



# Kent Academic Repository

**Murphy, Asia J., Ferguson, Barry and Gardner, Charlie J. (2017) *Recent Estimates of Ring-Tailed Lemur (*Lemur catta*) Population Declines are Methodologically Flawed and Misleading*. International Journal of Primatology, 38 (4). pp. 623-628. ISSN 0164-0291.**

## Downloaded from

<https://kar.kent.ac.uk/62118/> The University of Kent's Academic Repository KAR

## The version of record is available from

<https://doi.org/10.1007/s10764-017-9967-8>

## This document version

Author's Accepted Manuscript

## DOI for this version

## Licence for this version

UNSPECIFIED

## Additional information

## Versions of research works

### Versions of Record

If this version is the version of record, it is the same as the published version available on the publisher's web site. Cite as the published version.

### Author Accepted Manuscripts

If this document is identified as the Author Accepted Manuscript it is the version after peer review but before type setting, copy editing or publisher branding. Cite as Surname, Initial. (Year) 'Title of article'. To be published in *Title of Journal*, Volume and issue numbers [peer-reviewed accepted version]. Available at: DOI or URL (Accessed: date).

## Enquiries

If you have questions about this document contact [ResearchSupport@kent.ac.uk](mailto:ResearchSupport@kent.ac.uk). Please include the URL of the record in KAR. If you believe that your, or a third party's rights have been compromised through this document please see our [Take Down policy](https://www.kent.ac.uk/guides/kar-the-kent-academic-repository#policies) (available from <https://www.kent.ac.uk/guides/kar-the-kent-academic-repository#policies>).

1 **Recent estimates of ring-tailed lemur (*Lemur catta*) population declines are**  
2 **methodologically flawed and misleading**

3

4 Short title: Recent estimates of ring-tailed lemur decline misleading

5           Conserving and managing threatened species requires accurate population  
6 estimates. Recently, LaFleur et al. (2017) and Gould and Sauther (2016) attempted to  
7 estimate the size of the extant ring-tailed lemur (*Lemur catta*) population based on rapid  
8 field assessments and published counts from 32 and 34 sites, respectively, and estimated  
9 there to be fewer than 2,500 ring-tailed lemurs remaining in the wild (Gould & Sauther,  
10 2016: 2,000-2,400 individuals; LaFleur et al., 2017: 2,200 individuals). However, both  
11 studies have likely severely underestimated the size of the extant ring-tailed lemur  
12 population due to a range of methodological problems. Specifically, i) the population  
13 status of several sites was misinterpreted from the literature, ii) population estimates for  
14 several important sites are incomplete or lacking, and iii) total population estimates are  
15 based on an incomplete sample of known populations.

16

#### 17 *Misinterpretation of Literature*

18           Both studies depend primarily on published records; however, the data on  
19 presence and/or abundance of ring-tailed lemurs extracted from prior studies were  
20 misinterpreted or mischaracterized in several instances. For example, Gould and Sauther  
21 (2016) cite Gardner et al. (2009) to state that ring-tailed lemurs are likely extirpated from  
22 the Fiheranana-Manombo Complex (PK32 Ranobe). However, Gardner et al. (2009, p.  
23 41) did record the species in both the Fiherenana and Manombo valleys and state: “Our  
24 failure to record [this] species elsewhere should therefore not be interpreted as implying  
25 their absence in other areas of the PA...”. Additionally, Gould and Sauther (2016) claim  
26 that there are three ring-tailed lemur groups in Nord-Ifotaka based on Semel and  
27 Ferguson (2013), although Semel and Ferguson (2013) was focused on characterizing the

28 use of cliffs by lemurs, and not on surveying the ring-tailed lemur population. LaFleur et  
29 al. (2017) cite Irwin et al. (2005) for evidence that ring-tailed lemurs are extirpated from  
30 Pic d'Ivohibe and Kalambatritra, yet the latter paper reports a multi-site census that i) did  
31 not include Pic d'Ivohibe, and ii) did not census the areas of Kalambatritra where ring-  
32 tailed lemurs are thought to occur. Finally, LaFleur et al. (2017) cite Moniac and  
33 Heitmann (2007) to estimate Andohahela's ring-tailed lemur population at 82 individuals:  
34 however, this publication is merely an observation of two hunted lemurs within a pit near  
35 the National Park, and we were unable to determine the origin of the figure 82.

36

### 37 *Incomplete Sampling within Survey Sites*

38         Of the sites included in the papers, counts/population estimates are incomplete or  
39 lacking for many important areas. For example, Gould and Sauther (2016) include no  
40 data for several protected areas with well-known populations including Isalo and  
41 Zombitse-Vohibasia National Parks. In addition both surveys consistently use count data  
42 from limited survey localities, but present these data as population estimates for entire  
43 protected areas. Thus, the figures likely represent severe underestimates of the population  
44 sizes at these sites. For example, Tsimanampesotse National Park covers over 200,000  
45 ha, yet the population data presented are based on counts at two locations only and are  
46 not extrapolated for the whole National Park (LaFleur et al., 2017).

47

### 48 *Incomplete Geographic Coverage of Sites Considered*

49         The two studies' total population estimates were derived from 32 and 34 sites  
50 each, rather than systematic range-wide censuses or models, but these sites form an

51 incomplete and potentially unrepresentative sample of known ring-tailed lemur  
52 populations. Over 100 ring-tailed lemur populations are known historically (Goodman et  
53 al., 2006), and we are aware of at least 45 localities at which the species has been  
54 observed since 2000, but which were not included in either of the recent studies or were  
55 erroneously included as extirpated (Table 1; Appendix 1). Beyond these known  
56 populations, large areas of suitable habitat occur throughout southern Madagascar that  
57 have never been censused (Appendix 1). While LaFleur et al. (2017) acknowledge their  
58 total population estimate as being limited to surveyed sites, Gould and Sauther (2016, p.  
59 94) state that their research “represents all *known* populations”, and misleadingly present  
60 their estimate of 2,000-2,400 individuals as the total wild population of the species  
61 globally. Gould and Sauther (2016) also propose a new distribution map for the species,  
62 but omit vast areas of unsurveyed suitable habitat without presenting any evidence for  
63 their assumption that these areas are devoid of ring-tailed lemurs: of our 45 additional  
64 localities, about half (n=23) lie outside of their suggested distribution areas.

65

## 66 *Conclusion*

67 As both LaFleur et al. (2017) and Gould and Sauther (2016) highlight, there is  
68 ample evidence that the ring-tailed lemur has suffered population declines, local  
69 extinctions and an overall range contraction in recent decades. However the species  
70 continues to occur in at least 18 protected areas (Ambatotsirongorongo, Amoron’ny  
71 Onilahy, Ankodida, Analavelona, Andohahela, Andringitra, Angavo, Behara-Tranomaro,  
72 Beza-Mahafaly, Complexe Anadabolava, Complexe Mangoky-Ihotry, Kirindy-Mite,  
73 Mikea, Nord-Ifotaka, Ranobe-PK32, Tsinjoriake, Tsimanampesotse, Zombitse-

74 Vohibasia) as well as community-managed and private reserves, and is protected by  
75 robust cultural norms (*fady/faly*) that prevent its consumption by people through much of  
76 its range. Therefore we do not believe that the species is “headed for imminent  
77 extirpation” as suggested by Gould and Sauther (2016, p. 89). Rather, we believe that  
78 both studies have likely greatly overstated the severity of the species’ decline. LaFleur et  
79 al. (2017) suggest there may have been a 95% decline in the ring-tailed lemur population  
80 since 2000 by comparing their estimate to that of Sussman et al. (2006). However, both  
81 Sussman et al. (2006, p. 17) and LaFleur et al. (2017, p. 320) characterize their estimates  
82 as “preliminary”. Given the numerous caveats associated with both studies and their use  
83 of very different methods, the figure of 95% decline cannot be considered valid or  
84 reliable.

85         The use of unreliable scientific data in conservation can lead to suboptimal  
86 decision-making and may also undermine the credibility that scientists and  
87 conservationists depend on for public confidence in our findings and actions. Recent  
88 online headlines such as “Ring-tailed lemur populations have crashed by 95%” (Platt  
89 2017), generated by the research under discussion, are misleading and risk delegitimizing  
90 and undermining critical conservation and research efforts throughout Madagascar at a  
91 time when they are required more than ever. If population estimates are to be generated to  
92 inform the conservation of threatened primate species, then they must be based on  
93 rigorous census methods, robust density estimates (not counts of individuals), and make  
94 full use of existing knowledge of species’ range to ensure accurate and reliable  
95 assessments.

96

97 *Acknowledgements*

98 We would like to thank the editor, the anonymous reviewer, and, in particular, Mitchell  
99 Irwin for his very useful review; the manuscript was improved immensely thanks to his  
100 comments and insight. We would also like to thank Zach Farris for his encouragement to  
101 the first author in the process of submitting the manuscript.

102 Literature Cited

103

104 Gardner, C. J., Fanning, E., Thomas, H., & Kidney, D. (2009). The lemur diversity of the  
105 Fiherenana-Manombo Complex, southwest Madagascar. *Madagascar*  
106 *Conservation & Development*, 4(1), 38–43.

107 Goodman, S. M., Rakotoarisoa, S. V., & Wilmé, L. (2006). The distribution and  
108 biogeography of the ringtailed lemur (*Lemur catta* ) in Madagascar. In A. Jolly,  
109 R.W. Sussman, N. Koyama, & H. Rasamimanana (Eds.), *Ringtailed Lemur*  
110 *Biology* (pp. 3–15). New York, NY: Springer.

111 Gould, L., & Sauther, M. L. (2016). Going, going, gone... Is the iconic ring-tailed lemur  
112 (*Lemur catta*) headed for imminent extirpation? *Primate Conservation* 30, 89–  
113 101.

114 Irwin, M. T., Johnson, S. E. & Wright, P. C. (2005). The state of lemur conservation in  
115 southeastern Madagascar: population and habitat assessments for diurnal and  
116 cathemeral lemurs using surveys, satellite imagery and GIS. *Oryx* 39, 204–218.

117 LaFleur, M., Clarke, T. A., Reuter, K., & Schaeffer, T. (2017). Rapid decrease in  
118 populations of wild ring-tailed lemurs (*Lemur catta*) in Madagascar. *Folia*  
119 *Primatologica* 87, 320–330.

120 Moniac, N., & Heitmann, A. (2007). *Lemur catta* and hunting around Andohahela.  
121 *Lemur News* 12, 11.

122 Platt, J. R. (2017). Ring-tailed lemur populations have crashed by 95 percent. Scientific  
123 American Blogs. [https://blogs.scientificamerican.com/extinction-countdown/ring-](https://blogs.scientificamerican.com/extinction-countdown/ring-tailed-lemur-crashe/)  
124 [tailed-lemur-crashe/](https://blogs.scientificamerican.com/extinction-countdown/ring-tailed-lemur-crashe/). Accessed 20 January 2017.

125 Semel, B. P., & Ferguson, B. 2013. Ring-tailed lemurs (*Lemur catta*) using cliffs as  
126 sleeping sites. *Lemur News* 17, 4-6.

127 Sussman, R. W., Sweeney, S., Green, G. M., Porton, I., Andrianasolondraibe, O. L., &  
128 Ratsirarson, J. (2006). A preliminary estimate of *Lemur catta* population density  
129 using satellite imagery. In A. Jolly, R.W. Sussman, N. Koyama, & H.  
130 Rasamimanana (Eds.), *Ringtailed Lemur Biology* (pp. 16–31). New York, NY:  
131 Springer.

132

133 Table 1. Additional known locality records for ring-tailed lemur (*Lemur catta*) since 2000  
 134 that were not included in the population estimates published by Gould and Sauther (2016)  
 135 and LaFleur et al (2017). See Supplementary Materials for map of locations and  
 136 references (Appendices 1 and 2).

No.	Locality	Source	Coordinates
1	Ankotapiky (Mikea)	Ganzhorn & Randriamanalina 2004	21°52'09.3"S, 43°21'16.1"E
2	Abrahama-Jiloriaky (Mikea)	Ganzhorn & Randriamanalina 2004	22°48'1"S, 43°25'6"E
3	Middle Mangoky 1	Ravoahangy et al 2008	21°41'14"S, 44°19'45"E
4	Middle Mangoky 2	Ravoahangy et al 2008	21°48'52"S, 44°08'24"E
5	Manombo	Gardner et al 2009	22°48'16"S, 43°45'38.7"E
6	Fiherenana	Gardner et al 2009	23°10'28.2"S, 43°57'42.2"E
7	Analavelona	Ravoahangy et al. 2008	22°40'40"S, 44°11'30"E
8	Lavenombato	C. Gardner & L. Jasper pers. obs.	23°34'52.93"S, 43°49'57.24"E
9	Antafoky	Emmett et al. 2003	23° 29'12.79"S, 44°4'26.52"E
10	Manderano	Emmett et al. 2003	23° 31'46.15"S, 44°5'31.27"E
11	Sept Lacs	Emmett et al. 2003 ; C. Gardner & L. Jasper pers. Obs.	23° 31'23.79"S, 44°9'38.34"E
12	Ranomay	C. Gardner & L. Jasper	23°34'28.73"S,

---

		pers. obs.	44°19'41.53"E
13	Vombositse	Ralison 2008	24°11'3"S, 43°45'9"E
14	Antabore (Itampolo)	Ralison 2008; Raselimanana et al. 2005	24°23'9"S, 43°50'8"E
15	Tongaenoro (Itampolo)	Ralison 2008; Raselimanana et al. 2005	24°44'2"S, 44°01'8"E
16	Vohindefo	L. Jasper pers. obs.	25° 10'15.07"S, 44°32'8.32"E
17	Ankirikiriky Village (Marolinta)	B. Ferguson pers. obs.	25° 5'56.38"S, 44°37'3.07"E
18	Ankirikiriky Sacred Forest (Marolinta)	B. Ferguson pers. obs.	25° 5'11.88"S, 44°37'15.40"E
19	Main Road near Tsimilofo (Beloha)	B. Ferguson pers. obs.	24°57'7.18"S, 45°10'15.67"E
20	Vohipary (Andalatanosy)	B. Ferguson pers. obs. Sterman (2012)	24°36'8.14"S, 45°33'17.81"E
21	Vohitrosy, Elonty (Dadabe Matory)	B. Ferguson pers. obs.	24° 5'39.35"S, 46°10'20.54"E
22	Besakoa Ambany (Mahaly)	B. Ferguson pers. obs.	24°13'9.71"S, 46°14'16.52"E
23	Vohidava North (Anadabolava)	B. Ferguson pers. obs.	24°13'30.11"S, 46°16'18.63"E
24	Anadabolava 1	Ravoahangy et al 2008	24°12'38"S, 46°18'02"E
25	Anadabolava 2	Ravoahangy et al 2008	24°21'20"S, 46°10'51"E

---

---

26	Mitakeba Village (Imanombo)	B. Ferguson pers. obs.	24°34'52.07"S, 45°52'58.05"E
27	Vohitsiombe West (Kapila)	B. Ferguson pers. obs. Sass (2011)	24°25'22.18"S, 46° 6'9.87"E
28	Vohitsiombe East (Ebelo)	B. Ferguson pers. obs.	24°25'16.22"S, 46° 7'16.95"E
29	Betenina Andranobe (Tranomaro)	B. Ferguson pers. obs.	24°26'11.69"S, 46°24'42.26"E
30	Angavo East (Antanimora)	Rowland et al (2011)	24°52'1.60"S, 45°49'50.23"E
31	Angavo South West 1 (Antanimora)	Rowland et al (2011)	24°53'24.13"S, 45°48'38.93"E
32	Angavo South West 2 (Antanimora)	Rowland et al (2011)	24°54'44.02"S, 45°47'41.96"E
33	Kobokara (Ifotaka)	B. Ferguson pers. obs. Scherz et al (2012)	24°44'58.75"S, 46° 2'33.16"E
34	Ankazonampingaritse (Mahabo)	B. Ferguson pers. obs.	24°41'9.10"S, 46° 8'29.33"E
35	Befinenetse (Ifotaka)	B. Ferguson pers. obs.	24°45'5.60"S, 46° 9'40.79"E
36	Anjatsikolo Vohimamy (Ifotaka)	B. Ferguson pers. obs.	24°45'39.86"S, 46°10'16.39"E
37	Zanavo (Ifotaka)	B. Ferguson pers. obs.	24°48'25.29"S, 46° 4'22.15"E

---

---

38	Ambolihena (Ifotaka)	B. Ferguson pers. obs.	24°47'42.77"S, 46° 8'31.59"E
39	Betamboro (Ifotaka SW)	King et al (2011)	24°53'15.52"S, 46° 3'55.70"E
40	Behira (Bebarimo)	B. Ferguson pers. obs.	24°51'46.68"S, 46°12'22.07"E
41	Vohondava (Tranomaro)	Ralison 2008; Raselimanana et al. 2005	24°41'2"S, 46°27'2"E
42	Ampiaky Tsilamaha (Tranomaro)	B. Ferguson pers. obs.	24°43'14.57"S, 46°29'56.44"E
43	Bevia Gallery Forest (Behara)	Denton 2003	24°50'56.32"S, 46°26'52.70"E
44	Bevia Spiny Forest (Behara)	Denton 2003	24°51'26.24"S, 46°27'58.60"E
45	Ankodida (Amboasary Sud)	Gardner et al. 2008; B. Ferguson pers. obs.	25° 2'37.60"S, 46°30'51.71"E

---

137

138

139 Appendix 1. Google Earth image of southern Madagascar showing 45 localities at which  
140 ring-tailed lemurs (*Lemur catta*) have been recorded since 2000, but which were not  
141 included in the population estimates of LaFleur et al (2017) or Gould and Sautner (2016),  
142 or where the species was erroneously stated to be extirpated.



143

144

145 Appendix 2. References for location records in Table 1.  
146  
147 Denton, B. (2003) University of East Anglia Expedition to Bevia, Madagascar: Final  
148 report. Unpublished Report, University of East Anglia, Norwich.  
149  
150 Emmett, D.A., Fanning, E. and Olsson, A. (2003) The proposed Parc Regional de  
151 Belomotse: biodiversity survey and conservation evaluation. Frontier, London.  
152  
153 Ganzhorn, J.U. and Randriamanalina, M.H. (2004) Les lémuriens de la forêt de Mikea. In  
154 A.P. Raselimanana and S.M. Goodman (eds.) Inventaire Floristique et Faunistique de la  
155 Forêt de Mikea: Paysage Écologique et Diversité Biologique d'une Préoccupation  
156 Majeure pour la Conservation, pp 87-93. Recherches pour le Développement. Série  
157 Sciences Biologiques. Centre d'Information et de Documentation Scientifique et  
158 Technique, Antananarivo 21.  
159  
160 Gardner, C.J., Ferguson, B., Rebara, F. and Ratsifandrihamanana, A.N. (2008)  
161 Integrating traditional values and management regimes into Madagascar's expanded  
162 protected area system: the case of Ankodida. In J.M. Mallarach (ed) Protected  
163 Landscapes and Cultural and Spiritual Values, pp. 92–103. Kasperek Verlag, Heidelberg.  
164  
165 Gardner, C.J., Fanning, E., Thomas, H. and Kidney, D. (2009) The lemur diversity of the  
166 Fiherenana-Manombo Com-plex, southwest Madagascar. Madagascar Conservation &  
167 Development 4: 38–43.

168

169 King, P. et al. (2011) Final Report from University of Brighton Expedition to South West  
170 Ifotaka, Madagascar, Unpublished Report, University of Brighton, Brighton.

171

172 Ralison, J.M. (2008) Les lémuriens des forets sèches malgaches. In S.M. Goodman & L.  
173 Wilmé (eds) Les Forêts Sèches de Madagascar. Malagasy Nature 1: 135–156.

174

175 Raselimanana, A.P., Raherilalaon, M.J., Soarimalala, V. and Ralison, J. (2005) Faune de  
176 vertébrés des zones forestières des régions du sud-ouest et du sud de Madagascar:  
177 diversité, distribution, menaces et conservation. WWF/RAP-Gasy, Antananarivo.

178

179 Ravoahangy, A., Andriamaharoa, H.E., Randrianaina, L.A., Josso, A.T.S.,  
180 Raharimampionona, J. and Birkinshaw, C. (2008) Preliminary inventory of lemurs at ten  
181 Priority Sites for Plant Conservation. Lemur News 13: 40–43.

182

183 Rowland, N. et al. (2011) Final Report from University of Edinburgh Expedition to  
184 Angavo, Madagascar. Unpublished Report, University of Edinburgh, Edinburgh.

185 Sass, E. (2011) Survey of Rare Plants and Lemurs of Vohitsiombe. Unpublished Report,  
186 School for International Training, Fort Dauphin.

187

188 Scherz, M., May, M., Taylor, J., Smith, N.J., tsiafa, H.A., danvi, M.T., Rakotomalala, M.  
189 and Rabamazaka, J. (2012) Madagascar 2011: project Kobokara Final report.  
190 Unpublished Report, University of Edinburgh, Edinburgh.

191

192 Sterman, S. (2012) Biodiversity Reconnaissance of Vohipary Mountain. Unpublished

193 Report, School for International Training, Fort Dauphin.

194