

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

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4 **Abstract:**

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

19

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

21

22

23 **Introduction**

24 The illegal wildlife trade is an industry worth an estimated 7-23 billion
25 dollars annually that is firmly ensconced in a global system of organized crime
26 based upon the exploitation of the environment and human rights (Nellemann et al.,
27 2016). A review of reports describing drivers for the wildlife trade estimates that
28 22% of non-human animals are traded for use as pets or entertainment (Baker et al.,
29 2013). Human exploitation for use in traditional Asian medicine, the tourist photo
30 prop trade, and the illegal pet trade are the greatest threats to Asiatic lorises, in
31 addition to deforestation for palm oil and other cash crops (Nekaris, Shepherd,
32 Starr, & Nijman, 2010; Nekaris & Starr, 2015). Because slow lorises (*Nycticebus* spp.)
33 adapt fairly well to habitats altered by humans, the wildlife trade is thought to be
34 the most critical factor in their decline (Nekaris & Streicher, 2008).

35 In 2008, the IUCN (2016) recognized five species in the genus *Nycticebus*, all
36 with decreasing population trends, and as of 2017 will recognize nine species at
37 even greater threat levels (Nekaris, unpub. data). In particular, two species of
38 Sumatran slow lorises, the greater slow loris (*N. coucang*) from the South and the
39 Sumatran slow loris (*N. hilleri*) from the North, will both be listed as Endangered
40 (IUCN, 2016; Nekaris, unpub. data). Greater slow lorises are legally protected in
41 their range countries of Indonesia, Malaysia, and Thailand (Nekaris & Streicher,
42 2008). Greater slow lorises from southern Sumatra are disproportionately targeted
43 for trade due to ease of capture in disturbed habitats and close proximity to
44 Jakarta's trading hub (Nekaris & Streicher, 2008). Indeed, high levels of trade in
45 slow lorises precipitated the recent transfer of the genus *Nycticebus* from Appendix
46 II to Appendix I of CITES (Nekaris & Nijman, 2007).

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

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

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

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

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

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

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

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

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

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

125

126 **Methods**

127 *Medical Data Analysis*

128 We reviewed medical data for 77 greater slow lorises (*Nycticebus coucang*)
129 transferred to and treated at PPSC in West Java, Indonesia. Wilhelmina Eggen
130 maintained all medical records and was also the primary provider of medical care.
131 Our analysis includes medical data for the individuals from the time of their arrival
132 and the subsequent six months at PPSC, so as to include information both on
133 immediate sources of morbidity and mortality as well as longer-term impacts. We
134 coded each medical event in the record (illness, wound, or medical observation) by
135 the primary organ system affected following Fuller, Lukas, Kuhar, and Dennis
136 (2014). Anorexia, weight gain, and weight loss were coded as “Body Condition.”
137 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 m³. 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

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

169 Detailed observations were conducted on a subset of individuals (N = 7) that
170 displayed stereotypies using scan sampling of behavior (Altmann, 1974) at one-
171 minute intervals. Of these, 2 of 15 (13%) infants (all of which were born at PPSC
172 following the confiscation); 1 of 3 (33%) confiscated juveniles; and 4 of 12 (33%)
173 adult females performed stereotypic behavior. These individuals were each
174 observed for n = 60 focal observations (10 minutes each, for a total of 10 hours of
175 observation), except for #181, who died during the study period and was observed
176 23 times. Observations were balanced across 2000 to 0600 h and were completed
177 from January to June 2014.

178

179 **Results**

180 *Details of the Confiscation*

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

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

188 *Insert Figure 1*

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

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

203 *Insert Table One*

204 *Patterns and Sources of Mortality in Confiscated Slow Lorises*

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

207 included 5 of 29 adult males (17.2%), 8 of 35 adult females (22.9%), 1 of 5 juveniles
208 (20%), 4 of 7 infants (57.1%), and the only neonate. The majority of deaths occurred
209 in the first week (Figure 2) of the first month. After the first month, one additional
210 adult female died of an infected wound (Loris 163, Table 1) and the three remaining
211 infants died. In total, 22 of the 77 confiscated slow lorises (28.6%) died within six
212 months: five adult males (17.2%), nine adult females (25.7%), one juvenile (20%),
213 all seven of the confiscated infants (100%), and the only neonate.

214 *Insert Figure 2*

215 Additionally, 16 infants were born during the first six months at PPSC. Two of
216 these births occurred during the first week post-confiscation and appeared to be
217 spontaneously aborted fetuses rather than full-term neonates. Of the 14 live births,
218 3 (21.4%) did not survive.

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

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

232 *Insert Figure 3*

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

238

239 *Sources of Morbidity Post-Confiscation*

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

248 *Insert Table Two*

249 The majority of events (46.3%) occurred in the first month following
250 confiscation. In general, the number of events decreased over time, except for a
251 spike in month four associated with a large number of dental observations (Table
252 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

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

281

282 *Behavioral Stereotypies in Surviving Individuals*

283 At the time stereotypies were surveyed, 61 slow lorises lived in the
284 quarantine facility at PPSC: 25 males, 26 females, and 10 infants. In total, 13 of the
285 51 adults (25.4%: 6 males and 7 females) displayed repetitive, motion-based
286 stereotypic behavior. Stereotypies observed included pacing, head swaying and
287 weaving, and repeatedly somersaulting. An additional adult female living at the
288 Center's clinic performed extreme self-biting (Figure 3), to the extent that almost
289 her entire tail was lost. She eventually died as a result of her self-inflicted wounds.

290 The stereotypic behavior of seven individuals was studied in detail. The
291 juvenile and adults all regularly performed stereotypies when data collection first
292 began in January. The amount of time spent performing stereotypic behavior was
293 highest in the healthy adults. These three individuals spent on average $48.2 \pm 0.3\%$
294 (SE) of their time exhibiting stereotypies. The ill female (ID number 181) spent 13.5
295 $\pm 2.8\%$ of time performing stereotypies and the juvenile (191) $18.5 \pm 2.4\%$. Two of
296 these individuals head swayed only, while the other three head-swayed but spent
297 most of their time pacing (Figure 5). Stereotypies were also observed in two infants
298 of unknown sex, both of which belonged to mothers who performed stereotypic

299 behavior. The infant of mother 167 (Figure 5) was observed head swaying twice at
300 88 days old. The infant of 210 (Figure 5) performed on average 0.5 ± 0.3 pacing
301 bouts per hour, a behavior that appeared first at 78 days of age.

302 *Insert Figure 5*

303 **Discussion**

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

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

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

328

329 *Assessing the Five Freedoms in the Wildlife Trade*

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

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

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

362 Slow lorises are the only venomous primates. Nekaris, Moore, Rode, and Fry
363 (2013) review what is known about slow loris venom. Slow lorises have a brachial
364 gland located above the elbow that produces an odorous exudate that is chemically-
365 activated by mixture with their saliva. Bites inflicted with this chemical can cause
366 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 (Maestriperi,
414 Hoffman, Anderson, Carter, & Higley, 2009). Rejection of infants could reflect
415 evolutionary parent-offspring conflict (Maestriperi, 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

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

442

443 *Informing the Public about Welfare in the Exotic Pet Trade*

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

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

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

476

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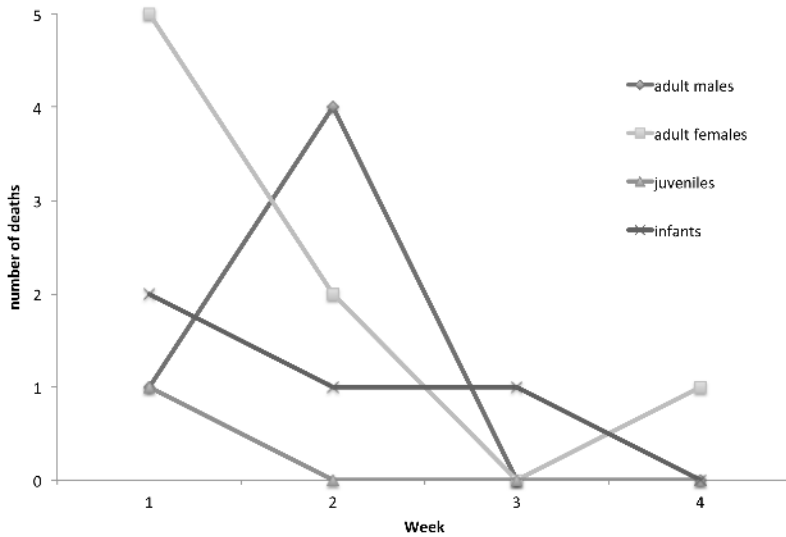
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 614 Figure 1. Transport conditions of greater slow lorises upon confiscation from a
 615 wildlife trader. Photos show the crates the trader used to transport live animals (top
 616 left) and the conditions of the slow lorises inside after they were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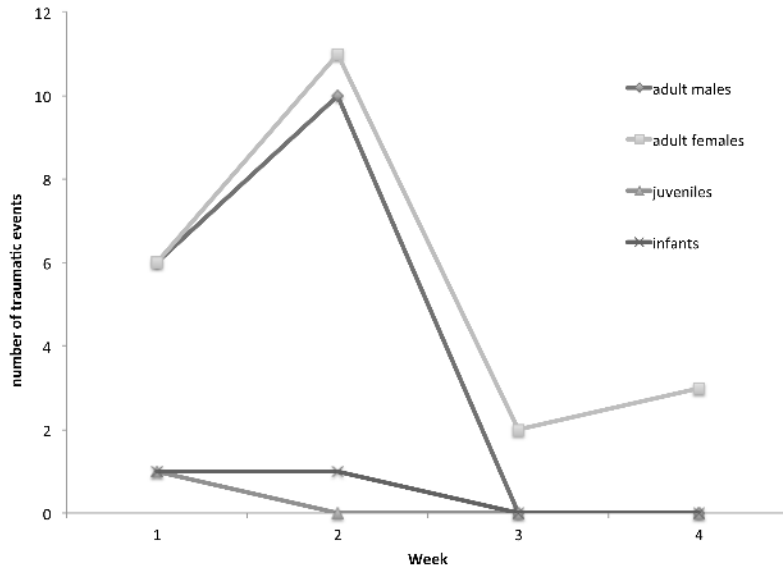


621
 622 Figure 2. Number of deaths for the first four weeks after 77 confiscated greater slow
 623 lorises arrived at Pusat Penyelamatan Satwa Cikananga in West Java, Indonesia.
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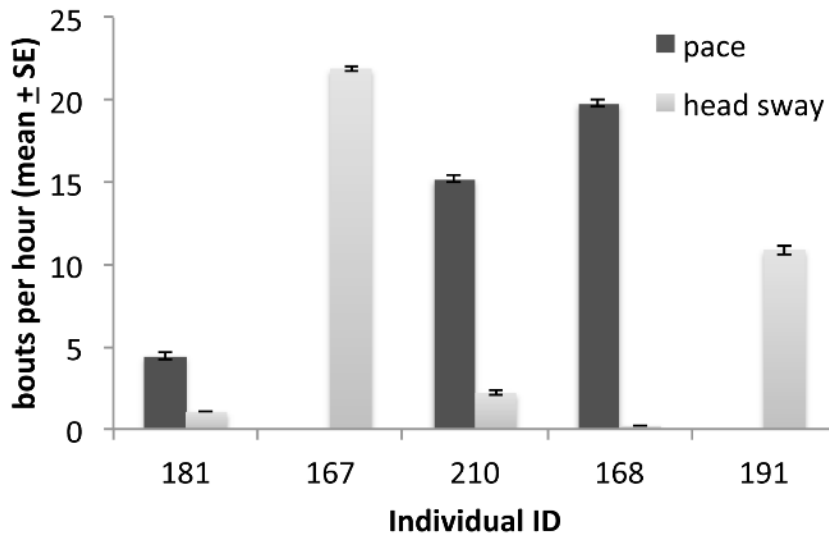
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627 Figure 3. Photographic examples of some of the wounds found in confiscated greater
628 slow lorises after their arrival at Pusat Penyelamatan Satwa Cikananga. Top Left:
629 Loris 156, an adult female who arrived with an infected leg wound, and
630 spontaneously aborted a fetus and died shortly after arrival; Top Right: Loris 163,
631 an adult female who arrived with a wound stretching around her entire belly, and
632 died three months post confiscation of an infected wound on her knee; Lower Left:
633 Infant 157, who became blind from necrotic wounds near her eyes and died after
634 being rejected by her mother; Lower Right: Loris 169, an adult female whose photo
635 shows a wound caused by self-mutilation.

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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.



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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

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

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