Supplemental Information:

**Reduced social-information provision by immigrants
and use by residents following dispersal**
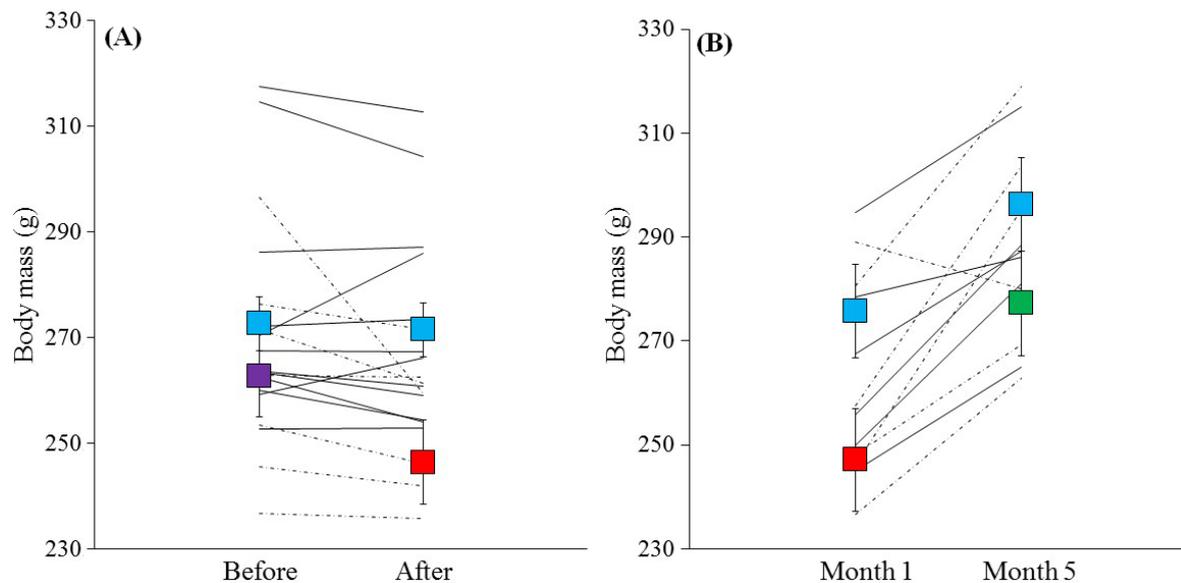
Julie M. Kern & Andrew N. Radford

Figure S1. Changes in body mass of dwarf mongooses in relation to dispersal events.
(A) The reduced contribution to sentinel activity by recent immigrants (see main paper; Figure 1B) might be explained by a loss in body mass incurred during dispersal. Body mass around the time of immigration was significantly affected by the interaction between residence status and time period (Table S1A; $N = 304$, 19 individuals, 14 group-years). The body mass of dispersing individuals decreased significantly between the month before emigration and the month after immigration (Tukey's post-hoc test: $P=0.001$; mean±SE decrease in body mass=9.0±5.7 g), while subordinate individuals in groups with a constant membership showed no significant change in body mass between equivalent consecutive months ($P=0.411$; mean±SE=1.7±2.0 g). Residents and dispersers did not differ significantly in body mass the month before dispersal ($P=0.294$), but immigrants were significantly lower in body mass than residents in the month following immigration ($P=0.009$). (B) Immigrants subsequently regained body condition after settling in a new group, matching the increase in sentinel activity (see main paper; Figure 1D). Post-immigration body mass was significantly affected by the interaction between residence status and time period (Table S1b; $N = 159$, 12 individuals, seven group-years). During the first month after arrival, immigrant individuals were significantly lower in body mass than subordinate residents (Tukey's post-hoc test: $P=0.049$), but no significant difference was found by the fifth month ($P=0.204$). Although resident individuals gained body mass between the first and fifth month after immigration events ($P<0.0001$; mean±SE increase in body mass=21.7±3.2 g), immigrants gained significantly more body mass during the same timeframe ($P<0.0001$; mean±SE=30.1±10.6 g). Shown in figure panels are mean body mass for each mongoose separately (dotted lines dispersers, solid lines residents) and the overall treatment mean ± SE predicted from Linear Mixed Models in Table S1 (solid squares, colours match those used in Figure 1 of main paper).

Table S1. Model output from Linear Mixed Models investigating changes in body mass (A) between the month before and after dispersal (*N*=304, 19 individuals, 14 group-years) and (B) between the month after immigration and five months after immigration (*N*=159, 12 individuals, seven group-years). Significant fixed terms shown in bold; variance±SE reported for random terms.

	Fixed effect	Effect±SE	df	χ^2	P
(A)					
Minimal model	(Intercept)	293.10±14.96			
	Residence status*time period		**1**	**77**	**0.009**
	Resident:month after	15.22±5.23			
	Group size	**-4.64±1.77**	**1**	**55**	**0.010**
	Residence status				
	Immigrant	0.00±0.00			
	Resident	9.91±9.44			
	Period				
	Month before	0.00±0.00			
	Month after	-136±5.04			
Random terms	Group	0.00±0.00			
	Individual	332.60±18.24			
(B)					
Minimal model	(Intercept)	296.90±15.42			
	Group size	**-8.31±2.86**	**1**	**8.18**	**0.004**
	Residence status*period		**1**	**60**	**0.010**
	Resident:month five	-9.60±3.68			
	Residence status				
	Immigrant	0.00±0.00			
	Resident	28.64±14.56			
	Period				
	Month one	0.00±0.00			
	Month five	30.12±2.77			
Random terms	Group	144.00±12.00			
	Individual	105.90±10.29			

Supplemental Experimental Procedures

Study site and population
Data were collected from nine groups (mean adult group size=7; range=3–12) of wild dwarf mongooses on Sorabi Rock Lodge, Limpopo Province, South Africa (24° 11'S, 30° 46'E). Dwarf mongooses are cooperatively breeding carnivores living in mixed-sex groups [S1]. A dominant pair reproduces, with help from related and unrelated subordinates [S2]; the presence of the latter often results from immigration events. Study groups were habituated to close human presence (<5 m) and generally visited every 3–4 days; individuals were identifiable from small blonde dye marks (Wella UK Ltd, Surrey, UK) or distinctive physical markings [S3,S4]. The population has been monitored since 2011, thus the age of most individuals is known; individuals can be sexed through observations of ano-genital grooming. Adult group members were classified as either 'dominant' (male and female pair) or 'subordinate' (the remaining individuals) (as in [S5]). The dominant pair could be identified through observations of aggression, feeding displacement, scent marking and greeting behaviour [S1]. All work was conducted under permission from the Limpopo Department of Economic Development, Environment and Tourism (permit number: 001-CPM403-00013), the Ethical Review Group of the University of Bristol, U.K., and the Ethical Committee of Pretoria University, South Africa.

Of the 165 individually marked dwarf mongooses in the population during the overall study period, 35 (21%) were classified as known dispersers (emigrants or immigrants). Dispersal events were recorded in all nine habituated groups, with a total of 22 emigrations and 28 immigrations recorded; 12 individuals moved from one study group to another study group, all moving between neighbouring groups. Known dispersers consisted of 31 males (88%) and four females (12%). Focal groups received immigrants at a mean rate of 1.2 individuals per year (range 0–5), and lost group members to emigration at a mean rate of 0.6 individuals per year (range 0–5). Of the 28 immigrants, one joined as a dominant, four attained dominance within a year, and 23 remained as subordinate or still were at the end of data collection. Dispersal events were heavily concentrated during the winter period, with the majority (80%) occurring between April and September, before the start of the breeding season; mating typically begins in September.

Observational data
Data on immigration and emigration events were collated from observation sessions conducted between October 2012 and December 2016, when full group compositions were recorded. Individuals were classified as immigrants when they left their natal group and joined a new group for at least 4 weeks [S6]. Once immigration was established, the recorded date of immigration was taken by backtracking to the first day that an individual was observed in a new group. Emigrations were recorded when individuals vanished from their group and were subsequently observed in another (including groups outside of the study population); date of emigration was taken as the earliest date that an individual was recorded as missing from the group.

To investigate contributions to sentinel behaviour, observations were conducted between January 2014 and December 2016. Once groups left the overnight refuge to begin foraging, scan samples were carried out every 30 min to record whether a sentinel was present and, if so, the sentinel's identity [S5]. Individuals younger than one year seldom contribute to sentinel behaviour (J.M. Kern unpublished data), therefore data collection and analyses focused on individuals of 12 months and older. Sentinels were defined as individuals positioned on an object (e.g. termite mound, tree, rock), with their hind feet at least 10 cm above the surrounding substrate, and actively surveying the surroundings while groupmates were engaged in other activities, primarily foraging [S3–S5].

To determine whether individuals of different residence status varied in their likelihood of acting as a sentinel (indicating a difference in provision of social information in this context), data were analysed using Wilcoxon matched-pairs signed-rank tests. Tests were performed using R version 3.2.2 [S7], were two-tailed and were considered significant at $P<0.05$. Three analyses were conducted, all entailing comparisons of the mean daily proportion of sentinel scan samples in which a focal class of individuals and matched individuals in their group acted as sentinels in a given period. Since groups changed in composition and individuals could not always be tracked through all three stages, different cohorts of individuals were used in each analysis. The first analysis compared contributions of recent immigrants with those of a resident subordinate adult in their new group during the one-month period immediately after an individual immigrated (N=10 pairs, 46 bouts, 487 scan samples, 90 sample days). The second analysis compared contributions of future dispersers in their natal groups with those of a stay-at-home subordinate adult in the same group during the one-month period immediately before an individual emigrated (N=10 pairs, 66 bouts in 712 scan samples on 91 sample days). The third analysis compared contributions of former immigrants with those of a resident subordinate adult from within the group during a one-month period occurring five months after an individual was first recorded in a new group (N=8 pairs, 71 bouts, 435 scan samples, 65 sample days).

Body-mass data

The study population is habituated to the use of weighing scales, and individuals will stand on an electronic balance (Salter Houseware, Kent, UK, accuracy±1 g) in exchange for a small reward of egg. Group members were weighed first thing after emerging from their overnight refuge, after the morning observation session (2–3.5 h later), and when they returned to the evening refuge. Body-mass data were only recorded when readings remained constant for 2 s (indicating that individuals were stationary on the balance).

To investigate whether the differences in contributions to sentinel duty at different time periods relating to dispersal (see Results in main paper) were related to changes in body mass, two Linear Mixed Models (LMMs) were conducted. One LMM compared the body-mass changes of recent immigrants with resident subordinates from the month before to the month after dispersal events (304 body-mass measurements, from six immigrants and 13 residents in groups without immigrants, in 14 group-years; mean±SE mass measurements per individual=17.4±1.8, range 4–40). For residents, body-mass measurements were taken over a two-month period from the same time of year as immigrant measurements. The other LMM compared the body-mass changes of former immigrants with resident subordinates in the first and fifth months after dispersal events (159 body-mass measurements, from five immigrants and seven residents, in seven group-years; mean±SE mass measurements per individual=13.3±2.3, range 4–34). In both models, body-mass measurements from early in the morning, after morning foraging and in the evening were used, but matched for every individual in that dataset: the same number of measurements from each time of day were used for each individual in both periods, across the same number of days. Group size, residence status (immigrant or resident) and period (first LMM: month before emigration or month after immigration; second LMM: first or fifth month after immigration) were fitted as fixed effects, with individual identity nested in group identity included as a random term.

Playback experiments

To assess the influence of sentinel identity (immigrant vs resident) on forager vigilance (an indicator of how much they rely on the social-information provider), two playback experiments were carried out. The first experiment investigated responses to recent immigrants, and was conducted from August 2014 to October 2015. For each of seven immigration events by subordinate adults in four groups, two treatments were conducted within 1 month of the arrival of the new group member: playback of the surveillance calls of the recent immigrant and those of a natal subordinate adult group member. The second experiment investigated responses to immigrants that had resided in the group for longer time periods, and was conducted from July to August 2016. For each of six previous immigration events by subordinate adults in four groups, two treatments were conducted >5 months after the arrival of the new group member: playback of the surveillance calls of the former immigrant and those of a natal subordinate adult group member. As a result of changes in group composition, the identity of some immigrants and matched resident individuals differed between experiments. In both datasets, two of the matched residents were the same sex as the relevant immigrant, and the remainder were of the opposite sex; no difference in this regard existed between datasets and thus could explain the difference in results.

Playback experiments followed the protocol in [S5]. Playback tracks were produced in Raven Pro 1.5 (Ithaca, New York, USA) from original sound recordings. Surveillance calls were recorded from 1−5 m onto a SD card (SanDisk, California, USA), using a Marantz PMD660 professional solid-state recorder (Marantz America, New Jersey, USA) and a handheld highly directional Sennheiser ME 66 shotgun microphone (Sennheiser UK, Buckinghamshire, UK) with a Rycote Softie windshield (Rycote Microphone Windshields, Gloucestershire, UK). Playback tracks consisted of surveillance calls inserted into 3 min of ambient noise (recorded from the centre of the territory of the focal group) at 12-s intervals to create a uniform call rate of 5 calls per minute, the mean call rate for sentinel bouts occurring more than 10 min since an alarm call [S3]. Tracks used multiple surveillance calls from the relevant individual but did not include any other conspecific or heterospecific vocalisations. Playback tracks used recordings from the relevant time period after an immigration event; in those cases where the same individual was played back in both experiments, playback tracks differed between them. Calls were broadcast from an iPod touch (Apple Inc., California, USA) connected to single SME-AFS portable field speaker (Saul Mineroff Electronics Inc., New York, USA) positioned at a height of 1 m. The amplitude of naturally occurring surveillance calls was measured using a HandyMAN TEK1345 sound meter (Metrel UK Ltd., West Yorkshire, UK) and playback amplitude was standardized to 55 dB at 2 m.

In both experiments, the dominant female of the relevant group was presented with paired playback trials in a counterbalanced order. The two trials to the same focal individual that related to a given immigration event were conducted on the same day, separated by a minimum of 1 h, and when the entire group was foraging in the same habitat type. Playbacks took place when there was no natural sentinel on duty, when there had been no sentinel present for at least 5 min, and no natural alarm call for at least 10 min. If a natural sentinel bout started during a trial, the trial would have been repeated 30 min later, but this never occurred. Using a tally counter and stopwatch,

the number of vigilance look-ups performed and the cumulative duration of time spent vigilant by the focal individual was recorded in each trial. To investigate whether foragers altered vigilance behaviour (indicating a difference in reliance on the social-information provider) depending on the residence status of a sentinel (first experiment: recent subordinate immigrant vs subordinate resident; second experiment: former subordinate immigrant vs subordinate resident), paired data were analysed using Wilcoxon matched-pairs signed-rank tests.

Supplemental References
S1. Rasa, O.A.E. (1977). The ethology and sociology of the dwarf mongoose (*Helogale undulata rufula*). Ethology *43,* 337–406.
S2. Rood, J.P. (1990). Group size, reproduction, and routes to breeding in dwarf mongooses. Anim. Behav. *39,* 566–572.
S3. Kern, J.M., and Radford, A.N. (2013). Call of duty? Variation in use of the watchman's song by sentinel dwarf mongooses (*Helogale parvula*). Anim. Behav. *85,* 967–975.
S4. Kern, J.M., and Radford, A.N. (2014). Sentinel dwarf mongooses (*Helogale parvula*) exhibit flexible decision-making in relation to predation risk. Anim. Behav. *98,* 185–192.
S5. Kern, J.M., Sumner, S., and Radford, A.N. (2016). Sentinel dominance status influences forager use of social information. Behav. Ecol. *27,* 1053–1060.
S6. Doolan, S.P., and Macdonald, D.W. (1996). Dispersal and extra-territorial prospecting by slender-tailed meerkats (*Suricata suricatta*) in the south-western Kalahari. J. Zool. *240,* 59–73.
S7. R Development Core Team. (2015). *R: A language and environment for statistical computing*. Vienna: R Foundation for Statistical Computing. http://www.R-project.org.