**SUPPLEMENTARY MATERIAL**

**The first observation of urine overmarking of pro-oestrus female dung by a male white rhino**

Marneweck et al. 2019

**Table S1**: The tentatively identified VOCs, and their relative proportion, present in dung odour of unmarked and over-marked female white rhino dung.

| VOC name | Functional group | CAS number | Weight ($g\ mol^{-1}$) | Proportion contribution to dung odour | |
|---|---|---|---|---|---|
| | | | | Sample one (unmarked) | Sample two (overmarked) |
| Limonene[c] | Monoterpene | 138-86-3 | 136 | 0.3785 | 0.2329 |
| (5*E*)-2,3,5,8-Tetramethyl-1,5,9-decatriene[a] | Alkadiene | 230646-72-7 | 192 | 0.1276 | 0.0921 |
| 3,4-dihydro-β-ocimene[a] | Monoterpene | 2436-90-0 | 138 | 0.1225 | 0.0711 |
| Toluene[c] | Aromatic compound | 108-88-3 | 92 | 0.0563 | 0.0667 |
| 2,7-Dimethyl-1,7-octadiene[a] | Monoterpene | 40195-09-3 | 138 | 0.0545 | 0.0443 |
| β-Caryophyllene[c] | Sesquiterpene | 87-44-5 | 204 | 0.0379 | 0.0589 |
| Camphene[b] | Monoterpene | 79-92-5 | 136 | 0.0207 | 0.0049 |
| α-Caryophyllene[a] | Sesquiterpene | 6753-98-6 | 204 | 0.0204 | 0.0373 |
| *p*-Cresol[c] | Aromatic compound | 106-44-5 | 108 | 0.0181 | 0.0949 |
| Cyclosativene[a] | Sesquiterpene | 22469-52-9 | 204 | 0.0125 | 0.0043 |
| Bicyclo[10.1.0]tridec-1-ene[a] | Miscellaneous | 54766-91-5 | 178 | 0.0113 | 0.0274 |

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|---|---|---|---|---|---|
| α-Muurolene[b] | Sesquiterpene | 10208-80-7 | 204 | 0.0112 | 0.0085 |
| Geranial[a] | Monoterpene | 141-27-5 | 152 | 0.0094 | 0.0218 |
| Nonane[c] | Aliphatic alkane | 111-84-2 | 128 | 0.0083 | 0.0092 |
| Cymene[a-] | Monoterpene | 99-87-6 | 134 | 0.0082 | 0.0000 |
| Tridecane[c] | Aliphatic alkane | 629-50-5 | 184 | 0.0079 | 0.0383 |
| Hexane[c] | Aliphatic alkane | 110-54-3 | 86 | 0.0073 | 0.0040 |
| (2*E*)-1,4-dihydro-β-ocimene[b] | Alkadiene | 2609-23-6 | 138 | 0.0073 | 0.0110 |
| (*E*)-Oct-2-ene[b] | Aliphatic alkene | 13389-42-9 | 112 | 0.0070 | 0.0061 |
| α-Pinene[c] | Monoterpene | 80-56-8 | 136 | 0.0067 | 0.0013 |
| (3*E*)-3-Ethyl-2,5-dimethyl-1,3-hexadiene[a] | Alkadiene | 62338-07-2 | 138 | 0.0062 | 0.0141 |
| (*Z*)-Oct-2-ene[b] | Aliphatic alkene | 7642-04-8 | 112 | 0.0058 | 0.0039 |
| (*Z*)-1,4-dihydroocimene[a] | Monoterpene | 2492-22-0 | 138 | 0.0054 | 0.0049 |
| 6-Methyl-5-heptene-2-one[b] | Irregular terpene | 110-93-0 | 126 | 0.0045 | 0.0121 |
| Pentanal[b] | Aliphatic aldehyde | 110-62-3 | 86 | 0.0039 | 0.0024 |
| α-Copaene[a] | Sesquiterpene | 3856-25-5 | 204 | 0.0039 | 0.0011 |
| Farnesane[a] | Sesquiterpene | 3891-98-3 | 212 | 0.0039 | 0.0148 |
| α-Panasinsen[a] | Sesquiterpene | 56633-28-4 | 204 | 0.0034 | 0.0091 |
| p-Mentha-1,4(8)-diene[a] | Monoterpene | 586-62-9 | 136 | 0.0032 | 0.0038 |
| β-Gurjunene[a] | Sesquiterpene | 17334-55-3 | 204 | 0.0029 | 0.0010 |
| 6,11-Dimethyl-2,6,10-dodecatrien-1-ol[b] | Aliphatic alcohol | | 208 | 0.0028 | 0.0040 |
| 2,6-Dimethylundecane[b] | Aliphatic alkane | 17301-23-4 | 184 | 0.0027 | 0.0066 |
| Tricyclene[a] | Monoterpene | 508-32-7 | 136 | 0.0021 | 0.0005 |
| Nonanal[c] | Aliphatic aldehyde | 124-19-6 | 142 | 0.0018 | 0.0083 |

| | | | | | |
|---|---|---|---|---|---|
| Butyric acid[b-] | Aliphatic acid | 107-92-6 | 88 | 0.0018 | 0.0000 |
| Dodecane[c-] | Aliphatic alkane | 112-40-3 | 170 | 0.0012 | 0.0000 |
| Styrene[c-] | Aromatic compound | 100-42-5 | 104 | 0.0011 | 0.0000 |
| γ-Terpinen[a] | Monoterpene | 99-85-4 | 136 | 0.0010 | 0.0008 |
| δ-Cadinene[a] | Sesquiterpene | 483-76-1 | 204 | 0.0008 | 0.0026 |
| 2,3-Dimethylundecane[a] | Aliphatic alkane | 17312-77-5 | 184 | 0.0008 | 0.0022 |
| Tetradecane[b] | Aliphatic alkane | 629-59-4 | 198 | 0.0007 | 0.0025 |
| (2*E*,6*E*)-4-Methyl-2,6-octadiene[a] | Alkadiene | 74498-94-5 | 124 | 0.0006 | 0.0027 |
| α-Calacorene[a] | Sesquiterpene | 21391-99-1 | 200 | 0.0006 | 0.0015 |
| 3-Methylpentane[b-] | Aliphatic alkane | 96-14-0 | 86 | 0.0006 | 0.0000 |
| 4,8-Dimethyl-1,7-nonadiene[a] | Alkadiene | 62108-28-5 | 152 | 0.0006 | 0.0012 |
| Isobutyric acid[b-] | Aliphatic acid | 79-31-2 | 88 | 0.0005 | 0.0000 |
| Hexadecane[c] | Aliphatic alkane | 544-76-33 | 226 | 0.0005 | 0.0071 |
| 1,2-Dimethyl-1,3-cyclopentadiene[a] | Alkadiene | 4784-86-5 | 94 | 0.0005 | 0.0010 |
| 3-Methyldecane[a] | Aliphatic alkane | 13151-34-3 | 156 | 0.0005 | 0.0016 |
| 2,3-Dimethyldodecane[a] | Sesquiterpene | 6117-98-2 | 198 | 0.0004 | 0.0012 |
| Quinoline[a] | Nitrogen compound | 91-22-5 | 129 | 0.0004 | 0.0026 |
| 1-Methyl-4-(1-hydroxy-1-methylethyl)benzene[a-] | Aromatic compound | 1197-01-9 | 150 | 0.0002 | 0.0000 |
| 3-Propylphenol[a] | Aromatic compound | 621-27-2 | 136 | 0.0002 | 0.0013 |
| Heptadecane[c] | Aliphatic alkane | 629-78-7 | 240 | 0.0002 | 0.0027 |
| Undecan-2-one[b] | Aliphatic ketone | 112-12-9 | 170 | 0.0002 | 0.0010 |

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| (2*E*)-3,7,11,15-Tetramethyl-2-hexadecene[a] | Aliphatic alkene | 14237-73-1 | 280 | 0.0001 | 0.0030 |
| 6,10,14-Trimethyl-2-pentadecanone[a] | Aliphatic ketone | 502-69-2 | 268 | 0.0001 | 0.0014 |
| Octadecane[c] | Aliphatic alkane | 593-45-3 | 254 | 0.0001 | 0.0010 |
| Pentan-1-ol[b+] | Aliphatic alcohol | 71-41-0 | 88 | 0.0000 | 0.0008 |
| 2-Ethylhexan-1-ol[b+] | Aliphatic alcohol | 104-76-7 | 130 | 0.0000 | 0.0078 |
| 3-Methyl-1H-indole[c+] | Nitrogen compound | 83-34-1 | 131 | 0.0000 | 0.0035 |
| (3-Methylbutylidene)cyclopentane[b+] | Aliphatic alkane | 53366-51-1 | 138 | 0.0000 | 0.0051 |
| Undec-1-ene[a+] | Aliphatic alkane | 821-95-4 | 154 | 0.0000 | 0.0153 |
| Decanal[c+] | Aliphatic aldehyde | 112-31-2 | 156 | 0.0000 | 0.0016 |
| 2-Methylundecane[b+] | Aliphatic alkane | 7045-71-8 | 170 | 0.0000 | 0.0006 |
| Geranylacetone[a+] | Monoterpene | 3796-70-1 | 194 | 0.0000 | 0.0026 |
| α-Longipinene[b+] | Sesquiterpene | 5989-08-2 | 204 | 0.0000 | 0.0011 |
| Germacrene D[a+] | Sesquiterpene | 23986-74-5 | 204 | 0.0000 | 0.0020 |
| 6-Methyloctadecane[a+] | Aliphatic alkane | 10544-96-4 | 268 | 0.0000 | 0.0005 |

Compound identification criteria and notes:

[a] denotes comparison of MS with published data

[b] denotes comparison of MS and retention time with published data

[c] denotes comparison of MS and retention time with authentic standard

[-] denotes VOC eliminated after overmarking

[+] denotes VOC appeared after overmarking

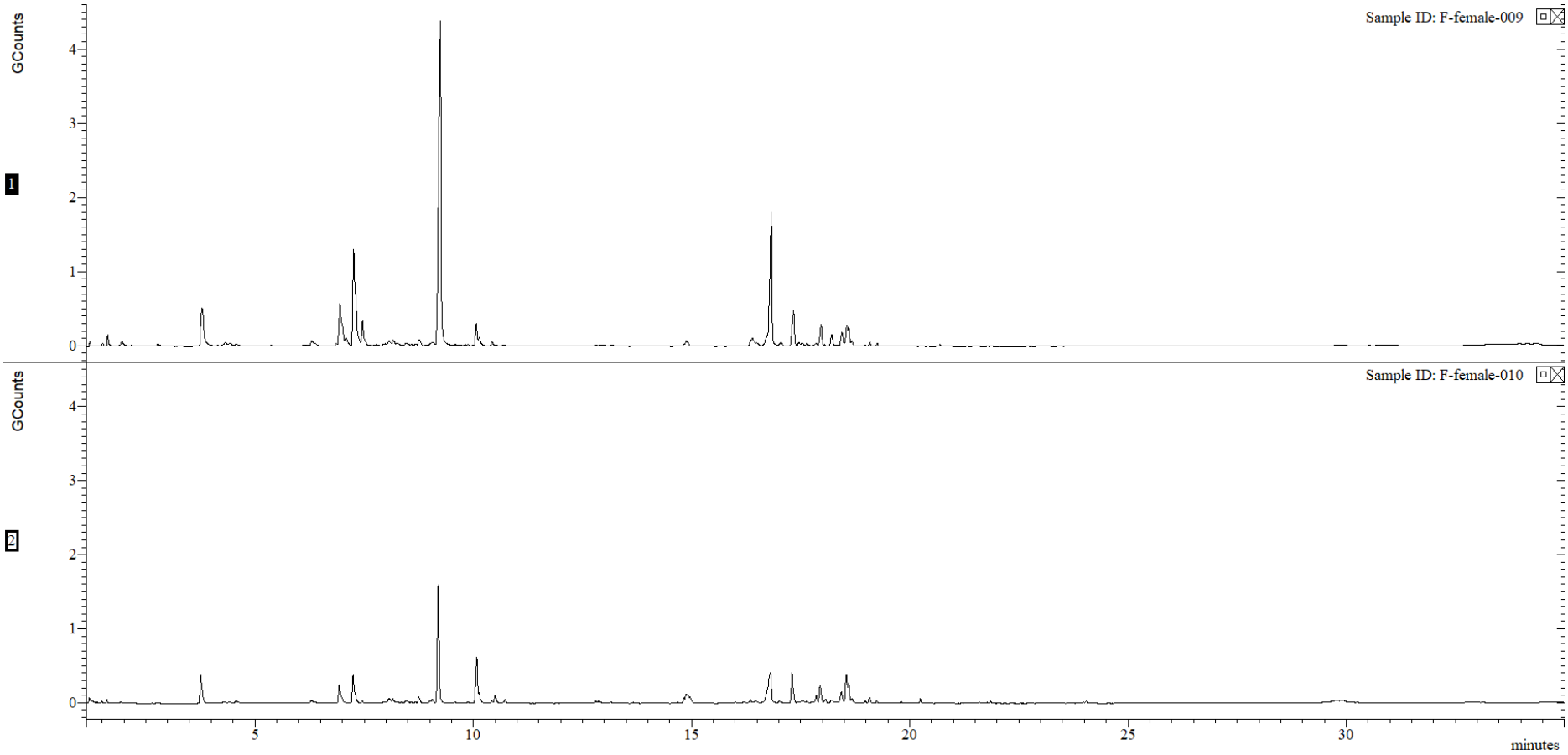


**Figure S1:** Chromatograms representing (1) the unmarked female dung odour (above), and (2) the overmarked female dung odour (below).