September 10, 2023

PETITION CHALLENING THE RED-LIST STATUS OF LONG-TAILED MACAQUE

This petition analyzes evidence presented in Hansen et al. (2022) relevant to IUCN Criteria A3c/d that resulted in an Endangered classification of Long-tailed macaque (*Macaca fascicularis*). Hansen et al. (2022) concluded that the global population of *M. fascicularis* will experience a reduction ≥50% over the next three generations, based on: (1) a decline in area of occupancy, extent of occurrence and/or quality of habitat; and (2) actual or potential levels of exploitation. The best available evidence does not support conclusions contained Hansen et al. (2022), as clarified by (Nijman et al. 2023), nor do data in Hansen et al. (2022) indicate IUCN listing criteria have been met (NABR 2023; Exhibit A).

A. Population size reductions within the next three generations

Hansen et al. (2022) state without scientific evidence that "we suspect the species has experienced a decline of at least 40% over the last three generations (approximately 40 years). We also suspect that the rates of decline are increasing as threats have increased and we suspect the species will experience at least a 50% decline in the coming three generations." Several of the citations provided to support the 40% population decline (5 million to 3 million) do not even reference *M. fascicularis* and include no scientific basis for the 3 million estimate. The two time-series data sets that are available show stable (Nuttall et al. 2021) or increasing (Brotcorne et al. 2021) trends. Hansen et al. (2022) selectively used the first and last points of a highly variable time series presented by Nuttall et al. (2021), even though the highest recorded count was the second to last in that time series.

Hansen et al. (2022) also repeatedly rely on "personal observations" and papers that anecdotally report declines. One source cited to support a decline in Laos never mentions Laos and is about Myanmar. Other than Nuttall et al. (2021), the only citation to quantitative data is Suzuki et al. (2017) with a trend based on only two consecutive years in Cambodia. Hansen et al. (2022) claimed that the species is "rapidly declining" and that "conflicts with humans, trade for the medical industry, and pet trade has resulted in their decline," citing Eudey (2008). However, Eudey (2008) does not present any data demonstrating declines in this species.

To justify an Endangered classification, it was necessary for Hansen et al. (2022) to suspect at least a 50% future decline, which is likewise uncoupled from actual data. To evaluate future threats, it is essential to consider two key questions: (1) are threats increasing, and if so at what rates; and (2) are cumulative threats incompatible with sustainable natural populations? Regarding question 1, Hansen et al. (2022) rely on vague, unsupported statements that conflict with available data, and provide no quantitative analysis of cumulative threats across the taxon's range (NABR 2023).

The only estimate of total population size in Hansen et al. (2022) is from Fooden (1995), who primarily used MacKinnon's (1986) estimate for Indonesia (based on estimated habitat area and densities in primary and secondary forests of roughly 3.7 million animals). Fooden (1995) then combined MacKinnon's (1986) estimate with other rough estimates to conclude "[i]f these provisional calculations are reasonable, the total population of this species about 10 years ago in its entire natural range…which may have been approximately 5 million."

Macaca fascicularis has multiple life history traits that make extinction highly unlikely. Available data indicate the species is highly abundant, certainly in millions of individuals (Hansen et al. 2022). The species thrives in close association with humans, both in agriculture and urban areas, achieving densities up to 1600/km^2 (Hansen et al. 2022), populations grow rapidly when introduced to new habitats such as Mauritius and Tinjil Island (Leeson et al. 2004), and are classified as "highly invasive" (IUCN 2023). These features mean that a rigorous assessment of the status of *M. fascicularis* in the wild will necessarily be very complex and require a much more nuanced treatment than provided by Hansen et al. (2022). Regarding the extent of species habitat, according to Ritchie and Roser (2021), total forest area of Indonesia declined by 22% between 1990 and 2020. These data could be used as a possible measure of change in population size, but this ignores the fact that densities are higher in secondary forest than primary forest, and that increasing agriculture and human population size also increases local

densities. Furthermore, culling has taken place because abundance is too high near people, creating conflicts (Perhiltan 2018). If the species were endangered, these conflicts likely would not exist.

Finally, of equal importance to the magnitude of decline is the time period over which decline occurs (3 generations). For Criterion A to be meaningful, decline and generation length should be measured for the same or comparable population(s). That was not the case in Hansen et al. (2022). Estimated and projected declines apply to the wild population, but estimated generation length (13.9 years) depends heavily on maximum longevity, which for this species was 39 years, based on one captive male. Hansen et al. (2022) could have used a published estimate of longevity for wild *M. fascicularis* of 22 years (Van Noordwijk and van Schaik 1999), which would reduce GL to a more credible 9.1 years, so the appropriate 3-generation interval for Criterion A is 27.4 years rather than >40. As detailed by NABR (2023), using annual rates of decline implied by Hansen et al. (2022), the past 40% decline would shrink to 28.5%, and the projected 50% decline would shrink to 36.5%--neither extreme enough to justify IUCN classification as Endangered.

B. Decline in area of occupancy, extent of occurrence or quality of habitat.

Hansen et al.'s (2022) statement that the species is experiencing a reduction in its historic range due to a loss of habitat is contradicted by available scientific information, which indicates the species can survive in a diverse array of tropical habitats, and is most successful in, and shows a preference for, disturbed habitats (Kemp and Burnett 2003). Given their robust adaptive capacity, *M. fascicularis* has been described as "ecologically diverse" (Kemp and Burnett 2003). Certainly, habitats are changing throughout the range of this species, but Hansen et al. (2022) fail to account for the fact that the species is highly adaptable, has robust populations in altered habitats, and thrives in close association with humans.

C. Actual or potential levels of exploitation

Hansen et al. (2022) claim that "demand for *M. fascicularis* as a trade commodity has skyrocketed during the Covid-19 pandemic," but references cited to support this claim contain no post-Covid data (NABR 2023). Most global imports come to the United States, and Centers for Disease Control and Prevention (CDC) data tell a very different story (NABR 2023). A total of 32,439 of the species were imported in the last pre-Covid fiscal year (October 2018 to September 2019), with reductions of 23%, 6%, and 3% in the most recent three years, respectively (CDC 2022).

II. Summary

Hansen et al. (2022) fail to present evidence to support reclassification of *M. fascicularis* from vulnerable to endangered under Criteria A3cd. A bedrock principle of the scientific method is that researchers must provide enough detailed information that independent scientists can replicate key experiments and/or reach the same conclusions when confronted with the same data. The Hansen et al. (2022) assessment of the status of *M. fascicularis* falls far short of this standard. Actual data are so skimpy that the bulk of the assessment hinges on professional judgement by a group of authors whose independence and credibility has been called into question (Jenkins 2023). The key finding – a projected 50% future decline – is supported by no quantitative analysis whatsoever, so it is impossible to know where the 50% value came from (why not 72% or 17%?). Thus, only personal opinions of the authors remained relevant to the outcome of the listing, which in the presence of potential conflict of interest (Jenkins 2023) and in the absence of a diversity of opinion, is vulnerable to group think and confirmation bias (Burgman 2015, Bland et al. 2017, O'Hagan 2019). Given the flimsy foundation and largely incoherent structure of the Hansen et al. (2022) report, there is no reasonable expectation that, presented with this same information, independent groups of scientists would reach similar conclusions. The only reasonable solution is to have the assessment of *M. fascicularis* redone in a more scientifically-defensible way by an independent group of authors who are not involved in advocacy work involving this species.

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Exhibit A. Response to Comments Received During Informal Discussions (Cite as NABR 2023)

Consistent with IUCN petition guidelines, NABR technical reviewers engaged in informal discussions with Hansen et al. (2022) authors in an attempt to resolve disagreements regarding NABR's draft petition challenging the IUCN listing status of long-tailed macaque (*Macaca fascicularis)*. The following are NABR reviewer responses to comments received during these informal discussions, cited as (Nijman et al. 2023).

As an initial matter, available scientific information does not indicate that *M. fascicularis* are at "very high risk of extinction in the wild" (the IUCN definition of Endangered), given their adaptability to secondary forest, agriculture and humans, and their rapid rate of increase from low densities. One should expect that IUCN status assessments are objective evaluations of a species' status, recognizing of course that scientists are human and complete objectivity can be difficult or impossible to achieve. An objective assessment would start with an open mind regarding the species' actual status and would begin by reviewing and summarizing the relevant empirical data and comparing them to each of the five IUCN listing criteria. Strengths and weaknesses of the empirical data, together with relevant caveats, should be discussed. The overall IUCN listing category would then be the highest level found for any of the IUCN listing criteria.

The Hansen et al. (2022) assessment falls far short of this objectivity standard. The stated rationale for the new assessment was that in 2008 a primate biologist (Eudey) proposed that *M. fascicularis* "urgently needed to be considered more vulnerable." Rather than an objective evaluation of the merits of this proposition, the Hansen et al. (2022) reads like an advocacy piece designed to turn this proposition into reality. This is borne out by Hansen et al.'s use of the analogy to the passenger pigeon introduced by Eudey et al. (2008).

The passenger pigeon represents a general cautionary tale for biodiversity conservation. However, its extreme social organization and its rapid demise from staggeringly large numbers have few parallels among extant species. The ecology and life history of the long-tailed macaque and the passenger pigeon differ dramatically. Recognizing this, Hansen et al. (2022) could have resisted the urge to repeat Eudey's (2018) analogy. Instead, they highlighted this comparison in the first paragraph of their Justification, where it is guaranteed to inflame more than illuminate.

It is against this backdrop that NABR reviewers expressed concerns about the apparent misuse and misrepresentation of data presented in Hansen et al. (2022) to portray an elevated IUCN extinction risk of this species. Responses provided during the informal process by Nijman et al. (2023) fail to address these concerns; instead, several of the responses suggested a biased interpretation of information.

<u>Declines in Species Abundance</u>

During informal interactions with NABR technical reviewers, Nijman et al. (2023) were unable to provide <u>any</u> data to support a historical decline except personal opinions and two studies that

show some decline. Nijman et al. (2023) also neglected to cite any of the existing published studies that show increases in *M. fascicularis* population sizes. Furthermore, Nijman et al.'s (2023) argument for future *M. fascicularis* declines is undocumented, simply citing human consumption, removal of nuisance animals, pet trade, and medical trade. The only data on trade presented by Nijman et al. (2023) or Hansen et al. (2022) concern animals used in medical research, which overwhelmingly originate from captive breeding colonies.

Given the lack of cited data, NABR reviewers independently considered whether changes in habitat availability would lead to a conclusion of declining trends in species abundance. Published forest area data indicate that between 1990 and 2020 Indonesia lost 22% of its forested area, while across all of Southeast Asia (not including Philippines), 16% had been lost (Ritchie and Roser 2021). Since *M. fascicularis* density is higher in secondary forest, we assume that any declines in *M. fascicularis* populations would be less than the loss of total forest cover overall, as some primary forest would have been converted to secondary forest. However, no data exist to show a decline in species abundance based on reductions in forested area.

Available scientific information instead indicates the species can utilize a range of habitats, suggesting that forest conversion on its own is not indicative of species declines. The estimates of tree cover loss, particularly 18% for Indonesia, do not suggest anything like the projected 50% decline in Hansen et al. (2022). Given the high densities of *M. fascicularis* near agriculture, one might suggest an increase rather than a decline as tree cover is lost to agriculture.

Nijman et al. (2023) stated during informal discussions that the fact there are no data to support a claim of a historical 40% decline isn't relevant; rather, the authors state that what is relevant is the projected 50% decline in *M. fascicularis*. However, Nijman et al. (2023) fail to acknowledge there are no data supporting Hansen et al.'s (2022) claims of *M. fascicularis* range-wide declines, either in the past or in the future. For example, no data indicate that there is increasing exploitation of wild populations, or that habitat changes are in fact causing the decline of the species. Rather, the Hansen et al. (2022) conclusions are based only on the "personal opinion" of the reviewers.

Next, estimates of a historical decline in *M. fascicularis* population size from 5 to 3 million are questionable because no data are presented to support an *M. fascicularis* population size estimate of 3 million, nor is the methodology explained how this estimate was derived. None of the citations provided in Hansen et al (2022) support this population estimate. Southwick and Siddiqi (1983) suggest the 3.7 million population estimate in Indonesia used in the 5 million population estimate is likely an overestimate. However, Southwick and Siddiqi (1983) provide an example of increasing abundance of *M. fascicularis* within their native range: "[a]nother example of thriving macaque populations that are protected in reserves, along with very successful commensalism at the edges of forest sanctuaries are the rhesus and cynomolgus populations of the Kowloon peninsula, Hong Kong."

Nijman et al. (2023) state that during informal discussions that "[w]e were in contact with Matt Nuttal from WCS last year who said that the decline was indeed 50% but that they were not able to statistically call it a 'decline over a decade' as the paper was investigating, due to an outlier

population estimate from 2018." However, Nijman et al. (2023) fail to explain the basis for the conclusion that data from 2018 are an outlier, and not simply part of "a noisy time series" (Normile 2023). The 2018 "outlier" was not observed in the other species' time series presented in Nuttall et al. (2021). In fact, Nutall was interviewed for a 2023 article published in *Science* (Normile 2023), and in the article Nutall makes no mention of a 50% decline and is quoted in reference to their study as saying, "this particular study says the species are stable," while suggesting "a shallow decline" (Normile 2023).

NABR technical reviewers analyzed data in Nuttall and conclude that the best estimate of decline in the 10 years is about 30%, but that estimate is statistically not significantly different from zero. Applying a Bayesian estimate, NABR reviewers found that the real rate of change lies with a 90% probability between a 30% increase and a 60% decline.

Nijman et al. (2023) next state that throughout their assessment, they acknowledge some populations of *M. fascicularis* are thriving, "but the fact that some populations are increasing does not change the fact that the species in general is declining across its range." The problem with this response is that no real time series of abundance exists for *M. fascicularis* across any major geographic range. Nijman et al. (2023) simply choose to ignore increasing populations and instead choose to interpret noisy data sets without statistically significant trends to indicate population declines, which is not scientifically defensible.

Nijman et al. (2023) defend their analysis by stating that throughout their assessment, they have acknowledged more data on population sizes are needed. Nijman et al. (2023) further state that data and inferences from several publications, including those of Fooden (1995; 2006), Mackinnon (1986; 1987), Southwick and Siddiqi (1994), Hansen et al. (2019), Suzuki et al. (2017), Nuttal et al. (2021), Kyes et al. (2011), Gumert et al. (2011), as well as "many personal observations," make it possible to "infer a population decline" in *M. fascicularis.* Nijman et al. (2023) then reference IUCN guidance on data interpretation to support their interpretation of available literature. Nijman et al. (2023) seem to be acknowledging that more data are needed to reach valid conclusions but then proceed to make strong assertions based on insufficient data.

There are several obvious problems with the responses provided by Nijman et al. (2023). First, Nijman et al. (2023) fail to acknowledge that the <u>only</u> citations that provide trends in abundance are contained in Nuttall et al. (2021) and Suzuki et al. (2017). Second, there are no species trend data in any of the publications cited by Nijman et al. (2023) or Hansen et al. (2022). Third, contrary to IUCN guidance on the subject, it is not the absence of "high quality data" that is at issue, but rather the total absence of <u>any</u> data indicating declining trends that is at issue. Stated differently, even under IUCN guidance, there is no "estimation, inference and projection" of data on trends or intensity of threats presented in Hansen et al. (2022) or in informal responses to the NABR review aside from personal opinions of individual authors.

Other *M. fascicularis* experts quoted in the *Science* article (Normile 2023) refute the Hansen et al. (2022) assessment and disagree with the IUCN's conclusion regarding the species' status. For example, William Laurence of James Cook University and Fellow of the Australian Academy of Science is quoted in *Science* as stating that IUCN is "being alarmist and not basing

its decisions on good data" (Normile 2023). Alice Hughs, a conservation biologist at the University of Hong Kong, goes on to state in *Science* that the Nuttall (2021) study cited by Hansen et al. (2022) "actually states that the species is stable" (Normile 2023).

Finally, Nijman et al. (2023) repeatedly summarily dismiss other key technical comments made by NABR (2023a):

- NABR (2023a) states "Hansen et al. (2022) misrepresents conclusions and data contained in Nuttall et al. (2021) as supporting a declining trend."
    - In response to this, Nijman et al. (2023) states "[t]his assertion, even if correct, has no relevance to the outcome of the listing."
- NABR (2023a) states "[g]iven that the 40% decline identified is not supported by actual data, there is no basis for projecting a steeper decline in the future.
    - Nijman et al. (2023) responds "[t]his assertion, even if correct, has no relevance to the outcome of the listing.

Thus, only personal opinion of the authors remained relevant to the outcome of the listing, which is vulnerable to group think and confirmation bias (Burgman 2015, Bland et al. 2017, O'Hagan 2019) in the presence of potential conflict of interest (Jenkins 2023) and in the absence of diverse opinions, such as those expressed in Normile (2023).

These summary dismissals of valid technical criticism by Nijman et al. (2023) suggest a strong bias towards a predetermined conclusion. Simply put, the Hansen et al. (2022) assessment contains no quantitative analysis to support the purported 50% decline in *M. fascicularis* population size, and summary statements from Nijman et al. (2023) dismissing criticisms of this fact illustrate the potential for confirmation bias in the unsupported claims contained in Hansen et al. (2022).

Use of Published Scientific Literature

NABR (2023a) noted concerns that Hansen et al. (2022) misused and misinterpreted published scientific literature. In response to this comment, Nijman et al. (2023) propose to make "minor changes" to language in their assessment. NABR technical reviewers rejected this proposal because "minor changes" in language contained in Hansen et al. (2022) would not adequately address the fundamental concerns raised by NABR reviewers.

For example, the introduction to Hansen et al. (2022) begins with a reference to Eudey (2008) stating that "[t]his was consolidated and expanded upon in a paper '[t]he crab-eating macaque (*Macaca fascicularis*): widespread and rapidly declining' published by Eudey in Primate Conservation in 2008." In fact, although the title to Eudey (2008) claims widespread declines, the published paper itself contains no data on widespread or rapid declines in *M. fascicularis*.

NABR technical reviewers evaluated Eudey (2008) and were unable to verify Hansen et al.'s (2022) interpretation of data derived from this publication. Reviewers noted that Brotcorne et al. (2021) shows a re-establishment and expansion of LTM in its native range, a point that Hansen et al. (2022) authors avoid addressing in their informal comments.

As noted above, Nijman et al. (2023) state the 2018 density estimate reported by Nutall et al. (2021) is an "outlier;" however, Nijman et al. (2023) fail to explain why increases in population data should be excluded from Hansen et al.'s (2022) risk assessment. Merely stating that an inconvenient data point is an outlier lacks scientific credibility and leads to biased conclusions.

Finally, NABR reviewers note that Hansen et al. (2022) reference a population decline in *M. fascicularis* from 5 million to 3 million; however, this reference is based upon a publication that cites a Chinese publication which, when translated to English, does not mention *M. fascicularis*. Yet, in spite of these misrepresentations of data and publications, Nijman et al. (2023) claimed the supportive analyses to be "meticulous." A more recent publication similarly repeats these misrepresentations of data and publications (see Gamalo et al. 2023 citing to Hoang et al. 2019 which does not mention *M. fascicularis)*.

Generation Length (GL)

A species' generation length or "GL" has a substantial impact on extinction risk as estimated by the IUCN decline criterion. For this reason, the IUCN has established policies regarding the GL to be used in assessments. Hansen et al. (2022) employed one of the approved IUCN methods in its review; however, Hansen et al. (2022) stated the GL used for *M. fascicularis* without explaining where the estimate came from or how it was calculated.

Hansen et al. (2022) cites Pacifici et al. (2013) in the references, and the appendix to the Pacifici et al. (2013) paper provides a GL estimate for LTM of 13.9 years, which agrees with the value used by Hansen et al. 2022. The method used by Pacifici (Equation 1 in their paper) was the following:

$$GL = R_{span} * z + AFR,$$

where AFR is age at first reproduction, R_{span} is the reproductive lifespan (equal to the difference between maximum longevity and AFR), and z is a taxon-specific constant (equal to 0.29 in this case). The data used by Pacifici were AFR = 3.9 and longevity = 38.5 (reported in days but converted here to years), which leads to R_{span} = 34.6 and GL = 13.9 using the above equation.

The problem with the GL estimate used in Hansen et al. (2022) is that the value of longevity of 38.5 years (derived from the AnAge database) is for a single captive LTM male. For mammals (as well as many other taxa), longevity in captivity is consistently greater than in the wild (Tidiere et al. 2016), which means that using captive data consistently overestimates GL and consequently leads to predictable overestimates of extinction risk under IUCN decline criterion A. Pacifici et al. (2013) acknowledged this bias but discounted its importance, saying that "we believe that these biases will probably influence only a limited number of large-bodied species" (p. 90). But *M. fascicularis* is one of those species, and for such species, the consequences of this bias can be substantial.

Nijman et al. (2023) and other IUCN reveiwers dismiss generation length as of trivial importance, but these statements are easily falsifiable. Tidiere et al. (2016) reported an estimated maximum longevity of *M. fascicularis* in the wild of 22 years (based on data from Van Noordwijk, and van Schaik 1999) - vastly shorter than the captive value used to estimate GL in this species. Using this longevity value, R_{span} becomes a more credible 18.1 years rather than 34.6 years, and GL drops to 9.1. This means that the appropriate 3-generation interval for calculating the decline criterion is 27.4 years rather than 41.7.

As noted above, NABR reviewers do not agree that actual data support Hansen et al.'s (2022) claim of a past 3-generation decline of 40% in *M. fascicularis*. However, if that were the case, it would imply an annual decline of 1.2%. Across 27.4 years rather than 41.7, that rate of decline would produce a total decline of only 28.5%. Similarly, the 50% projected future decline (which would imply an annual decline of 1.6%) would shrink to 36.5% when projected using a GL that is more meaningful for the wild population being assessed.

The data on wild longevity in *M. fascicularis* were published in the journal *Primates* over 20 years ago (Van Noordwijk, and van Schaik 1999) and could have been acknowledged by Nijman et al. (2023) or used in Hansen et al. (2022), at a minimum, for comparison purposes. Given the sensitivity and importance of GL to calculating extinction risk, IUCN assessments should make use of published literature when available to estimate GL. Doing so will provide a more accurate portrayal of species extinction risk.

Removal of the Species from the Wild

Nijman et al. (2023) state that "[b]oth price and demand for *M. fascicularis* as a trade commodity has skyrocketed during the Covid-19 pandemic." In responding to NABR's critique of this statement, Nijman et al. (2023) simply state "[o]ur statement is valid and robustly supported."

Nijman et al. (2023) fail to recognize or acknowledge that neither of the documents cited in Hansen et al. (2022) support their statement about post-Covid data. Rather, Hansen et al. (2022) only analyzed data through 2019, so this document cannot possibly support a post-Covid increase in demand.

Hansen et al. (2022) also does not present post-Covid data, although they make the following speculation: "Long-tailed macaques are heavily traded for biomedical research as discussed above, and with the CoVID-19 pandemic and a need for vaccines and treatment, the trade is not likely to diminish." The only actual Covid-relevant data presented by Nijman et al. (2023) are identical to the data NABR obtained from the Centers for Disease Control and Prevention (CDC), and these data show that total imports of LTM to the U.S. peaked in 2019 and declined in the subsequent three post-covid years (CDC 2022).

A key question in analyzing the import of this trade is whether the removal from wild populations is unsustainable and causing extirpation in certain populations or extinction for the species. The reported numbers of animals traded include both captive-reared and wild-caught animals. Nijman et al. (2023) fail to consider this or evaluate how wild-caught animals contribute to the number of animals used in medical research, or trade in general. In fact,

Nijman et al. (2023) refer to animal removals for bushmeat, or due to culling or poaching, in vague terms.

While a case may exist for improved management and collection of population data for *M. fascicularis*, conservation questions are best addressed at the local level. For example, Southwick and Siddiqi (1994) argue that the rhesus populations in India began to recover in response to effective management, noting the rhesus' high capacity for population growth.

Consideration of the Prior 2020 IUCN Assessment

During informal discussions, Nijman et al. (2023) directed the NABR reviewers' attention to the 2020 Red List assessment to support the conclusions by Hansen et al. (2022). However, the 2022 assessment does not build upon the 2020 assessment as one would expect, even though the authors of the previous assessment were listed as contributors to the most recent assessment. For example, of the 20 references in the 2020 assessment, only 7 were carried forward into the 2022 assessment. Also, Eudey et al. (2021), which is an amended version of the 2020 assessment, states the following:

> The species is extremely tolerant of a range of habitats, including mangrove and swamp forests, and can be found in agricultural areas near forest (secondary growth, secondary forest, and primary forest) (Thomas 1898; Fooden 1991,1995; Rabor 1986; Goodman and Ingle 1993; Heaney et al. 1991; Rickart et al. 1993; Danielsen et al. 1994).

However, of the eight references cited by Eudey et al. (2021) to support the above statement, Hansen et al. (2022) referenced only two publications - Fooden et al. (1991) and Fooden et al. (1995). It is unclear why these studies, cited in 2021, were no longer relevant in 2022. Indeed, the species' tolerance of a range of habitats is not mentioned in Hansen et al. (2022). This failure to build upon, or refute, the prior assessment is irregular and suggests selective use of data in Hansen et al. (2022).

Evaluation of Extinction Risk

Hansen et al. (2022) misrepresents published literature to support a claim of elevated extinction risk. For example, Southwick and Siddiqi (1994) and Kyes et al. (2011) are cited by Hansen et al. (2022) as providing evidence for overestimation of population size. However, both papers make only brief suppositions about the accuracy of estimates without presentation or reference to any supporting evidence or data. The totality of Southwick and Siddiqi's statement about the MacKinnon (1987) estimation of population size is as follows:

> The 3.7 million figure comes from extrapolation of population densities in known study areas, yet many studies have shown the patchiness of primate populations, which makes extrapolation potentially misleading.

And Kyes et al. (2011) state the following regarding estimating abundance:

> The fact that long-tailed macaque populations are often located in areas of human habitation, where sightings and conflict occur daily, may lead to assumptions of

over-abundance in regions where populations size may be much smaller than perceived. As such, we believe efforts should be made to conduct thorough population surveys of the long-tailed macaques throughout their range in Indonesia. Our preliminary survey, reported here, is just the first step in an ongoing effort to confirm the locations of long-tailed macaque presence thereby helping to "fill-in-the-blanks" regarding their distribution as we move ahead with plans to conduct an island-wide survey of the long-tailed macaque in Java.

It is well known that roadside counts used by Southwick and Siddiqi (1994) and Kyes et al. (2011) typically result in biased estimates of density, either due to avoidance or attraction to roads. In fact, both Southwick and Siddiqi (1994) and Kyes et al. (2011) call for improved population surveys of *M. fascicularis*, and their interpretations do not justify making strong conclusions based on existing biased estimates.

Nijman et al. (2023) and Hansen et al. (2022) fail to acknowledge the express limitations and bias contained in Southwick and Siddiqi (1994) and Kyes et al. (2011), as well as the high degree of uncertainty in the estimated trends in *M. fascicularis* population size. This lack of transparency by Nijman et al. (2023) and Hansen et al. (2022) calls in to question the reliability of these reviews.

Summary

NABR reviewers are both surprised and dismayed with responses received from Nijman et al. (2023) during the informal resolution process, as well as statements contained in Hansen et al. (2022) that clearly conflict with published literature. The key points raised by NABR reviewers were either not directly addressed by Nijman et al. (2023) or were summarily dismissed without any substantive response.

Based on the lack of substantive responses received during the informal resolution process, NABR reviewers conclude that the authors of Nijman et al. (2023) and Hansen et al. (2022) have not reached objective scientific conclusions regarding the status of *M. fascicularis* as required by IUCN criteria, and more importantly, scientific ethical standards.

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