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Factors Affecting the Scent Marking Behaviour of Dogs (*Canis familiaris*)

Scent-marking behaviour (SMB) in dogs (*Canis familiaris*) is the sniffing marks left by conspecifics and urinating on the landmark (Pal, 2003), defecating, or releasing glandular secretions (Bekoff, 2001; Cafazzo et al., 2012). Observational studies using a focal animal, all occurrences, or ad libitum methods are used to study SMB on free-ranging and shelter dogs.

Since dogs have strong olfactory receptors, they can differentiate chemicals from their own against others (Rezac et al., 2011; Bekoff, 2001). It gives them information about other dogs' presence, size (McGuire et al., 2018), and estrous in females (Cafazzo et al., 2012; Pal, 2003). In free-ranging dogs, SMB identifies dogs that belong in their pack (Cafazzo et al., 2012), and protects foraging and nest sites (Pal, 2003).

Wirant and McGuire (2004) studied whether SMB has importance to female dogs in shelters and found that 61% of the urinations by spayed females and 57% by intact non-estrous females they studied are directed towards a landmark. A study by Cafazzo et al. (2012) and Pal (2003) on free-ranging dogs revealed that female SMB is higher near nesting and feeding sites where females gather. From these studies, it's concluded that female SMB is not affected by reproductive state and that they perform SMB to protect puppies and food resources.

McGuire (2016) studied the effects of sex and age on SMB by studying 500 dogs from Tompkins County Society for the Prevention of Cruelty to Animals (SPCA) and Cortland Community SPCA and found that males exhibit SMB more than females. Other researchers studying this observed the same results (McGuire, 2019; Pal, 2003; Cafazzo et al., 2012). Researchers found that Senior dogs (>8 years old) are showed

SMB more than adults (16 months–8 years old) and juveniles (<16 months old) (McGuire, 2016).

McGuire (2019) studied the effect of gonadectomy (removal of gonads) on SMB in the same shelters and observed that intact exhibited SMB more than castrated males and there wasn't any significant difference between intact and spayed females' SMB. McGuire (2019) found a 13.8%-71.6% decrease in SMB after gonadectomy. Knol and Egberink-Alink (2011) reviewed several studies about treatments of problem behaviours (including SMB) using castration and progestagen (a steroid hormone that binds to progesterone receptors) and described that SMB is sex hormone-dependent and showed that castration reduced SMB in 50-70% of the dogs studied. Progestagen therapy showed promising results in decreasing SMB, but the effectiveness was dose-dependent (Knol & Egberink-Alink, 2011). From reviewing these studies, SMB may be caused by testosterone (male hormone) rather than estrogen and progesterone (female hormones).

McGuire et al. (2020) studied whether the sex of the dog walker also affects SMB in shelters and found that males show more SMB when walked by an unfamiliar female than males, while female dogs are unaffected. Rezac et al. (2011) studied factors affecting dog-dog interactions on walks with their owners and found that males had a higher SMB rate when the owners encountered an unfamiliar female than males. Researchers suggested that SMB serves as a mark on the female for mating purposes indicating that male SMB has a reproduction function (Rezac et al. 2011).

Pal (2003) was interested in examining the effect of sex, season, place, and posture on SMB in free-ranging dogs and found that from September to November, the peak period of mating, a higher rate of SMB in both genders were observed in courting places. Alpha males displayed the highest SMB rate mostly on estrous females to establish their dominance (Pal, 2003).

Another study by McGuire et al. (2018) explored the honesty of SMB of dogs in the same shelter. McGuire et al. (2018) found that smaller dogs (<30 cm at withers) communicated via SMB more since their urination rate is higher than large dogs (>50 cm at withers). Smaller dogs raised their legs at a higher angle, making them seem larger and since this falsifies their height, SMB becomes a dishonest signal (McGuire et al., 2018).

The study of scent-marking behaviour in dogs is a relatively new subject. Because of this, there isn't enough data to support if ultimate causes such as genetics play a role in this behaviour. The investigation of the gene responsible for scent-marking behaviour warrants further studies.

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