Unmonitored releases of small animals? The importance of considering natural dispersal, health, and human habituation when releasing a territorial mammal threatened by wildlife trade.

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Abstract

Unmonitored release is a common practice, especially in small animals, that present a series of adverse conditions if not well-planned. Small research centers and non-governmental organizations in developing countries often receive animals that are then subject to unmonitored releases. We explored the patterns of post-release and natal dispersal in the Javan slow loris, a Critically Endangered venomous and territorial mammal that is highly threatened by wildlife trade. We then determined the importance of health status and human habituation for the survival of translocated and natally dispersing animals. We collected data from 2012 to 2018 on pre-release and pre-dispersal health conditions and human habituation, post-release and post-dispersal presence of wounds, behavior, and ranging patterns of 11 translocated and 11 natally dispersing individuals and compared them with 12 stable resident individuals. Translocated animals had a larger home range size (15.9±4.1 ha) and higher wound presence during recaptures (0.47±0.13) than stable resident individuals (3.2±3.0 ha; 0.10±0.06) but they did not differ from natally dispersing individuals (13.8±3.7 ha; 0.28±0.11). Both translocated and natally dispersing individuals can move to a different habitat type compared to their release area or natal range. The fate of both translocated and natally dispersing individuals was influenced by their health state ($p<0.001$), and human habituation significantly affected the possibility of being captured for wildlife trade of translocated individuals ($p=0.048$). We highlight the importance of considering natal dispersal, health state, and human habituation before the release of small animals to avoid death and capture for wildlife trade.

Keywords

Population restoration; re-enforcement; health index; NGO; research center; pet trade.

1. Introduction

Despite evidence on best practices in planning and monitoring translocation projects being available (IUCN/SSC 2013, see Batson et al. 2015b for a review), unmonitored releases of animals are still frequent and can result in a series of adverse conditions if not well-planned (e.g. genetic changes, diseases, competition with resident individuals; Laikre et al. 2010, Champagnon et al. 2012). The reason for translocation failures is often unknown due to a lack of post-release monitoring (Griffith et al. 1989; Wolf et al. 1996; Fischer & Lindernmayer 2000; Seddon et al. 2007; Beck 2016). For example, a survey from 30 rescue centres revealed that only a third of respondents followed criteria to assess translocation success (Guy et al. 2013). Small research centers and non-governmental organizations in developing countries often receive animals brought in by villagers or law authorities and do not have the infrastructure to keep them (Cuarón 1997, Cuarón 2005, Agoramoorthy & Hsu 2007, Nijman et al. 2009, Kenyon et al. 2015). These animals are often former pets or wild animals adapted to live in human-modified habitats that people perceive as forest animals (Kumar et al. 2014). As a result, they are subject to unmonitored releases (Dodd Jr & Seigel

1991; Agoramoorthy & Hsu 2007; Moore et al. 2014; Kumar et al. 2014; van der Sandt, 2017; Beck 2019).

Animals translocated to an area where conspecifics are present may be forced to disperse (Le Gouar et al. 2012), thus translocated animals may share common characteristics with animals dispersing from their natal habitat (Macdonald & Johnson 2001). Understanding patterns of natal dispersal in wild animals is, thus, fundamental when planning translocations (Armstrong & Seddon 2008). Dispersal from the release site to another area is usually considered a criterion for failure in translocation projects, but often the information on wild dispersing animals is lacking (Stamp & Swaisgood 2007; Le Gouar et al. 2012; Villaseñor et al. 2013; Berger-Tal et al. 2019), so such secondary dispersals may be natural for some species (Sutherland et al. 2000 for a review).

The health condition of animals immediately after the release is considered a main factor determining translocation success and should be taken into consideration and monitored (Mathews et al. 2006; Dickens et al. 2010). Health condition (considering both visible signs and pathogens), however, needs to be considered carefully even before the release since it may determine the translocation success (Mathews et al. 2006; Parker et al. 2012; Portas et al. 2016). Furthermore, health monitoring after release is often limited to direct observations of diseases and mortality, while comprehensive health evaluations are often missing (Deem et al. 2012; Portas et al. 2016). Another fundamental factor to be considered before the release is the habitat suitability in the release area, although the definition of suitable habitats is not always clear since it is species-specific (Osborne & Seddon 2012). An unsuitable release area can determine a post-release dispersal as a consequence of the Natal Habitat Preference Induction (i.e. animals look for stimuli from their natal habitat instead of evaluating the habitat quality of the release site; Stamps & Swaisgood 2007). An additional factor to be taken into consideration when planning population restoration projects, often neglected, is the involvement and attitudes of the local community, especially for species subjected to hunting and other forms of wildlife trade (Hunter et al. 2007; Nilsen et al. 2007; Jule et al. 2008). Areas with long-term conservation projects that also include conservation education or community outreach programs may thus be more suitable for restoration of threatened populations.

We explored the patterns of post-release and natal dispersal and investigated the role of health state and human habituation on the fate of translocated and natally dispersing Javan slow lorises *Nycticebus javanicus*, a nocturnal mammal, as part of a long-term conservation and research project. Slow lorises are the only venomous primates and it is suggested that the main use of their venom is against conspecifics (Rode-Margono & Nekaris 2015). Javan slow lorises are highly territorial and animals can have severe wounds that are usually more frequent during dispersal (Fuller et al. 2018). Slow lorises are widely threatened by illegal trade for pets, medicines and tourist photography props (Nekaris & Starr 2015), meaning that a low alert response towards humans may be detrimental for their survival. Furthermore, traders may cut their teeth to prevent venomous bites, which has implications for feeding on their main food resources – exudates, which they must gouge from trees (Nekaris & Starr 2015). Slow lorises, despite being highly territorial and threatened by wildlife trade, are frequently subjected to unmonitored releases (Kumar et al. 2014). We collected data on translocated and natally dispersing animals and predicted that health state and human habituation would have been significant factors in determining animal survival and success in settling in a stable area. We then compared the presence of wounds and animals' ranging patterns after release or dispersal with those of stable resident animals present in the area to determine whether translocated and natally dispersing animals are similar. This information is important to determine whether post-release dispersal is abnormal or whether it is similar to the process of animals dispersing from their natal range. If unmonitored releases are to continue by welfare charities and governments, these data may provide some information on how to select appropriate release candidates.

2. Methods

2.1. Study site and subjects

We examined pre-release and pre-dispersal health conditions, human habituation, post-release and post-dispersal presence of wounds, behavior, and ranging patterns of 11 translocated (4 females, 7 males) and 11 natally dispersing (3 females, 8 males) Javan slow loris *Nycticebus javanicus* in Cipaganti, Garut District, Java, Indonesia (7° S, 107° E, 1200 m a.s.l.). The habitat consists of a mosaic of agricultural fields, bamboo patches, shrubs, and small agroforest patches in the vicinity of a protected rainforest watershed. We also collected data on presence of wounds, behaviors, and ranging patterns of 12 stable resident individuals (7 females, 5 males) as control data. Translocated animals were all rescued from areas adjacent with the study site, usually brought in by local villagers who found them during daily activities such as cutting bamboo. Three translocated animals (T-BK, T-CK and T-LA) were rescued from pet trade and required a longer pre-release monitoring time done at Cikananga Wildlife Rescue Centre, Sukabumi, West Java. Translocated animals were released in the study area where other wild animals were present. We can thus refer to this translocation as a re-enforcement (i.e. release of individuals of a species in their historic range conspecifics are present in the release area; Seddon et al. 2012). Please refer to Table 1 for more information on the translocation design based on the Translocation Tactics Classification System (Batson et al. 2015b).

2.2. Behavior and ranging patterns

We followed wild individuals at Cipaganti via radio telemetry between 17:00 and 05:00 h using Instantaneous Focal Sampling every 5-min (Altman 1974) and collected animal locations every 15-min via a handheld GPS Garmin GPSMAP® 60CSx with an accuracy of at least 6 m (Cabana et al. 2017). We followed slow lorises for a total of 6590 h from April 2012 to December 2018. We collared the slow lorises following previous protocols with radio collars (BioTrack, UK – 17 g) (Poindexter & Nekaris 2018). We tracked the slow lorises using a six-element Yagi antenna and SIKA receiver (BioTrack, UK) and observed them using LED headlamps with a red filter (Cluson Engineering Ltd., Hampshire, United Kingdom). No negative effects of collaring animals have been noted during the study period. We selected the 11 individuals that naturally dispersed from their natal area by investigating their ranging patterns every two months. We considered dispersal as the movement of an individual out of an area larger than its home range, with no predictable returns (Bunnell & Harestad 1983). Slow lorises usually disperse when they are around 20 months old and they have already reached an adult body size (Poindexter & Nekaris 2018). We calculated the home range size via 95% fixed kernel estimates using Ranges 9 software with least square cross validation as smoothing parameter (Seaman & Powell 1996). We selected the 12 stable resident individuals based on behavioral and ranging data and selected 8-month periods when more data were available on the individuals during the study period. We calculated the level of alertness (i.e. remain stationary like in rest but with active observation of environment or observer) for each stable resident individual during the 8-month periods and used them for comparison with levels of natally dispersing and translocated individuals. Translocated individuals were radio-collared and intensively followed during the first week after the release, and then followed in a similar pattern to the other individuals. For this reason, we used the level of alertness during the first week for translocated individuals, while for natally dispersing individuals we considered the first two months after dispersal. During the same period, we considered the occurrence of abnormal behaviors to include in a health index (see below). Abnormal behaviors included overgrooming and abnormalities in feeding such as reduced/abnormal gouging (i.e. feeding on gum, the main food item of Javan slow loris, by making a hole in the tree with their anterior teeth, Cabana et al. 2017).

2.3. Health and human habituation indices

We checked the health state of translocated animals before release by measuring body weight and anatomical characteristics, and by evaluating their general conditions. For the whole study period, we regularly checked and monitored natally dispersing and stable resident individuals. We created a health index score based on previous criteria presented in a guide for recognition and alleviation of distress in laboratory animals, which we found applicable to wild animal conditions (NRC 2008). We gave positive scores if the animals, before release or at the time of dispersal presented the following: i) underweight; ii) presence of abnormal skin or hair-coat/mucous membranes; iii) presence of parasites/worms in fecal samples; iv) missing body part, including tail, ears, limbs, etc.; v) abnormalities of the eye; vi) abnormalities of the teeth; vii) presence of unusual behaviors after release/dispersal (e.g. overgrooming, abnormal feeding behavior). The health index thus varied between 0 (normal condition) to 7 (severe distress). We considered an animal underweight when the body weight was lower than the body weight of the stable adults considered in this study using a one sample t-test. When the translocated animals presented abnormalities, we included a pre-release stage in which they were in a rehabilitation cage of 12 m^2 X 1 m high until any abnormal condition ameliorated (maximum two weeks and depending on health state). Healthy animals were immediately released the night after the health check to reduce their capture-related stress (Parker et al. 2012). Translocated animal health was re-checked after the release via re-captures (one or two times per loris, with 15 re-captures in total) to evaluate their general conditions and to see whether the animals presented new wounds and weight loss. These data were compared to the regular health checks of natally dispersing and stable resident individuals.

We created a human habituation index based on the behavior during animal handling and the alertness state post-release or dispersal, considering being calm and less alert than normal as a negative condition (Teixeira et al. 2007). We gave a positive score when the animal was very calm during captures and when it was presenting a proportion of time resting alert lower than the value for stable adults considered in this study using a one sample t-test. The health index thus varied between 0 (normal condition) to 2 (not alert and calm during captures) (Table 2).

RISTEK (Indonesian Ministry of Science and Technology) approved this study (039/SIP/FRP/SM/22; 5619/FRP/SM/1; 1393/FRP/SM/V; 070/2I83; 070/2828). We conducted all animal research in adherence with RISTEK, as well as ethical guidelines provided by the Association for the Study of Animal Behaviour; Oxford Brookes University Animal Ethics Sub-committee granted our research approval. We informed local Indonesian conservation authorities (BKSDA Garut) of any animal translocations and had their approval to act as we saw fit.

2.4. Statistical analysis

To determine whether translocated individuals differed from natally dispersing and stable resident individuals in terms of home range size in the first two months after the release or dispersal and in the proportion of wounds during captures, we ran generalized linear models with a sequential Bonferroni post hoc test and used the estimated means for graphical representation. For stable resident individuals, we considered eight months of stable home range and computed an average home range size between four 2-month periods. To test whether the fate of animals was determined by their health state, we ran a Goodman and Kruskal's gamma correlation since the dependent variable was set as ordinal (fate was 0 when the animal was dead or captured by traders, 1 when the animals was alive but not settled, 2 when the animal was alive and settled). We considered an animal as settled when the home range was stabilizing with time and the overlap of points in the previous home range was not statistically different from the mean home range of stable individuals (using a one sample t-test). If prolonged home range data were not available (for animals that moved out of the main study area to locations where we did not have the required permits to follow them, see table 2), the animals were considered settled when their health conditions remained stable and they did not move far from release point (we estimated their locations via the triangulation method from the forest boundary, Gese 2001). After an animal was considered as settled outside the main study area, we removed its collar. To test whether the fate of animals was determined by their habituation to humans, we ran a generalized linear model with fate as binary dependent variable (0 when the animal was dead or captured by traders, 1 when the animal was alive). We ran the tests using R software v3.5.1 considering p=0.05 as significance level.

3. Results

The probability of wounds was significantly different between translocated (estimated mean: 0.47 ± SE 0.13), natally dispersing (estimated mean: 0.28 ± SE 0.11), and stable resident individuals (estimated mean: 0.10 ± SE 0.06) (generalized linear model: Wald χ^2=6.42, p=0.040), with a significant difference between translocated and stable resident individuals (Sequential Bonferroni: p=0.029) (Figure 1). The home range size in the first two months after release or dispersal was also different between translocated (estimated mean: 15.9 ± SE 4.1 ha), natally dispersing (estimated mean: 13.8 ± SE 3.7 ha), and stable resident individuals (estimated mean: 3.2 ± SE 3.0 ha) (generalized linear model: Wald χ^2=6.89, p=0.028), with a significant difference between translocated and stable resident individuals (Sequential Bonferroni: p=0.039), and between natally dispersing and stable resident individuals (Sequential Bonferroni: p=0.043) (Figure 2). The home ranges of translocated and natally dispersing individuals decreased after the exploratory period in settled animals, until they reached home ranges similar to stable individuals, while not settled animals kept large home ranges during the eight-month period. There were cases in both translocated (N=1) and natally dispersing individuals (N=4) when the individuals left the main study area and settled in a nearby forested area (Table 2).

The fate of translocated and natally dispersing animals was negatively related to their initial health state (Goodman and Kruskal's gamma: $\gamma=-0.90$, $p<0.001$) (Table 2, Figure 3). Abnormalities of the teeth and in feeding behavior may be detrimental even after a prolonged time. For example, T-BT exhibited abnormal gouging behavior from the beginning, with no gouging teeth marks on offered substrates before the release. After the release, she started gouging only after three days and gouged at lower frequencies than stable resident animals for the first three months. After this period, she started over-gouging and this abnormal feeding behavior could have been the reason for her death since she was found with a deformed jaw.

The fate of translocated and natally dispersing animals was also significantly dependent on human habituation (generalized linear model: $\beta=-1.69$, $p=0.048$). The fit line for translocated animals suggests that human habituation is influencing the fate only in translocated animals (Figure 4).

4. Discussion

4.1. Translocated animals may be forced to disperse

Here we showed that translocated animals in re-enforcement programs may act as natally dispersing animals, showing similar home ranges and probability of wounds. It is often assumed that post-release survival and settlement in a release area are the main criteria for a successful translocation (Le Gouar et al. 2012; Parker et al. 2012). As a consequence, many management tools are often used to mitigate post-release dispersal (Richardson et al. 2015b). The biology and ecology of a translocated species, however, can be incomplete, and a deep knowledge is required when planning a translocation program (Dodd Jr & Seigel 1991; Stamps & Swaisgood 2007; Parker et al. 2012; Villaseñor et al. 2013; Berger-Tal et al. 2016, 2019). The post-release dispersal shown by one individual that moved from the agroforestry area to the forest could have been confused with a natal habitat preference induction (sensu Stamps & Swaisgood 2007) if the information on natally dispersing animals was lacking. Moving from the agroforestry area to the forest, however, was a common practice in this study for Javan slow lorises naturally dispersing from their natal home range (Table 2), which could have home ranges larger than 50 ha during this process, compared to their usual home range of around 3 ha (Figure 1). Many studies reported the proportion of individuals remaining in the release area but do not consider the natural dispersal tendencies of the animals (e.g. Ostro et al. 2000; King & Gurnell 2005; Hardman & Moro 2006). It is often true that dispersal from a release site can be associated with a high mortality rate (Bright & Morris 1994), but in highly territorial animals such as slow lorises, secondary dispersal appears to be a natural behavior. For example, repeated releases of the territorial Persian fallow deer (*Dama dama mesopotamica*) determined a larger dispersal area in newly reintroduced individuals (Dolev et al. 2002). As also pointed out by Berger-Tal et al. (2016), post-release dispersal should be better defined since it is dependent on the species and moving from the release habitat to another habitat and extending home ranges is not unusual. We also need to consider that animals recovered and successively released in this program may have been natally dispersing animals that arrived in proximity of the village (thus found by farmers during their usual activities) while exploring new areas. That may be another reason to explain their post-release dispersal.

4.2. Health and human habituation

The health index was a main factor influencing the fate of translocated and natally dispersing Javan slow loris. A health check of translocated animals is often missing, even though it has important implications to avoid disease transmission (Mathews et al. 2006; Ewen et al. 2012). In Javan slow lorises, we did not find many pathogens; rather, we found individual health problems that determined the death of animals. The common issue between animals that died after the translocation was related to abnormalities of the teeth or the related abnormalities in gouging behavior. It is evident that for a species that spends almost half of its feeding time gouging on tree exudates (Cabana et al. 2017), having problems with teeth or an abnormal gouging behavior is detrimental. It has been proposed that the high amount of exudates with medicinal properties eaten by slow lorises may be associated with recovery from frequent wounds in these territorial taxa (Das et al. 2014). It is noticeable that releasing animals with abnormalities of the teeth or in gouging behavior brings consequences such as a reduced recovery from wounds that can be detrimental for their survival. Some behaviors are species-specific; we thus highlight again the importance of knowing the biology and ecology of a species before the release. We should also note that the health index here is easy to apply and could be useful for studies of other animals.

Human habituation (i.e. reduced response to human presence in a way that humans are not seen as potential predators but are essentially ignored; Ellenberg et al. 2009) was also shown to influence the possibility of death or of being caught by humans. Human habituation can be detrimental for species that are subject to hunting for food or pet trade since it increases the risk of being caught (Geffroy et al. 2015; Blumstein 2016). It also reduces the level of alertness and this can also increase the predation risk (Geffroy et al. 2015). Despite the extensive conservation education program that started in 2012 in the study areas and in nearby villages (Nekaris et al. 2018), it is evident that there is still a potential risk for slow lorises to be caught by humans. Since human habituation is a factor influencing the success of translocation for Javan slow loris and presumably for other species threatened by wildlife trade (Frair et al. 2007; Ellenberg et al. 2009), in certain cases it is important to limit the time spent in the pre-release stage. Many studies showed that a soft release (i.e. extending the pre-release stage) may be better than a hard (i.e. immediate) release since it reduces post-release dispersal (e.g. King & Gurnell 2005; Tuberville et al. 2005; Kenyon et al. 2014). Other studies, however, found no effect (e.g. Lovegrove 1996; Hardman & Moro 2006) or even reduction in survival (e.g. Batson et al. 2015a; Richardson et al. 2015a) when soft release was employed. It is thus important to consider the threats faced by the individual species before deciding a soft *versus* hard release. For Javan slow lorises, a quarantine period to help animals with health problems to recuperate may not be a successful strategy in some circumstances since it will increase human habituation and thus the possibility of being caught by humans after the release. When a prolonged quarantine period is required, we suggest taking particular care on environmental preconditioning and post-release environmental management tactics (Batson et al. 2015b).

4.3. Concluding remarks

The quality of applied methods to wildlife translocation has dramatically improved especially in the last two decades. The large variety of tactics that can be employed during translocations (Batson et al. 2015b), however, suggests that there is a need to have a detailed and species-specific understanding of the biology and ecology of wild animals to be able to plan effective translocation plans. For small nocturnal animals such as slow lorises that are ubiquitous in wildlife trade, ecological field studies are often lacking, but the small size of such animals lends itself to random and unmonitored hard releases, e.g. amphibians and reptiles (Dodd Jr & Seigel 1991), rodents (Villaseñor et al. 2013), primates (Kumar et al. 2014; Fuller et al. 2018; Beck 2019). This is especially true in areas where long-term research projects are established, where villagers often find animals and give them to researchers who put them back to the forest without post-release monitoring (Agoramoorthy & Hsu 2007; van der Sandt 2017; Beck 2019). Furthermore, the health state of translocated animals and the threats to the species in the release area should be carefully taken into consideration before the release. We took the Critically Endangered Javan slow loris, a venomous and territorial mammal that is highly threatened by pet trade, as a model to show that i) dispersal from release site/habitat, often considered as main criterion for defining a successful translocation, can be a natural process in a territorial species (Sutherland et al. 2000 for a review), and ii) some factors, such as health and human habituation indices, can predict the fate of translocated animals before the release (Mathews et al. 2006; Frair et al. 2007; Parker et al. 2012; Portas et al. 2016). Despite a lack of scientific data, all too often welfare charities and governments hail unmonitored releases as a conservation success (Dodd Jr & Seigel 1991), especially for charismatic small animals (Moore et al. 2014; Beck 2019) and large mammals (Yeager 1997). Press releases and photographs of such releases even generate funding for such organizations (Dodd Jr & Seigel 1991). Clearly, a substantial death rate is to be expected from these releases since the tactical frameworks for translocations are not employed (Champagnon et al. 2012). As unmonitored hard releases of small animals are likely to continue, we hope that these data might provide some aid in selecting candidates suitable for release. We recommend following specific frameworks such as the Translocation Tactics Classification System (Batson et al. 2015b) when planning translocations and avoid unmonitored or uncontrolled releases of animals to the wild.

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Table 1. Checklist of tactics employed for translocated Javan slow lorises at Cipaganti, West Java, based on the Translocation Tactics Classification System (Batson et al. 2015b).

Tactical group	Tactical option	Application
Animal preconditioning	Behavior	Animals with abnormalities of feeding behavior were trained to hunt for insects and gouge for gum
	Health	Animals with health issues (e.g. parasites, worms, skin problems) were treated before the release
	Social	Animals coming from pet trade were kept for a period in communal housing of individuals to establish social networks
Animal release design	Population size	We controlled for population density over time and released in the study area only a limited number of animals to avoid overpopulation
Post-release animal management	Intervention	Animals were regularly checked after the release and we intervened in case of health issues
Environmental selection	Suitability	We previously modelled the habitat use and distribution of the study species (Voskamp et al. 2014). Agroforestry habitats are preferred habitats by Javan slow loris, and the study area limited threats to lorises
	Similarity	Animals were released in the study areas from neighboring areas with similar environmental conditions
Environmental preconditioning	Resource augmentation	We built a plant nursery and provided trees to farmers to be planted to increase connectivity and food resources for animals. We used artificial bridges to increase canopy connectivity (Birot et al. 2019).
	Threat control	We reduced hunting pressure in the study area via different activities involving conservation education and socialization events (Nekaris et al. 2018). We have reached an agreement with local communities for a total hunting ban.
Environmental release design	Timing	Lorises were released after sunset since that is the moment of the night when they are more active and they can have the whole night to habituate to the new environment

Post-release environmental management	Resource augmentation	Refer to environmental preconditioning as the actions described took place during the whole study period
	Threat control	Refer to environmental preconditioning as the actions described took place during the whole study period

Table 2: Health index (0=normal to 7=severe), human habituation index (0=normal to 2=not alert during captures and/or behavioral observations), and fate of translocated (T-) and natally dispersing Javan slow lorises at the Cipaganti agroforestry area, Java.

Animal	Pre-release/dispersal monitoring time (days)	Post-release/dispersal monitoring time (days)	Health Index*	Human habituation index	Fate
T-AJ	4	29	0	0	Alive and settled outside the study area
T-BK	259	17	5 [a,b,d,e,f]	2	Caught by hunters (found cut collar)
T-BT	25	235	3 [a,b,g]	2	Survived almost eight months then died, deformed jaw bone
T-BL	49	186	1 [g]	0	Alive but not settled yet
T-CK	76	73	4 [a,b,d,e]	0	Found dead, lost much weight before death
T-GE	4	48	0	0	Alive and settled outside the study area
T-KI	0	32	0	1	Caught by hunters (found cut collar)
T-LA	378	35	3 [a,d,f]	0	Alive but not settled yet outside

					the study area
T-PO	0	148	0	0	Alive and settled
T-RO	1	69	0	0	Moved to the watershed rainforest, alive and settled
T-XE	4	762	1 [c]	0	Alive and settled
AL	372	975	0	1	Alive and settled
DL	345	48	0	0	Moved to the watershed rainforest, alive and settled
LU	264	1863	0	0	Alive and settled
LP	413	185	1 [b]	1	Alive but not settled yet
MF	154	549	2 [b,e]	0	Alive but not settled yet
MK	418	278	0	0	Alive and settled
MU	275	145	2	0	Killed by villagers seven months after dispersal, health conditions were worsening
SP	312	258	0	1	Alive and settled
TM	685	42	0	1	Moved to the

					watershed rainforest, alive and settled
TZ	198	74	0	0	Moved to the watershed rainforest, alive and settled
YO	431	53	0	0	Moved to the watershed rainforest, alive and settled

*underweight (a); abnormal skin/fur (b); parasites/worms in feces (c); missing body part (d); abnormalities of the eye (e); abnormalities of the teeth (f); unusual behavior (g)

Figure 1. Presence of wounds in translocated, natally dispersing, and stable resident Javan slow loris at Cipaganti, Java. We considered the presence of wounds during recaptures for health check. Values are estimated proportion of wounds (mean ± SE) based on the generalized linear model.

Figure 2. Home ranges of translocated, natally dispersing, and stable resident Javan slow loris at Cipaganti, Java. We considered the first two months after the release/dispersal for translocated and dispersing individuals and the average size over eight months for stable individuals. Values are estimated home range sizes (mean ± SE) based on the generalized linear model.

Figure 3. Relationship between health index and fate of translocated and natally dispersing Javan slow loris at Cipaganti, Java. The model includes data from translocated and natally dispersing individuals. The dashed line indicates the fit for translocated individuals.

Figure 4. Relationship between human habituation index and fate of translocated and natally dispersing Javan slow loris at Cipaganti, Java. The model includes data from translocated and natally dispersing individuals. The dashed line indicates the fit for translocated individuals.

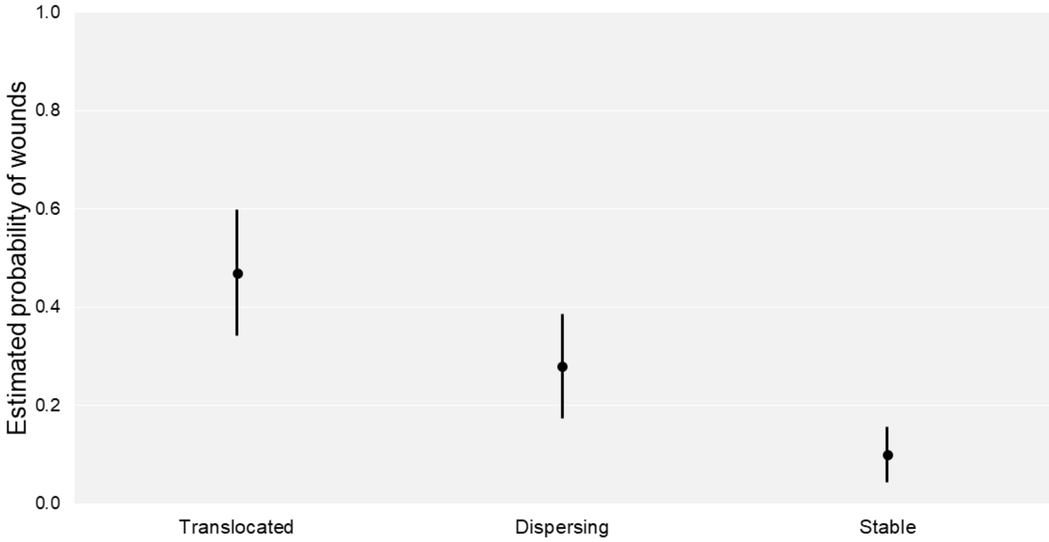

Figure 1.

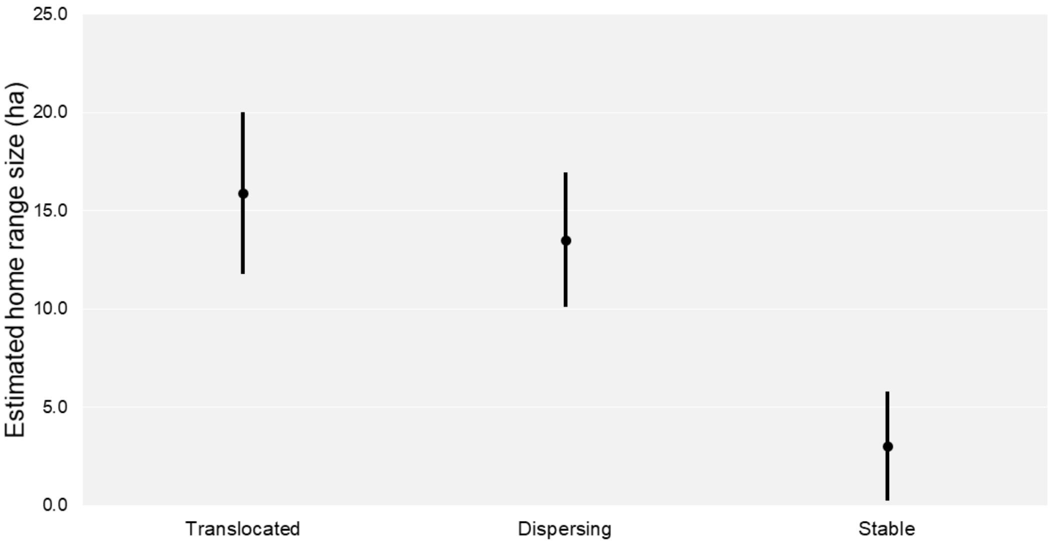

Figure 2

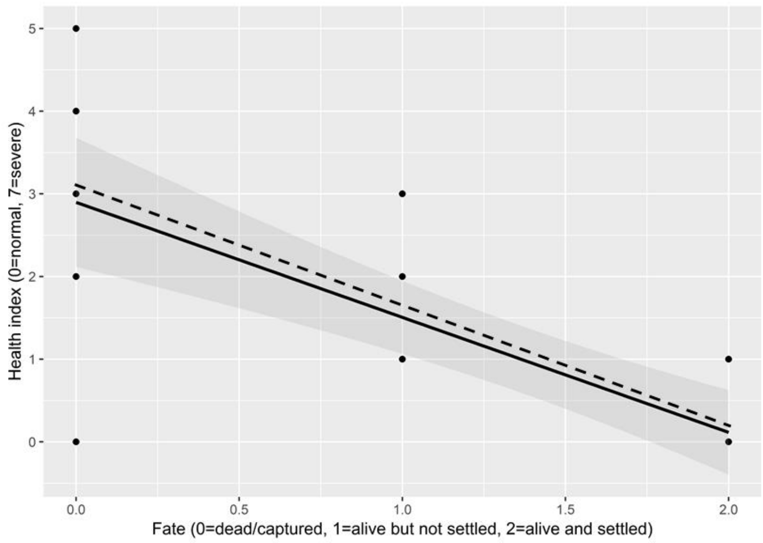

Figure 3

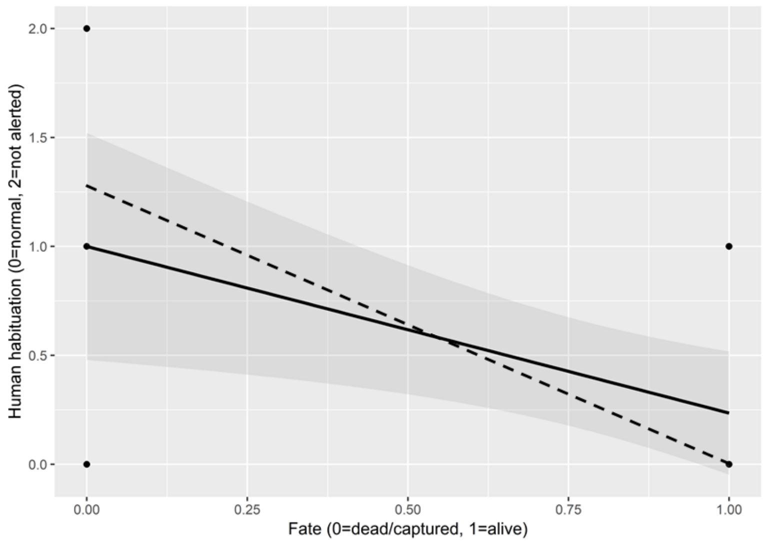

Figure 4