Welfare Impacts of the Illegal Wildlife Trade in a Cohort of Confiscated Greater Slow Lorises, *Nycticebus coucang*

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Abstract:

Illegal harvesting and trade is a major force behind population declines of wild slow lorises (genus *Nycticebus*). Less well-described are the impacts of the wildlife trade on individual slow lorises. In this paper we describe quantitatively the consequences of the wildlife trade for 77 greater slow lorises, *N. coucang*, confiscated *en masse* and brought to Cikananga Wildlife Center in Indonesia. Medical records indicate that in total 28.6% of the slow lorises died within the first six months, mostly due to traumatic injury, and all the infants died. The greatest sources of morbidity were external wounds (33.1% of 166 total medical events) and dental problems (19.3%). Of the surviving individuals, 25.4% displayed abnormal behavior. Behavioral observations indicate that healthy adults (n=3) spent 48.2% of their active period performing stereotypies. These data illustrate the physical and behavioral impacts of the illegal wildlife trade on the welfare of slow lorises. We suggest that sharing these individual stories may help generate empathy and educate the public about the impacts of the exotic pet trade on animal welfare.

Keywords: exotic pets; venomous primate; rescue center; sanctuary; conservation

Introduction

The illegal wildlife trade is an industry worth an estimated 7-23 billon dollars annually that is firmly ensconced in a global system of organized crime based upon the exploitation of the environment and human rights (Nellemann et al., 2016). A review of reports describing drivers for the wildlife trade estimates that 22% of non-human animals are traded for use as pets or entertainment (Baker et al., 2013). Human exploitation for use in traditional Asian medicine, the tourist photo prop trade, and the illegal pet trade are the greatest threats to Asiatic lorisines, in addition to deforestation for palm oil and other cash crops (Nekaris, Shepherd, Starr, & Nijman, 2010; Nekaris & Starr, 2015). Because slow lorises (*Nycticebus* spp.) adapt fairly well to habitats altered by humans, the wildlife trade is thought to be the most critical factor in their decline (Nekaris & Streicher, 2008).

In 2008, the IUCN (2016) recognized five species in the genus *Nycticebus*, all with decreasing population trends, and as of 2017 will recognize nine species at even greater threat levels (Nekaris, unpub. data). In particular, two species of Sumatran slow lorises, the greater slow loris (*N. coucang*) from the South and the Sumatran slow loris (*N. hilleri*) from the North, will both be listed as Endangered (IUCN, 2016; Nekaris, unpub. data). Greater slow lorises are legally protected in their range countries of Indonesia, Malaysia, and Thailand (Nekaris & Streicher, 2008). Greater slow lorises from southern Sumatra are disproportionately targeted for trade due to ease of capture in disturbed habitats and close proximity to Jakarta's trading hub (Nekaris & Streicher, 2008). Indeed, high levels of trade in slow lorises precipitated the recent transfer of the genus *Nycticebus* from Appendix II to Appendix I of CITES (Nekaris & Nijman, 2007).

In Asia, the main source country for animals in the wildlife trade is Indonesia (Baker et al., 2013). A survey of markets in Sumatra indicated that the most commonly traded primates are long-tailed macaques (*Macaca fascicularis*) and greater slow lorises (*Nycticebus coucang*), despite the protected status of the latter (Shepherd, 2010). The routine and open presence of slow lorises in Indonesian markets reflects a lack of effort to enforce laws protecting them (Nekaris, Shepherd, Starr, & Nijman, 2010). Numbers of slow lorises for sale in Javan markets have increased over the past 25 years (Nijman, Spaan, Rode-Margono, Wirdateti, & Nekaris, 2015). One likely reason for this trend is the nouveau celebrity of slow lorises in "cute" Internet videos that have engendered a growing demand for slow lorises as pets (Nekaris, Campbell, Coggins, Rode, & Nijman, 2013). Slow lorises in markets are often found in hot, crowded conditions without access to water or appropriate food sources; additionally, many slow lorises have their teeth removed as a precaution against their toxic bite to both humans and other slow lorises (Nijman et al., 2015; Nekaris et al., 2016). Such physical injuries can make their reintroduction to the wild impossible, and the need for sanctuary housing grows along with the popularity of slow lorises as pets (Nekaris & Jaffe, 2007).

Discussions of animal welfare are often framed in terms of the five freedoms, a set of proscriptions for promoting animal welfare first codified by the British Farm Animal Welfare Council in 1979. The five freedoms include the following: "(1) freedom from thirst, hunger or malnutrition; (2) appropriate comfort and shelter; (3) prevention, or rapid diagnosis and treatment, of injury and disease; (4) freedom to display most normal patterns of behavior; (5) freedom from fear." Recently this

framework has been synthesized into a more holistic model of animal welfare known as the "five domains," which includes four physical domains—nutrition, environment, health, and behavior—and a fifth mental domain that encompasses affective and cognitive states (Mellor, Patterson-Kane, & Stafford, 2009).

Baker et al. (2013) reviewed reports on global wildlife trade for reference to the five freedoms: 25% of articles referred to animals as impacted by disease, injury, or functional impairment; behavioral restriction was cited in 20% of reports; 18% referenced anxiety, fear, pain, or distress; and 13% referenced deprivation of food or water. The authors suggest that the fairly low frequency of reports concerning animal welfare indicate the extent to which welfare concerns are under-reported in the literature on wildlife trade, which is dominated by conservationist approaches (Baker et al., 2013). Although the urgent need to protect species likely underlies this focus, it is the authors' opinion that more explicit, empirical knowledge regarding the welfare impacts of the wildlife trade is also needed to inform the cultural, legal, and political discourse addressing the global trade in animals, and to reduce consumer demand by generating public empathy for the individual animals involved.

Here we add to this body of evidence by describing the welfare impacts of the illegal wildlife trade on a large cohort of greater slow lorises confiscated from a wildlife trader. The Indonesian Nature Conservation Agency (BKSDA: Balai Konservasi Sumber Daya Alam) notified Cikananga Wildlife Center (PPSC: Pusat Penyelmatan Satwa Cikananga) on October 5, 2013 that they had confiscated a large number of animals from a wildlife trader in Serang, Banten Province, Java,

Indonesia. The confiscation included 77 living greater slow lorises (*N. coucang*), which were most likely of Sumatran origin, two black-shouldered kites (*Elanus axillaris*), one kingfisher (Family Alcedinidae), 44 owls, 120 squirrels, 330 kacamata (white-eyed) birds (*Zosterops* spp.), and 20 bulbul birds (Family Pycnonotidae). BKSDA released the non-protected species that evening and transferred the slow lorises and kites to PPSC on October 6, 2013.

The illicit nature of the trade in slow lorises makes it difficult to establish causal links between injuries or other welfare challenges and clandestine treatment by wildlife traders. Information about how the slow lorises were captured, their origin and destination, and transport conditions prior to those at the time of confiscation is simply not known, although such trade routes in slow lorises typically follow a consistent pattern (Nekaris & Starr, 2015). Trade of other primate species in Indonesia has been better documented. For gibbons and orangutans, animals harvested in Sumatra generally are transported on cargo ships across the Sunda Strait to markets in Java (Nijman, 2005). Transport by air along this route is uncommon, suggesting the slow lorises in this confiscation traveled for many hours or more likely, multiple days (Nijman, 2005).

The large influx of animals at one time to PPSC also meant that not all individuals were treated immediately, and in some instances, injuries occurred before social housing conditions were adjusted due to group incompatibility. Therefore, it is not always clear from medical records whether injuries occurred prior to or during capture, during transport or in markets, or while housed at PPSC. With these limitations in mind, we interpret our findings using the assumption that

problems reported closer in time to the confiscation likely reflect the conditions of capture or transport, while subsequent issues more likely reflect the impacts of life in the rescue center. Acknowledging these limitations, our aims in this report are to describe the following.

1. The impact of transport conditions in the illegal trade on slow lorises as suggested by their physical condition following confiscation
2. Sex- and age-specific, temporal patterns of morbidity and mortality in rescued slow lorises living in a sanctuary setting
3. Behavioral stereotypies performed by rescued slow lorises

Methods

Medical Data Analysis

We reviewed medical data for 77 greater slow lorises (*Nycticebus coucang*) transferred to and treated at PPSC in West Java, Indonesia. Wilhelmina Eggen maintained all medical records and was also the primary provider of medical care. Our analysis includes medical data for the individuals from the time of their arrival and the subsequent six months at PPSC, so as to include information both on immediate sources of morbidity and mortality as well as longer-term impacts. We coded each medical event in the record (illness, wound, or medical observation) by the primary organ system affected following Fuller, Lukas, Kuhar, and Dennis (2014). Anorexia, weight gain, and weight loss were coded as "Body Condition." Abscesses were coded as "Integument." Finally, although several individuals gave

138 birth during this time period, pregnancies and births are not included in morbidity
139 totals.
140 Caretakers were unable to perform necropsies on deceased animals, which
141 were considered evidence against the wildlife trader and were thus required to be
142 maintained intact. Because cause of death could not be definitively determined, we
143 present descriptions of circumstances leading up to deaths rather than causes of
144 mortality.
145
146 *Observational Data on Live Animals*
147 The slow lorises were housed indoors as solitary individuals, mother-infant
148 pairs, or same-sex adult pairs or trios. Each group was housed in a wire-mesh cage
149 measuring between 0.68 and 2.81 m^3. All cages were similarly furnished with
150 wooden perching and densely packed fresh leaves. They were maintained on a
151 natural light regimen, although supplemental red lights were used for cage
152 maintenance and observation. Each slow loris was fed 60-150 g fruit/vegetable mix
153 and five to six crickets or mealworms once a day, and had access *ad libitum* to water.
154 The slow lorises were fed the insects in an enrichment device consisting of a garden
155 pot full of leaf litter.
156 We assessed the prevalence of stereotypic behavior in the population by
157 compiling reports in medical records and by behaviorally assessing the population
158 at six months. Assessments were completed by repeatedly scanning the entire
159 population (N = 14 scans) and noting the presence/absence of and type of
160 stereotypic behaviors being performed. All surveys were conducted in April, 2014

between 2100 and 0600 h, during the slow lorises' active period. Stereotypic behavior was defined as "repetitive, invariant behavior patterns with no obvious goal or function" (Mason, 1991 p. 1015). Many of the stereotypies observed, such as body flipping, have not yet been described in slow lorises. Observations of this behavior, as well as pacing and head swaying (or tossing) are consistent with operational definitions of stereotypic behaviors in rhesus macaques described by Lutz, Well, and Novak (2003), as well as those reported by Tarou et al. (2005) for prosimian primates.

Detailed observations were conducted on a subset of individuals (N = 7) that displayed stereotypies using scan sampling of behavior (Altmann, 1974) at one-minute intervals. Of these, 2 of 15 (13%) infants (all of which were born at PPSC following the confiscation); 1 of 3 (33%) confiscated juveniles; and 4 of 12 (33%) adult females performed stereotypic behavior. These individuals were each observed for n = 60 focal observations (10 minutes each, for a total of 10 hours of observation), except for #181, who died during the study period and was observed 23 times. Observations were balanced across 2000 to 0600 h and were completed from January to June 2014.

Results

Details of the Confiscation

Images taken at the BKDSA office show that the animals, which had been recovered from the back of an SUV, were being transported inside plastic fruit crates and cardboard boxes (Figure 1). All were tightly packed into boxes that included

some individuals that had died of apparent asphyxiation. Transport cages were filled with excrement and other debris. Almost every slow loris recovered was in poor body condition, with distressed pelage and multiple wounds (Figure 1). The number of dead slow lorises included in the confiscation is not known.

Insert Figure 1

The cohort of slow lorises received by PPSC included 32 males, 41 females, and four animals of undetermined sex. The majority of individuals were adults (29 males and 35 females): two males and three females were identified as immature (juveniles), one male and three females were considered infants; and of the four individuals of undetermined sex, three were considered infants and one a neonate.

Upon arrival at PPSC, individuals with dire illnesses or wounds were housed in the Center's medical clinic, and the remaining individuals were brought to an indoor quarantine space inside a warehouse. Staff and volunteers had prepared as many enclosures as possible, but they had only 19 available. The slow lorises were placed in same-sex groups in an effort to avoid breeding, and as many mother-infant pairs were housed separately as possible. Several infants had been separated from their mothers during transport, and staff did their best to match pairs as well as they could. Additionally, several individuals were mis-sexed upon arrival and had to be removed from their original groups at a later time.

Insert Table One

Patterns and Sources of Mortality in Confiscated Slow Lorises

During the first four weeks after their arrival at PPSC, 18 of the 77 slow lorises (23.4%) died due to the severity of their wounds (Table 1). This group

included 5 of 29 adult males (17.2%), 8 of 35 adult females (22.9%), 1 of 5 juveniles (20%), 4 of 7 infants (57.1%), and the only neonate. The majority of deaths occurred in the first week (Figure 2) of the first month. After the first month, one additional adult female died of an infected wound (Loris 163, Table 1) and the three remaining infants died. In total, 22 of the 77 confiscated slow lorises (28.6%) died within six months: five adult males (17.2%), nine adult females (25.7%), one juvenile (20%), all seven of the confiscated infants (100%), and the only neonate.

Insert Figure 2

Additionally, 16 infants were born during the first six months at PPSC. Two of these births occurred during the first week post-confiscation and appeared to be spontaneously aborted fetuses rather than full-term neonates. Of the 14 live births, 3 (21.4%) did not survive.

For all adults, the most prevalent cause of death appeared to be trauma-related. All the adult males that died had external wounds (Table 1). One male's wound showed evidence of infection, and two males clearly had bite wounds. The other two males that died had only small wounds and appeared healthy, but they died spontaneously with no other obvious external cause. Six of the confiscated adult females that died also had wounds. In three cases, these wounds were small and did not appear life threatening, but the individuals spontaneously died. In one of these cases, the slow loris suddenly fell to the bottom of the cage and was unable to move her hind limbs prior to death. Two adult females died during respiratory distress, one of which had no apparent external wounds. Two other females' deaths were associated with reproductive trauma; one female that spontaneously aborted a

fetus and then died also had an infected leg wound (Figure 3; Table 1). Finally, one adult female without obvious external wounds had an apparent seizure and died.

Insert Figure 3

Deaths of immature individuals from the confiscation were generally associated with maternal rejection or neglect. Four infants were rejected by their mothers during the first month after confiscation and subsequently died, and two died of apparent starvation. Another infant experienced major trauma to the face (Figure 3, Table 1) and was also rejected by her mother prior to her death.

Sources of Morbidity Post-Confiscation

We recorded a total of 166 medical problems (hereafter called 'events') in the medical records for the slow lorises over a six-month period following confiscation (Table 2). Medical events were recorded for 24 adult males (82.8% of the 29 confiscated), 34 of 35 (97.1%) adult females, all 5 juveniles, all 7 infants, and the only neonate. The average number of events reported for adult males was 2.5 (range 1-6), 2.5 (1-10) for adult females, and 1.8 (1-5) for immature individuals. Adult females contributed the largest number of events (50.6%) to the total, followed by adult males (35.5%), and immature slow lorises (13.9%).

Insert Table Two

The majority of events (46.3%) occurred in the first month following confiscation. In general, the number of events decreased over time, except for a spike in month four associated with a large number of dental observations (Table 2). During the first month (Figure 4), there were a total of 41 events reported in 39

253 animals that involved wounds, amputation, or other severe trauma (N.B. this total
254 includes all the Wounds listed in Table 2 as well as one each of the Respiratory,
255 Reproductive, and Amputation categories). The number of traumas was highest
256 during the second week after arrival for adults of both sexes and declined
257 precipitously afterwards.

258 *Insert Figure 4*

259 Overall the greatest numbers of events were reports of external wounds
260 (33.1% of events), followed by dental events (19.3% of events), and changes in body
261 condition (13.9% of events). Ocular (9.6% of events) and integument problems
262 (9.6% of events) were also fairly common overall. Wounds and ocular issues were
263 most common during the first month, while dental events and problems with body
264 condition were more common in subsequent months. Issues with body condition
265 were more prevalent in females (14 of 23 events, 60.9%) than males or immatures
266 (infants and juveniles), as were reports of wounds (32 of 55 wounding events,
267 58.2%).

268 Major problems within each organ system category were also summarized.
269 The most common event for the category Body Condition was anorexia (8 events),
270 followed by weight loss (5 events) and weight gain (3 events). The most common
271 dental problems reported were tooth wear (17 events) and tooth decay (7 events).
272 The most common integument problem reported was hair loss (8 events), but
273 individuals also suffered from abscesses (2 events), dry skin, and necrotic skin.
274 Musculoskeletal events reported included paralysis, loss of mobility, a possible
275 intramuscular mass, and muscle spasms. Ocular problems reported included

infection (4 events), glaucoma, cataracts, and swelling. Whole body events included reports of fever, low body temperature, dehydration, and swelling. In most cases, the causes of wounds were not known, although one female (Loris 169) got her leg caught in a cage, resulting in an amputation. Of the 55 wounds reported, 15 (27.3%) were described as purulent, necrotic, or infected.

Behavioral Stereotypies in Surviving Individuals

At the time stereotypies were surveyed, 61 slow lorises lived in the quarantine facility at PPSC: 25 males, 26 females, and 10 infants. In total, 13 of the 51 adults (25.4%: 6 males and 7 females) displayed repetitive, motion-based stereotypic behavior. Stereotypies observed included pacing, head swaying and weaving, and repeatedly somersaulting. An additional adult female living at the Center's clinic performed extreme self-biting (Figure 3), to the extent that almost her entire tail was lost. She eventually died as a result of her self-inflicted wounds.

The stereotypic behavior of seven individuals was studied in detail. The juvenile and adults all regularly performed stereotypies when data collection first began in January. The amount of time spent performing stereotypic behavior was highest in the healthy adults. These three individuals spent on average 48.2 $\pm$ 0.3% (SE) of their time exhibiting stereotypies. The ill female (ID number 181) spent 13.5 $\pm$ 2.8% of time performing stereotypies and the juvenile (191) 18.5 $\pm$ 2.4%. Two of these individuals head swayed only, while the other three head-swayed but spent most of their time pacing (Figure 5). Stereotypies were also observed in two infants of unknown sex, both of which belonged to mothers who performed stereotypic

behavior. The infant of mother 167 (Figure 5) was observed head swaying twice at 88 days old. The infant of 210 (Figure 5) performed on average 0.5 ± 0.3 pacing bouts per hour, a behavior that appeared first at 78 days of age.

Insert Figure 5

Discussion

The 77 greater slow lorises received *en masse* by Cikananga Wildlife Center after their confiscation from a wildlife trader provide an opportunity to examine the welfare impacts of the illegal wildlife trade on a demographically mixed group of individuals whose experience is likely typical of others caught in the live-animal trade. Whereas infants are the predominant age-class sold in markets for other Indonesian primates, slow lorises in markets are likely to be adults or juveniles (Nijman et al., 2015). The demographics of this group are consistent with this observation, as the confiscation included mostly juveniles and adults. For this group, the youngest individuals were the least likely to survive; in fact, all the infants that arrived with the confiscation were eventually lost. The poor survivability of orphaned slow lorises is likely why infants are less commonly traded than adults.

In total, 23% of these individuals died within their first month after confiscation, and 28% died within the first six months—and these totals only reflect the individuals that survived long enough to be taken to the rescue center. Mortality was higher among females than males, a trend also observed in slow lorises at Ciapus Primate Center in Indonesia (Moore, Wihermanto, & Nekaris, 2014). Almost every animal brought to PPSC was impacted; 92% of all individuals were observed to have a medical problem at least once. Behavioral abnormalities were common as

well. One quarter of the surviving adults performed stereotypic behavior, often for nearly half their active period. In short, a large number of the confiscated slow lorises showed evidence of physical and psychological trauma. Although, it is not possible to link these impacts definitively to either the conditions of their capture and transport or their housing at the rescue center, such conditions have never been observed in wild slow lorises nor are they typical of zoo-housed slow lorises.

Assessing the Five Freedoms in the Wildlife Trade

Although we do not know the means by which the slow lorises were originally captured, the conditions of their transport by the wildlife trader show clear violations of the five freedoms. The slow lorises were transported without access to food or water, and many were dehydrated upon rescue. They were tightly packed into crates in obviously uncomfortable conditions. Photos show evidence of skin scalded by contact with urine, and many individuals had wounds on their hands and feet that likely resulted from attempting to grab the rough plastic crates. Slow lorises are quadrupedal climbers that cannot leap; therefore, they require a continuous network of branches or other substrates that they can grasp to move about (Fitch-Snyder, Schulze, & Streicher, 2008). The inability to grasp a substrate was likely a great source of distress for the slow lorises during transport and is also a source of stress for slow lorises kept as pets in unsuitable conditions (Nekaris, Musing, Vazquez, & Donati, 2016). In most cases it is not possible to determine whether traumatic injuries resulted from the physical or social conditions of

transport. Almost every individual experienced some type of medical problem, suggesting that pain, injury, and disease were widespread.

Forced social proximity to other slow lorises was likely another major source of injury and distress for the slow lorises during transport. Wild slow lorises live in long-term stable pairs that may take years to form, and exhibit intense territoriality towards their neighbors that sometimes results in injuries (Nekaris, 2014). As in other wild greater slow lorises (Wiens & Zitzmann, 2003), traumatic injuries involving bite wounds were more common for males than females in the slow lorises at PPSC. It is likely that individuals forced into contact with a large number of other slow lorises during transport became aggressive and afraid, inflicting traumatic wounds upon one another. Indeed, during interviews with traders, one reason they give for cutting the teeth of slow lorises is to reduce damage in transport, as damaged slow lorises are less sellable (Nekaris, unpub. data). Other traumas occurred at PPSC as a result of aggression during the process of establishing compatible social groups. The spike in wounds that occurred during the second week at PPCC likely reflects the process of social group formation, while wounds recorded during the first week likely reflect the impact of the conditions of the wildlife trade.

Slow lorises are the only venomous primates. Nekaris, Moore, Rode, and Fry (2013) review what is known about slow loris venom. Slow lorises have a brachial gland located above the elbow that produces an odorous exudate that is chemically-activated by mixture with their saliva. Bites inflicted with this chemical can cause anaphylactic shock in humans (Madani & Nekaris, 2014) and result in festering,

367 necrotic wounds in other slow lorises (Nekaris et al., 2013). The potential role of
368 slow loris venom in competition between individuals is in fact thought to be a
369 possible explanation for its evolution (Hagey, Fry, & Fitch-Snyder, 2007; Nekaris et
370 al., 2013). In the slow lorises in this study, several individuals died after receiving
371 what appeared to be relatively small wounds. Similar reports detail deaths of
372 rescued slow lorises in Java from small puncture wounds with radiating necrosis
373 (Rode-Margono & Nekaris, 2015); Prameswari, Sanchez, and Moore (2014) report
374 four deaths from 40 venomous bites in 25 slow lorises in a two-week period. Fatal
375 effects of bite wounds that became necrotic or non-healing despite treatment have
376 also been reported in slow lorises housed in zoos (Fuller et al., 2014) and sanctuary-
377 housed pygmy slow lorises (Streicher, 2004). Although we cannot causally link the
378 deaths at PPCC to the effects of venom, the impact of intraspecific aggression would
379 likely be intensified by forcing a large number of individuals from a venomous
380 species into close proximity.

381 The physical and behavioral effects of the wildlife trade on these slow lorises
382 lasted well after their immediate transport and capture. Photographic evidence
383 suggests the slow lorises did not have the physical space to perform natural
384 behaviors during transport, but additionally, many individuals exhibited behavioral
385 stereotypies after the confiscation that consumed a large portion of their activity
386 budgets. Although the causes of stereotypic behavior are complex and not entirely
387 understood, repetitive motor stereotypies are often associated with inadequate
388 environments (Mason, 1991). Moore, Cabana, and Nekaris (2015) noted levels of
389 stereotypic behavior (33% of 90 animals) similar to those reported at PPSC in three

390 species of Indonesian slow lorises housed at another rescue center in Java. Their
391 analysis of factors contributing to the occurrence of stereotypies showed that cage
392 size was not predictive of stereotypy development, but social group composition
393 was an important factor. Animals housed alone performed the most stereotypies,
394 while those housed in same-sex groups showed the lowest rates of these behaviors
395 (Moore et al., 2015). Neither time at the rescue center nor origin (market, transit,
396 pet owner, or captive born) were significant predictors in their model. However, the
397 majority of the animals in their study came from markets or pet owners, and Moore
398 et al. (2015) notes that the high prevalence of stereotypies in rescued animals—
399 compared to the near absence of stereotypies reported for zoo-housed slow lorises
400 (Tarou, Bloomsmith, & Maple, 2005)—suggests that an underlying trauma related
401 to the wildlife trade likely contributes to abnormal behavior in rescued animals.
402 However, the etiology of stereotypies is complex, and isolating the impact of capture
403 from other causes, such as conditions at PPCC or even genetic predisposition is not
404 possible in this case. Regardless of their etiology, these stereotypic behaviors are
405 likely to be persistent; for example, stereotypies first developed after orphan
406 chimpanzees were rescued from the bushmeat and live trade persisted for decades
407 (Lopresti-Goodman, Kameka, & Dube, 2013).
408 The impact on infants was recorded through the multiple cases of maternal
409 rejection that occurred in this group. Failures to nurse, carry, or provide other
410 sources of maternal care to infants in nonhuman primates may result from
411 inadequate environments or exposure to extreme stress. For example, free-ranging
412 rhesus macaques (*Macaca mulatta*) that score higher on an index of maternal

413 rejection also have higher cortisol levels, an indicator of stress (Maestripieri,
414 Hoffman, Anderson, Carter, & Higley, 2009). Rejection of infants could reflect
415 evolutionary parent-offspring conflict (Maestripieri, 2002) or a response to extreme
416 stress, or both operating at different levels of causality. For this slow loris group, the
417 end result was that multiple mothers rejected their infants soon after confiscation,
418 and none of the confiscated infants/neonates ultimately survived.
419 Trends in morbidity and mortality in this group of slow lorises over the
420 months following their confiscation reflect the difficulties of managing large
421 numbers of exotic species recovered from traumatic circumstances in a rescue
422 center, especially with limited resources. Slow lorises have long been erroneously
423 considered frugivores, but newer research shows that the slow loris diet consists
424 predominantly of tree gums and exudates (Das, Nekaris, & Bhattacharjee, 2014;
425 Starr & Nekaris, 2013; Swapna, Radhakrishna, Gupta, & Kumar, 2010).
426 Epidemiological research on slow lorises living in zoos has shown that diets high in
427 fruit and low in exudates are associated with dental disease (Cabana & Nekaris,
428 2015), and that dental disease and issues with body condition (especially obesity)
429 are common for slow lorises in captivity (Fuller et al., 2014). Both of these maladies
430 were major sources of morbidity for the slow lorises at PPSC as well. Slow lorises
431 will (and did) readily consume fruit, and even though gum was known to be an
432 important part of their diet, it was extremely difficult locally to source gum Arabic
433 or a similar substitute in Java. Nekaris, Musing, Vazquez, and Donati (2015)
434 evaluated the welfare of slow lorises kept as pets by using videos posted online and
435 found that videos of pet slow lorises rarely (if ever) showed an appropriate diet

offered to the animals, which often were obese. They conclude that it is unlikely that a private owner could or would source gum as the main diet (Nekaris et al., 2015), and they note that even accredited zoos rarely provide gum as part of the loris diet (Fuller, Kuhar, Dennis, & Lukas, 2013). Even under the best of circumstances, replicating the natural diet for animals can be difficult in a captive setting, and this may lead to compromised welfare.

Informing the Public about Welfare in the Exotic Pet Trade

Stories of individual animals like the ones described here can play an important role in educating the public about the consequences of the exotic pet trade. Recent increases in the number of slow lorises traded illegally are likely due in large part to the popularity of videos of pet slow lorises shared on YouTube and other social media (Nekaris et al., 2013). "Cute" videos of slow lorises eating rice balls or being tickled belie an ugly truth, which is that most of these animals are being cared for in captive conditions that violate their five freedoms (Nekaris, Musing, Vazquez, and Donati, 2015). An analysis of the welfare of primates kept as pets in the United Kingdom found that generally, it is not possible for human caregivers to provide the proper social and physical environment for nonhuman primates, and likely all pet primates are welfare compromised to some extent (Soulsbury, Iossa, Kennell, & Harris, 2009). In general, the public does not associate the wildlife trade with animal welfare concerns (Dubois & Fraser, 2013). However, people are becoming more aware; for example, online comments on an infamous video of a pet pygmy slow loris in Russia being tickled reflected a greater concern

for conservation and less desire to own one as a pet after educational outreach efforts (Nekaris et al., 2013). Public education can influence the desire to own exotic pets, although some evidence suggests that issues pertaining to disease and legal consequences may be more persuasive than welfare or conservation concerns (Moorhouse, Balaskas, D'Cruze, & Macdonald, 2016).

We have provided medical and behavioral evidence showing that the illegal trade in slow lorises results in violations of welfare that physically and psychologically harm individuals. Although we are at times unable to differentiate between causal impacts of the trade itself or of life in a rescue center, it is important to remember that their captivity is a result of their illegal harvesting for the trade. Welfare challenges in rescue centers will persist either until sanctuaries have the funding and capacity to provide confiscated animals with conditions promoting good welfare, or the influx of animals from trade is stopped. We hope that by quantifying how these individuals were impacted by the wildlife trade and the captive care available in a rescue center with limited resources, this report will serve to educate the public and curtail the demand driving the illegal trade in slow lorises.

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Figure 1. Transport conditions of greater slow lorises upon confiscation from a wildlife trader. Photos show the crates the trader used to transport live animals (top left) and the conditions of the slow lorises inside after they were recovered by the Forestry Department in West Java, Indonesia.

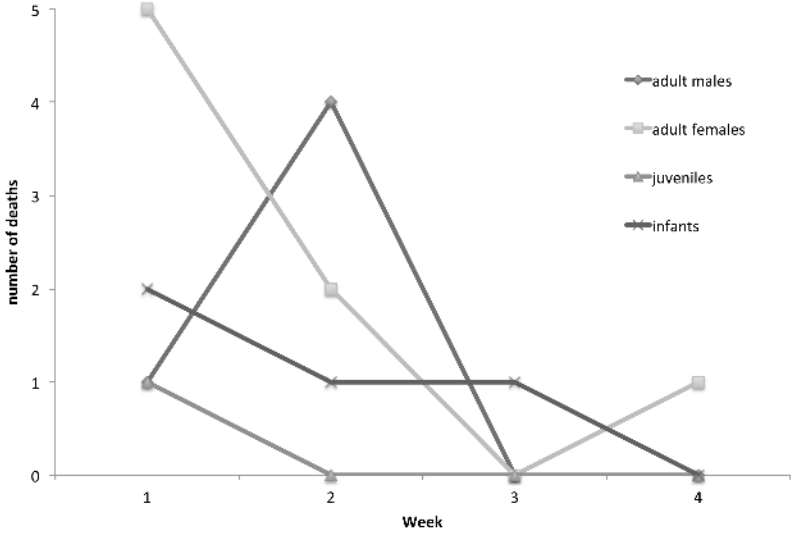

Figure 2. Number of deaths for the first four weeks after 77 confiscated greater slow lorises arrived at Pusat Penyelamatan Satwa Cikananga in West Java, Indonesia.

Figure 3. Photographic examples of some of the wounds found in confiscated greater slow lorises after their arrival at Pusat Penyelamatan Satwa Cikananga. Top Left: Loris 156, an adult female who arrived with an infected leg wound, and spontaneously aborted a fetus and died shortly after arrival; Top Right: Loris 163, an adult female who arrived with a wound stretching around her entire belly, and died three months post confiscation of an infected wound on her knee; Lower Left: Infant 157, who became blind from necrotic wounds near her eyes and died after being rejected by her mother; Lower Right: Loris 169, an adult female whose photo shows a wound caused by self-mutilation.

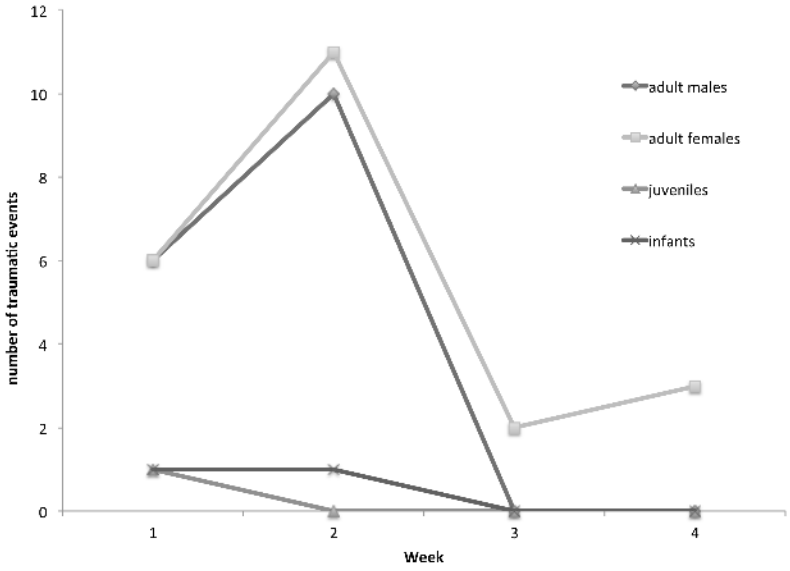

Figure 4. Number of wounds or other traumatic injuries for the first four weeks after 77 confiscated greater slow lorises arrived at Pusat Penyelamatan Satwa Cikananga in West Java, Indonesia.

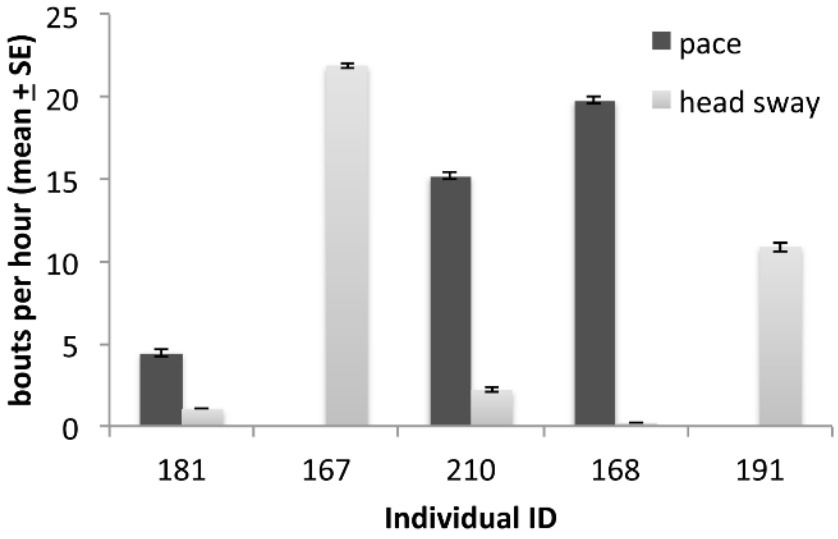

Figure 5. Rates of stereotypic behaviors performed by five greater slow lorises confiscated from a wildlife trader. Each individual was observed for ten hours, except Loris 181, who died partway through the study and was observed for 3.8 hours. Loris 191 was a juvenile female, and the remaining animals were all adult females.

653 Table 1. Sources of mortality for 22 greater slow lorises that died within the first six

654 months after their confiscation from a wildlife trader.

ID	Sex	Age Class	Date of Death	Death Summary	Notes
143	female	adult	07 Oct 13	respiratory distress	blisters in the mouth; heavy respiration; died suddenly, bleeding from the nose
145	female	adult	08 Oct 13	respiratory distress	weak, cold, unresponsive; heavy respiration
146	female	adult	10 Oct 13	possible seizure	appeared healthy but underweight; then found at the bottom of a cage with shaking, muscle spasms, and foam coming from the mouth
149	female	adult	12 Oct 13	trauma; cause unknown	appeared healthy except for small wounds on tail and shin; suddenly died
151	female	adult	12 Oct 13	uterine infection	wounded nose; pus, blood coming from vagina; obviously in pain, laying on back
156	female	adult	17 Oct 13	abortion, anorexia, trauma	gave birth to undeveloped fetus; blood coming from vagina for several days; infected wound on upper leg; anorexic despite treatment
163	female	adult	21 Jan 14	infection; trauma; anorexia	infected wound on knee, upper leg; stopped eating and died despite treatment
214	female	adult	19 Oct 13	trauma	multiple small wounds on face and buttocks; treated but found dead with foam in the mouth
216	female	adult	29 Oct 13	trauma; paralysis	rejected her infant; several old wounds; collapsed and was unable to move hind limbs; died in spite of treatment
147	male	adult	11 Oct 13	sudden death, cause unknown	appeared healthy then found dead with a small wound next to the mouth
152	male	adult	13 Oct 13	trauma (wounds)	cold, unresponsive, found with multiple fresh wounds on legs

					and arms, thought to be bite wounds; died soon after
153	male	adult	14 Oct 13	trauma, wounds	wounds on feet; infected wound in mouth; found unresponsive and died
154	male	adult	14 Oct 13	trauma, wounds	apparent bite wounds on legs, body; treated and died
155	male	adult	15 Oct 13	trauma, wounds	wounds on hands and feet; became unresponsive despite treatment and died
144	unknown	neonate	7 Oct 13	maternal rejection	less than one week old; rejected by its mother; eyes cloudy; unable to get another female to foster the neonate
150	male	juvenile	12 Oct 13	abscess; anesthesia-related	necrotic skin, infected abscess near right eye; anorexic; sedated to treat wound and did not recover from anesthesia
157	female	infant	17 Oct 13	maternal rejection; trauma; infected wound	eye infection; hair loss and possible skin infection on head; attacked by mother and rejected; necrotic wound near eyes leading to blindness; multiple necrotic fingers; sedated to amputate three fingers; became anorexic after treatment
148	unknown	infant	11 Oct 13	maternal rejection	many small wounds to fingers and toes; rejected by mother; died the same day
215	unknown	infant	20 Oct 13	maternal rejection	rejected by mother; being hand-fed; found cold and unresponsive, died
217	unknown	infant	8 Nov 13	unknown	found cold, unresponsive; died shortly after
218	male	infant	10 Nov 13	inanition	emaciated with small wounds on leg and fingers; separated for treatment but died
219	female	infant	19 Nov 13	inanition	emaciated; housed with mother and twin, not receiving enough nutrition

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Table 2. Overview of major factors contributing to morbidity in greater slow lorises in a rescue center for the first six months following their confiscation the illegal wildlife trade. Medical problems are classified by organ system. Totals are given for adult males (M), adult females (F), immature animals (juveniles and infants) of either or unknown sex (I), and all animals (T). One individual may have reports in multiple organ systems.

Month, Age & Sex Class/ Organ System	One				Two				Three				Four				Five				Six				TOTAL			
	M	F	I	T	M	F	I	T	M	F	I	T	M	F	I	T	M	F	I	T	M	F	I	T	M	F	I	T
Amputation	0	0	1	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	3
Body Condition	1	4	1	6	0	1	3	4	0	1	0	1	3	4	0	7	0	3	1	4	0	1	0	1	4	14	5	23
Dental	3	1	0	4	0	0	0	0	0	0	0	0	12	7	0	19	3	2	0	5	1	2	1	4	19	12	1	32
Integument	1	1	2	4	0	0	0	0	0	0	0	0	3	1	1	5	0	2	0	2	2	3	0	5	6	7	3	16
Maternal Rejection	-	-	4	4	-	-	0	0	-	-	0	0	-	-	0	0	-	-	0	0	-	-	0	0	-	-	4	4
Musculoskeletal	2	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	4	1	0	5
Ocular	3	5	2	10	1	3	0	4	0	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	5	9	2	16
Reproductive	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
Respiratory	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
Whole Body	0	1	1	2	0	0	1	1	0	0	0	0	3	0	0	3	0	0	0	0	0	0	0	0	3	1	2	6
Wounds	17	19	2	38	0	8	3	11	0	3	0	3	1	1	0	2	0	1	0	1	0	0	0	0	18	32	5	55
TOTAL	27	38	13	78	1	13	7	21	0	5	0	5	22	14	1	37	5	8	1	14	4	6	1	11	59	84	23	166