by comparing the two treatments and revealing areas that require further research since the author found some conflicting data. We can investigate other factors that contribute to the management of behaviours. It provided plenty of new information and data that I could use as additional evidence for my literature review.

*This article was cited 36 times.

Wirant, S. C., & McGuire, B. (2004). Urinary behavior of female domestic dogs (*Canis familiaris*): Influence of reproductive status, location, and age. *Applied Animal Behaviour Science*, 85(3), 335–348.

<https://doi.org/10.1016/j.applanim.2003.09.012>

Article Summary:

There have been notable sex differences in factors that affect scent-marking behaviours such as posture, frequency of urination, and directed urination. Most of the studies suggest that female dogs' urination has no other function than elimination. Here, Wirant and McGuire (2004) study the effect of reproductive status, location, and age.

They observed 12 female Jack Russel Terriers ranging from 0.4 to 12 years old during a leashed walk on their home area and off using all-occurrence sampling.

Wirant and McGuire (2004) found that females urinated at a higher frequency outside their home area than in their home area. However, defecation rate and sniffing were unaffected by their reproductive status, or age. Ground scratching was unaffected by age and reproductive status but when the location variable is ignored, reproductive status predicts urination rate, defecation, and ground scratching.

The urinary postures observed in the dogs in the study were consistent with wild canids' postures. They exhibited squat-raise the most and squat second. Elimination is set apart from scent-marking by the direction of urine and its target. By this criterion, 61% of the eliminations by spayed females were scent marking and 57% in non-estrous intact females were. They propose that female elimination also functions as scent-marking and is independent of reproductive status.

They concluded that there's a positive relationship between the increase of age and the urination rate. The urination rate is higher outside the home area suggests attempts to familiarize themselves with the area or establish a territory. All behaviours observed

were similar no matter what their reproductive status is. However, they noticed a higher frequency of ground scratching in spayed females after urination and defecation than non-estrous intact females. There found no studies that explain this occurrence, but they theorize that it may be associated with dominance.

Article Contribution:

I chose this article as part of my literature review because most studies on scent-marking behaviour only involve male dogs unless they're comparing sex differences. Here, they focus on female dogs and provide evidence that females also use scent-marking behaviours. The positive correlation between age and frequency of urination was consistent with McGuire (2016). This article was limited to Jack Russel Terriers, however. Whether these tendencies exist in other breeds is still unclear and needs further investigation.

*This article was cited 40 times.

Pal, S. (2003). Urine marking by free-ranging dogs (*Canis familiaris*) in relation to sex, season, place and posture. *Applied Animal Behaviour Science*, 80(1), 45–59.
[https://doi.org/10.1016/S0168-1591\(02\)00178-8](https://doi.org/10.1016/S0168-1591(02)00178-8)

Article Summary:

Due to the high sensitivity of olfactory sensors in dogs, they can detect urine, vaginal secretions, and feces even in low concentrations. Previous scent-marking behaviour studies on free-ranging dogs focus on functions of the behaviour such as territorial defence and establishing dominance. Pal (2003) aims to study the urine marking behaviour of free-ranging dogs in relation to sex, season, place, and posture.

Two groups of residential dogs were observed for a total of 4320 hours over three years. They used ad libitum and focal animal sampling to gather data on the behaviour during summer (March-May), monsoon (June-August), late monsoon (September-November), and winter (December-February).

Pal (2003) observed similar results to previous studies. Males had a higher urination rate than females and territorial defence was observed. The peak period of mating, September-November, showed a significantly high urination rate for both genders. The peak period of pup rearing, December-February, was a close second. Additionally, courting places during the late monsoon have higher urination frequencies when females are in estrous (in heat). Alpha males marked more in areas marked by an estrous female demonstrating possessive urine marking. There was no significant difference in the marking behaviour between males and females in feeding areas.

These results propose that aggressiveness and territoriality are associated with urine marking behaviour due to limited food and sleeping areas. Marking in late monsoon may be caused by selective pressure on sexual selection. A higher urination rate near nest sites during the winter presents evidence for pup protection by females. Dogs that

marked on strange objects such as tire wheels demonstrate familiarization in unfamiliar areas.

Dominance/threat hypothesis is the tendency of high-ranking dogs to display scent-marking behaviour than lower-ranking dogs which was displayed by alpha males.

Dominance was established using raised leg urination and marking near territorial sites and courting places.

Article Contribution:

I included this study as part of my literature review because aside from the analysis of the effect of place and posture, it included the effect of seasons on scent-marking behaviour. Most studies focused on more proximate causes of the behaviour and this article leans towards the ultimate causes. It concurs with previous studies such as Cafazzo et al., (2012) study on free-ranging dogs where similar trends in relation to sex and place were seen. Because of the small sample size, the effect of the seasons on the behaviour may be caused by other factors so more studies are required.

*This article was cited 94 times.

Cafazzo, S., Natoli, E., & Valsecchi, P. (2012). Scent-marking behaviour in a pack of free-ranging domestic dogs. *Ethology*, 118, 955-966.

<https://doi.org/10.1111/j.1439-0310.2012.02088.x>

Article summary:

Dominance/threat hypothesis is the tendency of high-ranking dogs to display scent-marking behaviour than lower-ranking dogs. The instance where dogs tend to mark around their home boundary as a “keep out” sign without direct interaction, is called indirect territorial defence.

Most of the studies that focus on the scent-marking behaviour of dogs observe them in a laboratory or a house as a companion pet. Cafazzo et al. (2012) aims to study the significance of scent-marking behaviour in free-ranging dogs. He did so by testing the indirect territorial defence and the dominance/threat hypothesis.

To do this, Cafazzo et al. (2012) studied 100 adult dogs in the study area. The indirect territorial defence hypothesis was tested by looking at the number of marks over the time spent in the area. The dominance/threat hypothesis was tested by looking at the amount of scent marking by dogs after or during an agonistic and non-agonistic interaction within and outside the pack.

Cafazzo et al. (2012) found that male canines establish their territory seeing that they frequently marked at the boundary where they are more likely to encounter neighbouring dogs. Females, contrarily, were observed marking more near the nesting and feeding sites perhaps to protect her pups. Cafazzo et al. (2012) also discovered that the probability of observing scent-marking behaviour is higher in agonistic than non-agonistic interactions. Alpha males marked the most during the fight encounter, to establish dominance and protect their territory.

This article contributes new data since the study is done outside a laboratory and domestic setting. Variables such as the influences of the scientist and owner don't affect free-ranging dogs. The dominance/threat and territorial defence hypothesis are mainly observed in male canines. Future studies may focus on studying this and examine whether females also get involved in aggressive interactions and to what degree.

Article Contribution:

I chose this article as part of my literature review because it examines free-ranging dogs compared to the majority of the studies that focus on companion dogs and laboratory canines. This article advances the knowledge in the field because it presents two functions of scent-marking behaviour, and it's studied elaborately that no other studies have done yet. It supports the results of most of the studies on this behaviour, such as Wirant and McGuire (2004), where they found that females tend to mark near the nesting and feeding sites. This article provides enough background on the behaviour.

* This article was cited 43 times.

McGuire, B. (2016). Scent marking in shelter dogs: Effects of sex and age. *Applied Animal Behaviour Science*, 182, 15-22.

<http://dx.doi.org/10.1016/j.applanim.2016.06.001>

Article summary:

A great deal of articles on scent-marking behaviour studies the impact of age on behaviour. However, only some include both seniors and puppies. In this study, McGuire (2016) looks at all types of scent-marking behaviours such as urination, defecation, and ground scratching rates in addition to the sex differences.

To do this, McGuire (2016) and her team studied 500 dogs from Tompkins County Society for the Prevention of Cruelty to Animals (SPCA) and Cortland Community SPCA. The age of dogs ranged from 9 months old (juvenile) and over eight years old (seniors). They recorded each occurrence of scent-marking behaviours.

McGuire (2016) found that older dogs urinated more frequently than dogs younger than them (seniors urinated more than adult dogs, and adults urinated more than juvenile dogs). The probability of urinating towards a target is higher in older dogs, similar to the trend in the urination rate. Consistent with other studies, McGuire (2016) also found that males had higher occurrences of marking behaviours than females.

The amount of ground scratching was neither affected by age or sex of the dog but there is a significant increase of ground scratching with the increase of directed urination. Ground scratching after defecation or urination was not significantly affected by age or sex in both shelters.

The increased rate of marking behaviours by senior dogs may be explained by the prevalence of kidney diseases in older dogs, but it would not explain why they tend to raise their hind limbs and perform directed urination at a higher rate. This presents an opportunity for further studies. These results help reinforce future studies by showing a

broader analysis of the scent-marking behaviour throughout the lifespan of the dog. It also allows shelter staff to individualize walking and bathroom breaks for seniors considering these results.

Article Contribution:

I chose this article as part of my literature review because it analyzes age and the sex of dogs as factors in scent-marking behaviour. In addition to reproductive status and hormonal levels, these proximal effects provide additional information for a complete analysis of scent-marking behaviour. The outcome of this study agrees with most results such as Cafazzo et al. (2012) finding that males had higher urination rates than females. This article shows enough background information that general readers can follow what is being discussed. Additional studies on the cause of higher directed urination rates in seniors should be considered.

*This article was cited 13 times.

McGuire, B., Fry, K., Orantes, D., Underkofler, L., & Parry, S. (2020). Sex of walker influences scent-marking behavior of shelter dogs. *Animals*, 10, 362.

[10.3390/ani10040632](https://doi.org/10.3390/ani10040632)

Article Summary:

Dogs interact with several different staff members in shelters. Their behaviour ranges from timid to erratic depending on their stress levels. Their response to unfamiliar people varies, so McGuire et al., (2020) determined whether the sex of an unfamiliar walker influences the behaviour of dogs at an animal shelter.

For this study, 100 dogs were observed during leash walks and occurrences of scent-marking behaviour were recorded. Every individual dog was walked at least once by a male and a female, both of which are unfamiliar to the dog. They also looked at the posture, ground-scratching and defecation rate of every dog when eliminating.

McGuire et al., (2020) found that male dogs have a higher rate of urinating when they are accompanied by an unfamiliar woman and less urination rate when they are walked by an unfamiliar male. Additionally, there are higher rates of defecation with an unfamiliar female than an unfamiliar male and no significant predictors of ground scratching are observed for both sexes of the dog. The sex of the walker didn't affect the urination rate and the posture of female dogs. However, the sex of the walker affected the posture of a male.

McGuire et al., (2020) also found that the urination rate decreases when the time spent in the shelter increases for both dog genders and regardless of the sex of the walker.

These results advance the knowledge in the field by taking the sex of the walker as a factor that affects the scent-marking behaviour. These results can also help staff in shelters individualize or standardize the walking routines of every dog and alleviate

high-stress levels caused by the walker. By doing this, it increases the chances of the dogs being adopted.

Article Contribution:

I chose this article as part of my literature review because most studies focus on internal factors that affect scent-marking behaviour in dogs such as age, sex, reproductive status, etc. This article advances our knowledge in the field by providing information about external factors that affect this behaviour to provide better care for dogs in shelters. McGuire (2016) previously found that the time spent in shelters doesn't affect the urination rate of dogs. This disagrees with the data in this study. Further studies on the effect of long-term stay on scent-marking behaviour are warranted.

*This article was cited 5 times.

Rezáč, P., Viziová, P., Dobesřová, M., Havlíček, Z., & Pospíšilová, D. (2011). Factors affecting dog–dog interactions on walks with their owners. *Applied Animal Behaviour Science*, 134, 170-176. <https://doi.org/10.1016/j.applanim.2011.08.006>

Article Summary:

Encounters with another dog during a walk with their owns are affected by different factors. These factors are either motivators or constraints that affect decisions made by the owners during walks. Rezac et al. (2011) studied the effects of age, gender and size, human gender, and the use of leash in dog-dog interactions.

Rezac et al. (2011) observed 1870 dogs using focal-animal and all-occurrences sampling. They explored instances where dogs body-sniffed, scent-marked, played games, showed threat, and bit another dog during the walk. Scent-marking will be the focal point of this summary as it relates to the literature review topic.

Sniffing, a part of scent-marking behaviour if it's immediately followed by urination, was observed in $\frac{3}{4}$ of all the interactions. Next to it is scent-marking by urination makes up $\frac{1}{3}$ of the observed interactions. Researchers noticed higher scent-marking rates in senior dogs when they encountered other dogs of the same age than in adults and juveniles on and off-leash. There's also a higher scent-marking behaviour observed in males than females when they encounter dogs of the same gender. Males also marked at higher rates when they encountered female owners than males. This pattern was statistically significant in both on and off-leash scenarios.

Rezac et al. (2011) concluded that scent-marking behaviour is key to dog-dog communication more so to males than females. They theorized that senior dogs had a higher urination rate because juveniles have yet to develop territorial behaviours, and they usually show submissiveness to dogs older than them. There was no statistically significant difference in the results of all the interactions between on-leash and off-

leash. This suggests that the use of a leash is independent of the factors that affect dog-dog interactions.

Article Contribution:

I included this article in my literature review because previous studies control the use of leashes during walks. This article was designed to observe the behaviour off-leash and when they encounter conspecifics. It was also consistent with McGuire et al. (2020), who found that male dogs tend to urinate more than females when they encounter the opposite sex. This study provided new evidence on the behaviour under new conditions, and it further reinforces the results from previous studies. However, the owners' age wasn't specified, so additional testing may be essential to see if the difference is a significant effect.

*This article was cited 6 times

McGuire, B., Olsen, B., Bemis, K. E., & Orantes, D. (2018). Urine marking in male domestic dogs: Honest or dishonest? *Journal of Zoology*. 306, 163-170.
<https://doi.org/10.1111/jzo.12603>

Article summary:

Dogs primarily use scent-marking as a form of chemical communication. They can deduce reproductive status, size and height, and competitive ability, all of which are honest signals. In some conditions, falsified information about the signaller is delivered to the receiver. McGuire et al (2018) determined whether urine marking in adult domestic dogs, which tend to raise a hindlimb when marking static objects, is dishonest.

McGuire et al. (2018) did so by analyzing urination videos of 15 adult male dogs and measuring the height of marks (Study 1). They also examined 45 dogs and tested whether the raised leg angles (RLA) of small (< 30cm) dogs were higher than large (> 50cm at withers) dogs (Study 2). They also took the body mass of each dog (kg), and both neutered and intact males were included since they both displayed the RLA when urinating.

In study 1, they found that smaller dogs compensate for their height by having a larger RLA. This places their mark higher and sequentially falsifies their competitive ability. False information is conveyed; therefore, it is a dishonest signal. Body mass (kg) is positively correlated to the height. So, in some cases, receivers get honest and accurate information from the mark.

In study 2, they found that dogs with higher body mass (kg) and height (cm) have lower RLA. They propose that heavier dogs are unable to lift their hind legs and resulting in a lower RLA. Since smaller dogs are lighter, they can lift their legs and have a higher RLA. They also suggest that taller dogs don't raise their legs higher when urinating because they already have the competitive ability if they encounter agonistic

interactions. Smaller dogs can't afford to have direct aggressive interaction because their size puts them at a disadvantage.

Article Contribution:

I chose this article for my literature review because it describes another function of scent-marking behaviour. Previous articles report the importance of scent-marking behaviour according to sex differences, but this study reports according to the size of the dog. To date, this is the only study in scent-marking behaviour of dogs that analyzes the honesty of the signal concerning the dog's height. It provided new evidence of the function of scent-marking behaviour. This study was conducted using shelter animals though, hence whether free-ranging canines will exhibit similar patterns is still unknown and requires further investigation.

*This article was cited 12 times.