**Supporting Documentation**

**The effects of intergroup conflict on collective defence behaviour in wild banded mongooses (*Mungos mungo*)**

**Sampling regime and collection methods**

The Banded Mongoose Research Project studies a population of wild banded mongooses (*Mungos mungo*) living on the Mweya Peninsula, Queen Elizabeth National Park, Uganda (0°12′ S, 29°54′E). This population has been continually studied since 1995 and typically consists of 10 to 12 social groups occupying distinct territories. Groups usually comprise around 20 adult males and females, plus their offspring. Individuals are uniquely marked for identification using shave patches on the fur on the back (in adults), or dye marks (in pups), enabling us to observe individuals throughout their life. Identification marks are maintained through regular trapping every two months. One to two individuals in each group are fitted with a radio collar allowing groups to be located using radio telemetry, and most groups are habituated to walking observers (from less than 5 metres). Groups are visited every one to three days for at least 20 minutes to record data on group composition, life history, and reproductive and cooperative behaviour. Reproduction is highly synchronized within groups, and females in a social group come into oestrus within a few days of one another. Groups are visited daily when females are pregnant to record accurate birth dates of pups.

**Experimental design**

We experimentally simulated an intrusion by a rival group in each of five focal groups between March 2016 and May 2017. Simulated intrusion trials were designed to simulate an intergroup conflict with escalating cues by presenting a sequence of rival faeces and scent marks (olfactory), rival ‘war cry’ recordings (auditory), and rival individuals in traps (visual). For each focal group we collected stimuli from a neighbouring rival group, using the same rival group for all simulated intrusion trials for that focal group. Faeces, urine and scent marks were collected from the rival group on the morning of the presentation as the group emerged from the den. A plastic sheet was laid on the ground to encourage urination and scent marking. Samples were collected from multiple individuals in the rival group (both males and females from different age classes) and a standardized volume of faeces was used in each trial (100 × 137 mm ziplock bag). Samples were collected within 30 minutes and transferred as quickly as possible to the presentation site. Faeces samples were presented in a semi-circle surrounding the plastic sheet in the path of the foraging focal group between 07:43–10:27. After 3 minutes of the focal group exploring the faeces and scent marks, or slightly before if the focal group began to move away from the area, we performed a playback of war cries from the same rival group. War cries were recorded in advance by presenting individuals from the focal group in traps to the rival group. We recorded war cry vocalisations from multiple individuals in the rival group that were calling together from 2-3 metres away using an H1 Zoom recorder attached to a Sennheiser directional microphone. The recordings were cut into 30 second sections in which vocalizing was occurring, and the amplitude of each clip was standardized using the normalize function in Audacity 2.1.2 to −1 dB (<http://audacityteam.org>). We played back the rival group war cry to the focal group using a portable USB speaker (iHome IHM60) hidden in vegetation. Each 30 second playback clip was used only once to prevent habituation of the mongooses to particular recordings. On the afternoon of the same day, we trapped four adult males from the same rival group, covered the traps in black cloth to minimize stress, and transferred them to the presentation site of the focal group. The traps were placed in the foraging path of the focal group and the cloth was removed. After 5 minutes, the rival males were removed (and the traps re-covered with the cloth) and then returned to their own group. Presentations of rival males were made to the focal group between 16:35–18:18.

In each focal group we also performed control trials during the same study period in which we presented the same type of stimuli as in simulated intrusion trials, except that stimuli originated from the focal group themselves. The same procedures were carried out for control presentations as in simulated intrusion presentation but with the following notable differences: faeces and scent marks were collected from the focal group and represented to them; war cry recordings were replaced with ‘close call’ recordings from the focal group (a non-threatening communication call between group members recorded when focal group was foraging); and four adult males from the focal group were trapped and taken to a safe, shaded location for 30 minutes, and then represented to the rest of the focal group. In total, we carried out 22 simulated intrusion trials and 22 control trials. Trials were separated by at least 2 weeks to prevent habituation of the mongooses to the stimuli being presented.

The focal group was filmed during presentations of stimuli for each stimulated intrusion and control trial using either a handheld tablet computer (Samsung Galaxy Note 10.1) or a video camera (Panasonic HC-V520) from approximately 5 metres away, taking care to not disturb the group.

**Fieldwork instrumentation**

Life history data is recorded using a bespoke data collection app (Mongoose 2000; available via the Google Play Store: <https://play.google.com/store/apps/details?id=foam.mongoose>) on Samsung Galaxy Note 10.1 tablets. Data is downloaded and imported into a database (MSAccess). Individuals wear radio collars weighing around 30 g (Sirtrack Ltd, Havelock North, New Zealand) with a 20 cm whip antenna (Biotrack Ltd, Dorset, UK). Recordings of war cries and close calls were made using an H1 Zoom recorder attached to a Sennheiser directional microphone, and played back using an iHome IHM60 speaker. Presentations of stimuli were filmed using either a Samsung Galaxy Note 10.1 or a Panasonic HC-V520 video camera.

**Calibration steps and values**

Field instruments are calibrated to factory settings.

**Analytical methods**

Behavioural data were collected by one observer from videos of the presentations. Because of logistical constraints, data could not be collected fully blind to treatment. To minimise bias, initial observations were conducted without audio, such that the observer was blind to the identity of the focal group and the location in which the treatment occurred, as well as to when in the video the call stimulus occurred (if applicable). Once behavioural data was collected, videos were re-watched with sound to record the time at which the call playback was performed.

We scan sampled group members in videos at 30 second intervals, beginning 30 seconds after the time at which the first group member came within two metres of the stimulus and ending approximately 3 minutes 30 seconds from this time, unless the video ended beforehand. This allowed us to ensure that at least two samples were collected for each stimulus type (scents, calls, intruders). We discarded any presentations in which there were fewer than two samples for each stimulus type. At each sampling timepoint, we collected data on the number of group members within and outside 2m of the stimulus (except for call stimuli because the speaker was hidden and it was impossible to know when individuals were within or outside of 2m of the speaker). We also recorded the number of group members exhibiting each of six behaviours: stationary, walking/running, digging, standing upright, scent marking, attacking. An individual was defined as stationary if they were still and not exhibiting any other behaviour such as standing upright; walking/running if they were walking/running and not exhibiting any other behaviour such as attacking; digging if they were pawing at the ground around the stimulus and not foraging; standing upright if they were standing up on their hind legs; scent marking if they were marking the ground or other group members with urine or faeces, or scent marks from anal or cheek glands; attacking if they were lunging at, biting, or scratching the stimulus. From these behavioural data, we calculated the number of group members acting defensively (standing upright, scent marking or attacking) and non-defensively (stationary, walking/running, digging). We then calculated a number of different metrics of behavioural responses to the presented stimuli.

1. *Spatial cohesion*

We calculated the mean across sampling points in each video of the proportion of individuals within 2 metres of the stimulus. We also recorded the number of group members out foraging that could have interacted with the stimulus, and whether the presentation of the stimulus occurred in the core of the group’s territory.

1. *Participation in collective defence*

We calculated the mean across sampling points in each video of the proportion of individuals acting defensively. We also recorded the number of group members out foraging that could have interacted with the stimulus, and whether the presentation of the stimulus occurred in the core of the group’s territory.

1. *Homogeneity of behavioural response*

We calculated the mean across sampling points in each video of behavioural diversity (H-index). We also recorded the number of group members out foraging that could have interacted with the stimulus, and whether the presentation of the stimulus occurred in the core of the group’s territory.

**Quality control**

The Mongoose 2000 app contains various internal checks to reduce errors in data collection, e.g., an individual is required to be marked as present at the group composition to collect further behavioural data about them (for instance, reproductive status). Data is quality checked using a combination of queries in MSAccess, and bespoke R code. These are used to detect errors such as an individual having more than one death record.

**Details of data structure**

Data is contained in 3 csv files.

1. **BMRP04\_01\_proportion\_within\_2m**

**Description of content:**

The mean proportion of individuals within 2m of the stimulus during each presentation.

**Column names:**

**video** video ID code

**grp** focal group ID code

**stim** type of trial and type of stimulus (c\_intruders = control intruders, c\_scents = control faeces and scents, t\_intruders = simulated intrusion intruders, t\_scents = simulated intrusion faeces and scents)

**loc** location of presentation (Core = within boundary of 50% area of activity of group in preceding 3 months, Non-core = outside of boundary of 50% area of activity of group in preceding 3 months)

**field.grp.sz** number of group members aged >6 months out on foraging trip

**stim.mean.prop2m** mean proportion of group members within 2 metres of the stimulus

1. **BMRP04\_02\_proportion\_defensive**

**Description of content:**

The mean proportion of individuals exhibiting defensive behaviour during each presentation.

**Column names:**

**video** video ID code

**grp** focal group ID code

**stim** type of trial and type of stimulus (c\_call = control calls, c\_intruders = control intruders, c\_scents = control faeces and scents, t\_call = simulated intrusion calls, t\_intruders = simulated intrusion intruders, t\_scents = simulated intrusion faeces and scents)

**loc** location of presentation (Core = within boundary of 50% area of activity of group in preceding 3 months, Non-core = outside of boundary of 50% area of activity of group in preceding 3 months)

**field.grp.sz** number of group members aged >6 months out on foraging trip

**stim.mean.propdef** mean proportion of group members exhibiting defensive behaviour

1. **BMRP04\_03\_behavioural\_diversity**

**Description of content:**

The mean H-index of behavioural diversity of group members during each presentation.

**Column names:**

**video** video ID code

**grp** focal group ID code

**stim** type of trial and type of stimulus (c\_call = control calls, c\_intruders = control intruders, c\_scents = control faeces and scents, t\_call = simulated intrusion calls, t\_intruders = simulated intrusion intruders, t\_scents = simulated intrusion faeces and scents)

**loc** location of presentation (Core = within boundary of 50% area of activity of group in preceding 3 months, Non-core = outside of boundary of 50% area of activity of group in preceding 3 months)

**field.grp.sz** number of group members aged >6 months out on foraging trip

**avg.h.bystim** mean H-index of behaviour exhibited by group members