Group size estimation:

Group sizes were determined by the number of individuals (cubs and adults) that were present in a social group in a given year. Given high natal philopatry (75.8%), low permanent dispersal rates (19.1%), and high levels of inter-group movements leading to extra-group paternity in badgers [1], individuals ($n = 1726$) were assigned as a resident of a social group each year, according to the following rules adapted from [1, 2]:

1. Badgers first caught as cubs ($n = 1241$) were considered resident in the social group they were first caught, until they subsequently satisfied dispersal rules or were considered dead.
2. Badgers first caught as adults ($n = 490$) were assigned to their lifetime modal social group, until dispersal rules applied. If an individual was captured equally between two groups ($n = 29$), they were assigned to the social group they were initially captured in until dispersal rules applied.
3. Dispersal rules were satisfied when the two most recent captures of an individual (>30 days apart), as well as 1 of 2 captures before, were made in a different social group than the current residential social group. Individuals were resident in the new social group until dispersal rules applied again.

The number of individuals per social group were then calculated as the sum of individuals present in the social group in a given year.
| Model 1 | AICc  | ΔAICc |
|---------|------|------|
| With interaction between log age * sex * group size | 125450.5 | -2.8 |
| No interaction between log age * sex * group size | 125453.3 |

| Model 2 (males) | AICc  | ΔAICc |
|----------------|------|------|
| With interaction between log age * group size | 75987.4 | -9.8 |
| No interaction between log age * group size | 75997.2 |

| Model 3 (females) | AICc  | ΔAICc |
|-------------------|------|------|
| With interaction between log age * group size | 49477.8 | 2.5 |
| No interaction between log age * group size | 49475.3 |

| Model 3 (females) | AICc  | ΔAICc |
|-------------------|------|------|
| With interaction between linear age * group size | 49477.6 | 2.1 |
| No interaction between linear age * group size | 49475.5 |
Table S2: Parameter estimates and 95% confidence intervals of fixed effects from a mixed model and subsequent parametric bootstrapping testing age and group size effects (without their interaction) on the proportion of neutrophils and lymphocytes that are lymphocytes in female European badgers. $\beta =$ direction and magnitude of effect, s.e. = standard error, 95% CI = 95% confidence intervals; reference terms in brackets = reference level for factors. Significant parameters (95% CI does not overlap zero) are in bold.

| Parameter (reference level)      | $\beta$ | s.e.  | 95% CI          |
|---------------------------------|---------|-------|-----------------|
| Intercept                       | -2.276  | 0.183 | -2.628 to -1.928 |
| Log age                         | -0.076  | 0.150 | -0.381 to 0.225 |
| Group size                      | -0.107  | 0.114 | -0.350 to 0.115 |
| Year (2017)                     |         |       |                 |
| 2018                            | -0.025  | 0.201 | -0.418 to 0.378 |
| Season (Spring)                 |         |       |                 |
| Summer                          | 0.138   | 0.193 | -0.237 to 0.520 |
| Autumn                          | 0.547   | 0.313 | -0.063 to 1.170 |
| Body condition index            | -0.259  | 0.144 | -0.542 to 0.032 |

Random effect estimates (variance): Individual ID ($4.659 \times 10^{-2}$), Slide nested in individual ID ($1.858 \times 10^{-1}$), Social group (<1.000*10^{-12}), Cohort (<1.000*10^{-12}), Observation (1.207*10^{-1})
Table S3: Parameter estimates and 95% confidence intervals of fixed effects from a mixed model and subsequent parametric bootstrapping testing age and group size effects on the proportion of neutrophils and lymphocytes that are lymphocytes in female European badgers. β = direction and magnitude of effect, s.e. = standard error, 95% CI = 95% confidence intervals; reference terms in brackets = reference level for factors; * = interaction. Significant parameters (95% CI does not overlap zero) are in bold.

| Parameter (reference level)                  | β    | s.e.  | 95% CI          |
|---------------------------------------------|------|-------|-----------------|
| Intercept                                   | -2.265 | 0.201 | -2.666 to -1.880 |
| Linear age                                  | 0.028 | 0.144 | -0.258 to 0.315  |
| Group size                                  | -0.093 | 0.117 | -0.323 to 0.136  |
| Year (2017)                                 | -0.100 | 0.204 | -0.505 to 0.315  |
| Season (Spring)                             |       |       |                 |
| Summer                                      | 0.165 | 0.188 | -0.212 to 0.542  |
| Autumn                                      | 0.494 | 0.316 | -0.127 to 1.140  |
| Body condition index                        | -0.259 | 0.132 | -0.524 to 0.001  |
| Linear age * Group size                     | 0.067 | 0.103 | -0.138 to 0.265  |

Random effect estimates (variance): Individual ID (1.211*10^{-2}), Slide nested in individual ID (1.743*10^{-1}), Social group (<1.000*10^{-12}), Cohort (6.032*10^{-2}), Observation (1.207*10^{-1})
Table S4: Parameter estimates and 95% confidence intervals of fixed effects from a mixed model and subsequent parametric bootstrapping testing age and group size effects (without their interaction) on the proportion of neutrophils and lymphocytes that are lymphocytes in female European badgers. β = direction and magnitude of effect, s.e. = standard error, 95% CI = 95% confidence intervals; reference terms in brackets = reference level for factors. Significant parameters (95% CI does not overlap zero) are in bold.

| Parameter (reference level) | β     | S.E.  | 95% CI          |
|-----------------------------|-------|-------|-----------------|
| Intercept                   | -2.293| 0.191 | -2.670 to -1.927|
| Linear age                  | 0.011 | 0.133 | -0.252 to 0.273 |
| Group size                  | -0.094| 0.115 | -0.321 to 0.138 |
| Year (2017)                 |       |       |                 |
| 2018                        | -0.061| 0.199 | -0.453 to 0.338 |
| Season (Spring)             |       |       |                 |
| Summer                      | 0.150 | 0.190 | -0.228 to 0.530 |
| Autumn                      | 0.543 | 0.317 | -0.069 to 1.198 |
| Body condition index        | **-0.279** | **0.129** | **-0.538 to -0.034** |

Random effect estimates (variance): Individual ID (1.131*10^-2), Slide nested in individual ID (1.843*10^-3), Social group (<1.000*10^-12), Cohort (4.444*10^-2), Observation (1.207*10^-1)
Table S5: Parameter estimates and 95% confidence intervals of fixed effects from a mixed model and subsequent parametric bootstrapping testing age, sex and group size effects on the proportion of neutrophils and lymphocytes that are lymphocytes in European badgers. β = direction and magnitude of effect, s.e. = standard error, 95% CI = 95% confidence intervals; reference terms in brackets = reference level for factors; * = interaction. Significant parameters (95% CI does not overlap zero) are in bold.

| Parameter (reference level)               | β       | s.e.  | 95% CI          |
|------------------------------------------|---------|-------|-----------------|
| Intercept                                | -2.360  | 0.122 | -2.593 to -2.125|
| Log age                                  | -0.108  | 0.104 | -0.313 to 0.098 |
| Sex (female)                             | 0.115   | 0.121 | -0.124 to 0.349 |
| Group size                               | -0.152  | 0.099 | -0.344 to 0.042 |
| **Year (2017)**                          |         |       |                 |
| 2018                                     | 0.258   | 0.119 | 0.025 to 0.496  |
| **Season (Spring)**                      |         |       |                 |
| Summer                                   | 0.045   | 0.116 | -0.186 to 0.278 |
| Autumn                                   | 0.628   | 0.196 | 0.251 to 0.995  |
| **Body condition index**                 |         |       |                 |
| Log age * Sex (female)                   | -0.275  | 0.082 | -0.432 to -0.114|
| Log age * Group size                     | -0.060  | 0.118 | -0.293 to 0.172 |
| Sex (female) * Group size                | -0.096  | 0.106 | -0.302 to 0.115 |
| **Log age * Sex (female) * Group size**  | 0.392   | 0.124 | 0.146 to 0.637  |

Random effect estimates (variance): Individual ID (1.223*10^{-2}), Slide nested in individual ID (1.821*10^{-1}), Social group (<1.000*10^{-12}), Cohort (7.078*10^{-9}), Observation (1.131*10^{-1})
References

1. Macdonald DW, Newman C, Buesching CD, Johnson PJ. 2008 Male-biased movement in a high-density population of the Eurasian badger (*Meles Meles*). *J. Mammal.* 89, 1077-1086. (doi:10.1644/07-Mamm-a-185.1)

2. Annavi G, Newman C, Dugdale HL, Buesching CD, Sin YW, Burke T, Macdonald DW. 2014 Neighbouring-group composition and within-group relatedness drive extra-group paternity rate in the European badger (*Meles meles*). *J. Evol. Biol.* 27, 2191-2203. (doi:10.1111/jeb.12473)