



Title	Seroprevalence of filovirus infection of <i>Rousettus aegyptiacus</i> bats in Zambia
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1 **Seroprevalence of filovirus infection of *Rousettus aegyptiacus* bats in Zambia**

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48

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58 **Abstract**

59 Bats are suspected to play important roles in the ecology of filoviruses, including ebolaviruses
60 and marburgviruses. A cave-dwelling fruit bat, *Rousettus aegyptiacus*, has been shown to be a
61 reservoir of marburgviruses. Using an enzyme-linked immunosorbent assay with the viral
62 glycoprotein antigen, we detected immunoglobulin G antibodies specific to multiple filoviruses
63 in 158 of 290 serum samples of *R. aegyptiacus* bats captured in Zambia during the years 2014-
64 2017. In particular, 43.8% of the bats were seropositive to marburgvirus, supporting the notion
65 that this bat species continuously maintains marburgviruses as a reservoir. Interestingly,
66 distinct peaks of seropositive rates were repeatedly observed at the beginning of rainy seasons,
67 suggesting seasonality of the presence of newly infected individuals in this bat population.
68 These data highlight the need for continued monitoring of filovirus infection in this bat species
69 even in countries where filovirus diseases have not been reported.

70 **Keywords:** Filovirus; Ebolavirus; Marburgvirus; Antibody; Fruit bats; Ebola virus; Marburg
71 virus; ELISA; *Rousettus aegyptiacus*

72

73 **BACKGROUND**

74 Marburgviruses and ebolaviruses belonging to the family *Filoviridae* cause severe
75 hemorrhagic fever in humans and nonhuman primates. In contrast to the genus *Marburgvirus*,
76 which contains only one known species, *Marburg marburgvirus* consisting of Marburg virus
77 (MARV) and Ravn virus (RAVV), five distinct species are known in the genus *Ebolavirus*;
78 *Zaire ebolavirus*, *Sudan ebolavirus*, *Taï Forest ebolavirus*, *Bundibugyo ebolavirus*,
79 and *Reston ebolavirus*, represented by Ebola virus (EBOV), Sudan virus (SUDV), Taï Forest
80 virus (TAFV), Bundibugyo virus (BDBV), and Reston virus (RESTV), respectively. In
81 addition, a new filovirus named Lloviu virus (LLOV), as yet not known to cause any disease
82 in humans or non-human primates, was discovered in bats and assigned to the new genus
83 *Cuevavirus*, species *Lloviu cuevavirus* [1, 2].

84 While previous studies have suggested that these filoviruses infect several different
85 species of animals, some species of fruit bats are suspected to be natural reservoirs of
86 filoviruses [3]. The EBOV genome was detected in fruit bats (*Epomops franqueti*,
87 *Hypsipnathus monstrosus*, and *Myonycteris torquata*) [4], whereas infectious ebolaviruses
88 have never been isolated from any species of fruit bats. However, some populations of
89 *Rousettus aegyptiacus* bats (Egyptian fruit bats) have been shown to maintain both MARV and
90 RAVV [5-7]. It was also reported that some of the bats were seropositive for EBOV [8].
91 Egyptian fruit bats are widely distributed within Africa, including in non-endemic countries
92 like Zambia. Experimental infection of Egyptian fruit bats with MARV demonstrated viraemia,
93 viral antigens in numerous tissues, seroconversion and horizontal transmission of the virus
94 while they remained clinically healthy [9-13].

95 In the present study, we focused on cave-dwelling Egyptian fruit bats, which could
96 potentially be infected with filoviruses, as suggested by previous studies [5-8]. We detected
97 filovirus-specific immunoglobulin G (IgG) antibodies using viral glycoprotein (GP) antigens

98 of all known filovirus species. This paper presents the results of a three-year genetic and
99 serological survey for filoviruses in these bats in Zambia.

100 **METHODS**

101 **Animals and sera**

102 Serum and tissue samples were collected from wild healthy cave-dwelling Egyptian
103 fruit bats (119 males and 171 females) caught by harp traps in Lusaka Province in Zambia from
104 December 2014 to December 2017 (Supplementary Table 1). Captured bats were euthanized
105 with diethyl ether, and samples were collected for antibody detection and reverse-transcription
106 polymerase chain reaction (RT-PCR) assays. All these activities were performed under the
107 aegis of the research project “Molecular and Serological Surveillance of Viral Zoonoses in
108 Zambia” approved by the Department of National Parks and Wildlife (formerly Zambia
109 Wildlife Authority), Ministry of Tourism and Arts of the Republic of Zambia (Act No. 12 of
110 1998).

111 **Enzyme-linked immunosorbent assay (ELISA)**

112 Filovirus envelope GP and nucleoprotein (NP)-based ELISA was performed as
113 described previously [14, 15]. His-tagged soluble recombinant GPs of EBOV (Yambuku),
114 SUDV (Nzara), TAFV (Pauléoula), BDBV (Butalya), RESTV (Philippines89), MARV
115 (Angola), RAVV (Kitum Cave), and LLOV (Asturias) were purified from the supernatants of
116 human embryonic kidney 293T cells transfected with pCAGGS expressing each GP. The
117 recombinant NP of MARV (Mt. Elgon) was purified by ultracentrifugation through
118 discontinuous CsCl gradient centrifugation using the lysate of 293T cells transfected with
119 pCAGGS expressing NP as described previously [16]. ELISA plates (Nunc, Maxisorp) were
120 coated with purified filovirus antigens (2 µg/ml in phosphate-buffered saline, 50 µl/well)
121 overnight at 4°C, followed by blocking with 3% skim milk, and serum samples (diluted at

122 1:100) were added. Bound antibodies were visualized with a goat anti-bat IgG heavy and light
123 chain antibody conjugated with horseradish peroxidase (Bethyl Laboratories, Inc.) and
124 3,3',5,5'-tetramethylbenzidine (Sigma). The reaction was stopped by adding 1N phosphoric
125 acid, and the optical density (OD) at 450 nm was measured. To offset the nonspecific antibody
126 reaction, the OD value of the control antigen was subtracted from that of each sample. Assays
127 were conducted in duplicate and averages were used for further data analyses.

128 **Reverse transcription polymerase chain reaction (RT-PCR)**

129 RT-PCR assays were performed as described previously [7, 15, 17, 18]. Briefly, total
130 RNA was extracted from pooled 10% (w/v) spleen and liver homogenates of individual bats
131 using a QIAamp Viral RNA Mini Kit (QIAGEN) according to the manufacturer's instructions.
132 One-step RT-PCR assays were carried out using a QIAGEN OneStep RT-PCR kit (QIAGEN)
133 according to the manufacturer's instructions. The filovirus-specific universal primers for
134 detection of the NP gene, FiloNP-Fm, FiloNP-Rm, FiloNP-Fe, and FiloNP-Re, were used for
135 the one-step RT-PCR program as described previously [18]. Nested RT-PCR assays for virus
136 protein 35 (VP35) and NP genes of marburgvirus were also performed using primers F1
137 (forward-outside), F3 (forward-inside), R1 (reverse-outside), and R2 (reverse-inside) for the
138 VP35 gene and MBG704F1 (forward-outside), MBG719F2 (forward-inside), MBG1248R1
139 (reverse-outside), and MBG1230R2 (reverse-inside) for the NP gene as described previously
140 [7, 17].

141 **Statistics**

142 For the cutoff value, the Smirnov-Grubbs rejection test, which is widely used to detect
143 significantly higher or lower values (i.e., outliers) that do not belong to the population
144 consisting of all other values in the data set, were employed as described previously [15, 19].
145 Briefly, the highest OD value was first selected, and the statistical significance of the *T* value
146 was calculated based on the critical values given by the Smirnov-Grubbs test. If it was

147 considered to be an outlier, the T -value for the second highest OD value was then similarly
148 tested without the highest one. These steps were repeated until the T value fell to below the
149 level of statistical significance ($P < 0.05$) and the cutoff OD values were determined. The
150 correlation coefficient was determined by Pearson's method.

151 **RESULTS**

152 **Serological and genetic screening of Egyptian fruit bats for filovirus infection**

153 Two hundred ninety Egyptian fruit bat serum samples were screened for IgG antibodies
154 specific to all known species of filoviruses (Supplementary Figure 1), and the OD values
155 obtained by the GP-based ELISA were analyzed statistically to determine the cutoff OD value
156 as described in Methods. Samples that showed OD values above the cutoff value for at least
157 one filovirus species were regarded as positive. When a sample showed cross-reactivity to GPs
158 of multiple species, the OD values for each GP antigen were compared and the filovirus species
159 that gave the highest OD value was selected for each positive sample [15, 19]. We found that
160 158 of 290 bats tested in this study were positive for anti-filovirus antibodies (Figure 1).
161 However, viral RNA genomes were not detected in any of the tested samples.

162 **Specificity of serum IgG antibodies detected in fruit bats**

163 The specificity of the positive samples to each filovirus species is summarized in Table
164 1. Among the 158 ELISA-positive samples, 127 had the highest reactivity to the MARV GP
165 antigen. The overall seroprevalence of MARV among the tested bat population was 43.8%
166 (127 of 290 individuals). MARV-specific IgG antibodies were constantly detected in Egyptian
167 fruit bats in Zambia during the research period (2014-2017). Serum samples reactive to the
168 other filovirus GPs were also found except for EBOV GP. In total, 3.8% (11 of 290), 2.8% (8
169 of 290), 1.0% (3 of 290), 2.8% (8 of 290), and 0.3% (1 of 290) of the serum samples showed
170 the highest reactivity to SUDV, TAFV, BDBV, RESTV, and LLOV antigens, respectively

171 (Table 1 and Supplementary Table 2). There was no significant difference between male and
172 female bats for seropositivity (data not shown).

173 To further confirm the specificity to MARV, serum samples were also analyzed by NP-
174 based ELISA (Figure 2A, B) and the correlation of the OD values given by GP and NP antigens
175 was analyzed. We found that the OD values obtained in MARV GP and NP ELISA had a
176 positive correlation (correlation coefficient $r = 0.48$). Since no correlation was observed
177 between the OD values obtained in MARV GP and EBOV NP ELISA ($r = 0.09$), the positive
178 correlation of the reactivity to MARV GP and NP antigens strongly suggested that these bats
179 were predominantly infected with MARV. It was also found that most of the MARV GP-
180 positive serum samples were less reactive to RAVV GP (Figure 2C), suggesting that the
181 Egyptian fruit bat population in this cave might be mostly infected with MARV but not RAVV
182 during the research period. However, due to the nature of this assay (i.e., potential differences
183 in the specificity and sensitivity to each GP) and crossreactivity of anti-GP antibodies,
184 specificity of detected antibodies could not be conclusively determined.

185 **Seasonal patterns and maternal antibodies associated with the seroprevalence**

186 To understand the seasonal pattern of filovirus infection related to the reproductive
187 cycle of Egyptian fruit bats in Zambia, serological data were analyzed for each sampling date
188 and body weight range (Figure 3). We found that the seroprevalence of filoviruses, including
189 MARV, peaked in November to December and then decreased in January and February (Figure
190 3A, B). Interestingly, our field observations indicated that Zambian bats gave a birth once a
191 year in November/December, as has been reported in South Africa [20], suggesting a possible
192 link between the seroprevalence and reproductive cycle of Egyptian fruit bats in Zambia.
193 Moreover, the high seroprevalence in bats weighing less than 50 g indicated that these pups
194 passively acquired virus-specific maternal antibodies from seropositive mothers (Figure 3C,
195 D). The seroprevalence was lowest in the bats with body weights ranging from 51 to 60 g and

196 gradually increased as they grew, which likely reflects the disappearance of their maternal
197 antibodies and subsequent infection of young bats.

198 **DISCUSSION**

199 Despite numerous epidemiological studies, the ecology of filoviruses, such as the
200 natural reservoirs, transmission modes, and geographical distribution, remains largely
201 unknown. Infectious ebolaviruses have never been isolated from any bat species, and there is
202 only one report showing that a partial genome of EBOV was detected in 3 species of fruit bats
203 in the Central African region [4]. In contrast, it has been shown that MARV and RAVV are
204 maintained in large populations of Egyptian fruit bats in Uganda [7]. However, epidemiological
205 information on filovirus infections outside endemic areas is quite limited. In the present study,
206 we conducted serological investigations of cave-dwelling Egyptian fruit bats sampled in
207 Zambia.

208 The overall seroprevalence of filovirus infection was very high (54.5%) in the bats
209 tested in this study (Table 1). The majority of seropositive samples were specific to the MARV
210 antigen. The high seroprevalence of MARV infection may suggest that this virus is circulating
211 in Egyptian fruit bat colonies in Zambia. Although Zambia has never had a recognized human
212 case of Marburg virus disease, it is not surprising that the virus has existed in the country, since
213 Zambia lies within the modelled zoonotic niche of Marburg virus disease including
214 neighboring countries with reported outbreaks of the disease such as Angola, Zimbabwe, and
215 Democratic Republic of Congo [21]. Our data support the hypothesis that Egyptian fruit bats
216 act as a natural reservoir of MARV even in the Southern African region.

217 There was a distinct peak in the seroprevalence of filoviruses, as well as to MARV
218 specifically, at the beginning of every rainy season during the research period (Figure 3A, B).
219 The repeated pulses of the seroprevalence in November/December suggest that MARV has

220 been maintained in the Egyptian fruit bat population in Zambia. In a previous study in Uganda,
221 Amman et al. [7] demonstrated that seasonal pulses of MARV infection in Egyptian fruit bats
222 coincided with biannual reproductive seasons of the bats when the population of old juveniles
223 (approximately 4-6 months old) increased in the colonies [7]. However, this transmission
224 manner seems unsuitable for the Zambian population of Egyptian fruit bats that give a birth
225 once a year in November/December. Experimental infection of the bats with MARV induced
226 virus-specific IgG antibodies that peaked by 28 days post-infection and rapidly declined by 3
227 months [13]. Considering the 2-3 months duration of the presence of detectable virus-specific
228 antibodies, it is speculated that active transmission of MARV in the studied bat colony likely
229 occurs from August to October (i.e., a few months before the peak seropositivity) in Zambia.
230 It is also worth noting that newborn pups might efficiently acquire maternal antibodies as
231 shown in Figure 3. The increased proportion of immunologically naive bats due to the decline
232 of maternal antibodies might trigger active transmission of the virus in the colony. Recently,
233 Schuh et al. reported that MARV was horizontally transmitted from inoculated to contact
234 Egyptian fruit bats 7 months after infection [13]. This long-term latent infection of the bats
235 may partially explain how MARV could be maintained even in an Egyptian fruit bat population
236 that has a single reproductive cycle per year. However, there is still another possibility that the
237 virus is repeatedly introduced into the Egyptian fruit bat colonies in this cave from the same or
238 different bat species migrating to this study area in some particular seasons. To understand the
239 ecology of filoviruses, particularly MARV, in Zambia, longitudinal epidemiological studies of
240 Egyptian fruit bats need to be continued.

241 It is of interest that IgG antibodies specific to RESTV and LLOV, which are thought to
242 be Asian and European filoviruses, respectively [2, 22], were detected (Figure 1, Table 1). Our
243 previous study also detected RESTV-specific antibodies in serum samples of migratory straw-
244 colored fruit bats (*Eidolon helvum*) captured in Zambia [15]. These findings suggest that

245 RESTV, LLOV, and/or uncharacterized filoviruses antigenically similar to these viruses exist
246 in Africa. Recently, partial genomes of unidentified filoviruses were detected in fruit bats in
247 China [23]. IgG antibodies specific to African ebolaviruses such as EBOV were also detected
248 in orangutans in Indonesia and fruit bats in Bangladesh [19, 24], while IgG antibodies to
249 EBOV, SUDV, TAFV, and BDBV were recently found in fruit bats in Singapore [25]. These
250 accumulated data on the filovirus ecology suggest that filoviruses are more divergent and
251 widely distributed than currently assumed.

252 Though filovirus genomic RNA was not detected, the present study strongly suggests
253 that Zambia is at risk for an outbreak of filovirus infection. This underlines the need for
254 continued surveillance of these bats as well as monitoring of wildlife and domestic animals,
255 and also for careful attention to residents living in close proximity to caves that Egyptian fruit
256 bats inhabit in Zambia.

257

258 **Supplementary Data**

259 Supplementary materials are available at The Journal of Infectious Diseases online.
260 Consisting of data provided by the authors to benefit the reader, the posted materials are not
261 copyedited and are the sole responsibility of the authors, so questions or comments should be
262 addressed to the corresponding author.

263 **Notes**

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268

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333 **Figure legends**

334 **Figure 1. Filovirus-specific immunoglobulin G (IgG) antibodies detected in the sera**
335 **collected from *Rousettus aegyptiacus* bats in Zambia.**

336 Serum samples were tested (1:100 dilution) for IgG antibodies specific for glycoproteins of
337 Ebola, Sudan, Taï Forest, Bundibugyo, Reston, Marburg, and Lloviu viruses (EBOV, SUDV,
338 TAFV, BDBV, RESTV, MARV, and LLOV, respectively) by enzyme-linked immunosorbent
339 assay. All optical density values (see Supplementary Figure 1) were subjected to the Smirnov-
340 Grubbs rejection test. For the 158 positive samples, optical density values at 450 nm (OD_{450})
341 for the filovirus antigens are shown.

342 **Figure 2. Reactivity of bat sera to marburgvirus antigens.**

343 *A* and *B*, Serum samples positive for immunoglobulin G (IgG) antibodies specific for Marburg
344 virus (MARV) glycoprotein (GP) were tested (1:100 dilution) for MARV (*A*) or Ebola virus
345 (EBOV) (*B*) nucleoprotein (NP) by enzyme-linked immunosorbent assay (ELISA). A scatter
346 plot of the optical densities at 450 nm (OD_{450}) obtained by GP- and NP-based ELISA is shown
347 with the linear regression line and the coefficient of determination, R^2 . *B*, Serum samples
348 positive for IgG antibodies specific for MARV GP were tested (1:100 dilution) for Ravn virus
349 (RAVV) GP by ELISA. A scatter plot of OD_{450} obtained by MARV and RAVV GP-based
350 ELISA is shown.

351 **Figure 3. Seropositive rates of the bats by sampling months or body weight ranges. A and**
352 ***B*, Anti-glycoprotein (GP) immunoglobulin G positive rates for all filovirus species (*A*) and**
353 **Marburg virus (MARV) (*B*) of the bats by sampling months, respectively. *C* and *D*,**
354 **Seropositive rates to all filovirus species (*C*) and MARV (*D*) of the bats by body weight ranges,**
355 **respectively.**

Table 1. Filovirus species-specificity of serum immunoglobulin G antibodies detected in *Rousettus aegyptiacus* in Zambia

Sampling	Seropositivity to the respective antigens, % (no. positive/total no.) ^a							
	EBOV	SUDV	TAFV	BDBV	RESTV	MARV	LLOV	Total
2014 Dec	0 (0/10)	10.0 (1/10)	20.0 (2/10)	0 (0/10)	0 (0/10)	60.0 (6/10)	0 (0/10)	90.0 (9/10)
2015 Jan	0 (0/66)	4.5 (3/66)	3.0 (2/66)	1.5 (1/66)	4.5 (3/66)	43.9 (29/66)	0 (0/66)	57.6 (38/66)
2015 Feb	0 (0/40)	0 (0/40)	0 (0/40)	0 (0/40)	2.5 (1/40)	27.5 (11/40)	0 (0/40)	30.0 (12/40)
2015 Jul	0 (0/26)	3.8 (1/26)	3.8 (1/26)	0 (0/26)	3.8 (1/26)	42.3 (11/26)	3.8 (1/26)	57.7 (15/26)
2015 Nov	0 (0/20)	0 (0/20)	0 (0/20)	0 (0/20)	5.0 (1/20)	85.0 (17/20)	0 (0/20)	90.0 (18/20)
2015 Dec	0 (0/22)	0 (0/22)	0 (0/22)	0 (0/22)	0 (0/22)	63.6 (14/22)	0 (0/22)	63.6 (14/22)
2016 Apr	0 (0/39)	2.6 (1/39)	2.6 (1/39)	0 (0/39)	2.6 (1/39)	33.3 (13/39)	0 (0/39)	41.0 (16/39)
2016 Dec	0 (0/4)	0 (0/4)	0 (0/4)	0 (0/4)	0 (0/4)	50.0 (2/4)	0 (0/4)	50.0 (2/4)

2017 Jul	0 (0/31)	6.5 (2/31)	0 (0/31)	0 (0/31)	3.2 (1/31)	19.4 (6/31)	0 (0/31)	29.0 (9/31)
2017 Dec	0 (0/32)	9.4 (3/32)	6.3 (2/32)	6.3 (2/32)	0 (0/32)	56.3 (18/32)	0 (0/32)	78.1 (25/32)
Total	0 (0/290)	3.8 (11/290)	2.8 (8/290)	1.0 (3/290)	2.8 (8/290)	43.8 (127/290)	0.3 (1/290)	54.5 (158/290)

^a The filovirus species for which each positive sample had the highest optical density value in the glycoprotein (GP)-based enzyme-linked immunosorbent assay was selected when a sample showed cross-reactivity to GPs of multiple species. Abbreviations, EBOV (Ebola virus), SUDV (Sudan virus), TAFV (Taï Forest virus), BDBV (Bundibugyo virus), RESTV (Reston virus), MARV (Marburg virus), and LLOV (Lloviu virus).

Figure 1

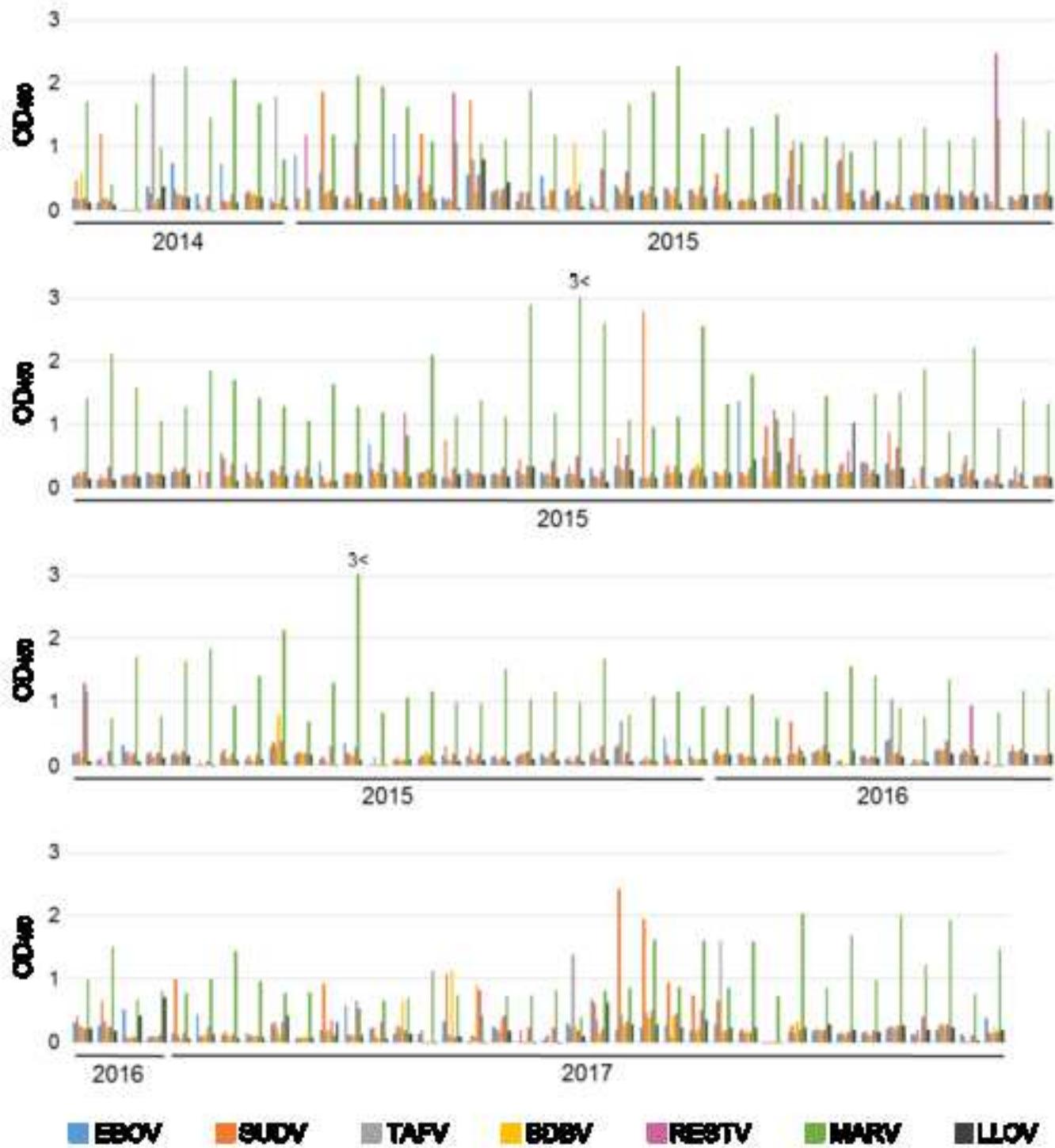


Figure 1

Figure 2

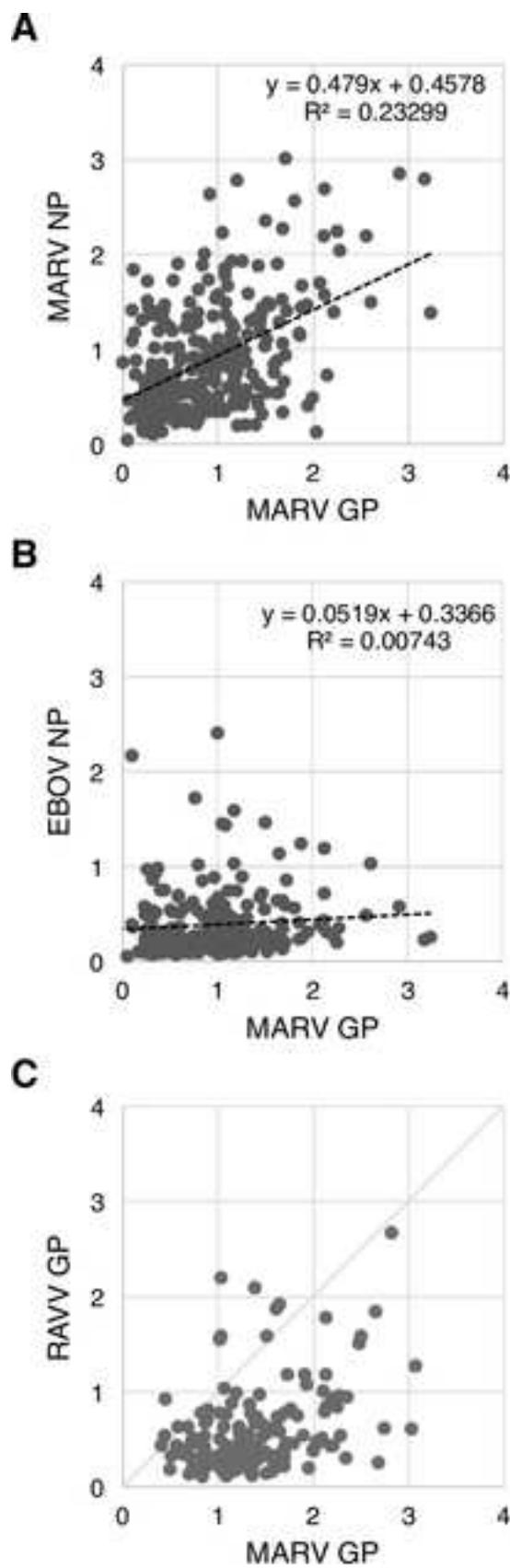


Figure 2

Figure 3

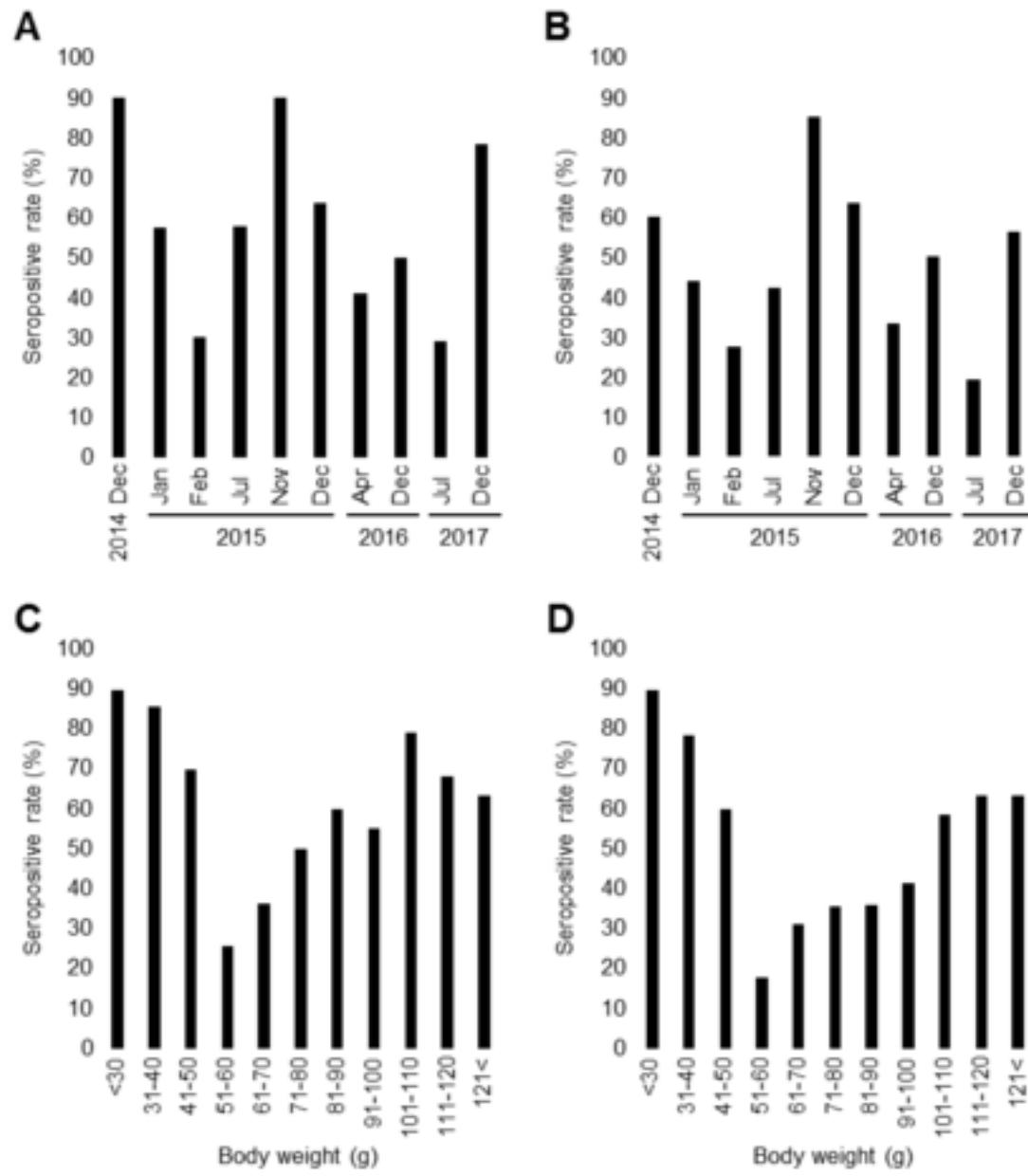


Figure 3

Supplementary Table 1. Summary of the fruit bat serum samples analyzed

Date	Province	District	No. of bats analyzed		
			Male	Female	Total
December 7, 2014	Lusaka	Chongwe	5	5	10
January 8, 2015	Lusaka	Chongwe	13	16	29
January 28, 2015	Lusaka	Chongwe	17	20	37
February 12, 2015	Lusaka	Chongwe	18	22	40
July 15, 2015	Lusaka	Chongwe	12	14	26
November 6, 2015	Lusaka	Chongwe	8	12	20
December 3, 2015	Lusaka	Chongwe	6	16	22
April 26, 2016	Lusaka	Kafue	6	10	16
April 28, 2016	Lusaka	Chongwe	7	16	23
December 7, 2016	Lusaka	Chongwe	1	3	4
July 31, 2017	Lusaka	Chongwe	12	19	31
December 4, 2017	Lusaka	Chongwe	14	18	32
Total			119	171	290

Supplementary Table 2

Sampling Date	Bat ID	Sex	Zaire	Sudan	Tai Forest	Bundibugyo	Reston	Angola	LLOV	Highest OD	Filo Positive	Angola Positive
12/7/2014	ZFB14 #122	M	0.18105	0.46875	0.16985	0.5686	0.18955	1.71115	0.1066	Angola		
12/7/2014	ZFB14 #123	M	0.11825	1.1973	0.1795	0.1935	0.15055	0.3993	0.08235	Sudan		
12/7/2014	ZFB14 #124	F	0.02945	0.88735	0.35855	-0.06685	0.01225	0.90905	-0.1138			
12/7/2014	ZFB14 #125	M	-0.2862	-0.0253	-0.22965	-0.2605	-0.1086	1.67975	-0.4082	Angola		
12/7/2014	ZFB14 #126	F	0.36795	0.26135	2.15715	0.1048	0.1778	0.98045	0.37235	Tai Forest	8/10	6/10
12/7/2014	ZFB14 #127	F	0.7353	0.34005	0.24725	0.2473	0.2196	2.2509	0.1923	Angola		
12/7/2014	ZFB14 #128	F	0.2517	0.0802	-0.0756	0.0157	0.22095	1.45835	-0.16715	Angola		
12/7/2014	ZFB14 #129	M	0.7301	0.1489	0.1219	0.1496	0.2524	2.0747	0.11015	Angola		
12/7/2014	ZFB14 #130	F	0.2707	0.306	0.2315	0.26535	0.2168	1.67135	0.196	Angola		
12/7/2014	ZFB14 #131	M	0.19025	0.1225	1.79415	0.10265	0.20065	0.79745	0.0485	Tai Forest		
1/8/2015	ZFB15 #1	M						Sample missing				
1/8/2015	ZFB15 #2	M	0.163165	0.192165	0.341065	0.116115	0.239415	0.498615	0.020115			
1/8/2015	ZFB15 #3	F	0.862235	0.177985	-0.00301	0.028935	1.186485	0.342885	-0.07871	Reston		
1/8/2015	ZFB15 #4	M	0.58667	1.86177	0.25797	0.27792	0.32567	1.17757	0.22072	Sudan		
1/8/2015	ZFB15 #5	M	0.20929	0.20924	0.18384	0.14869	0.25469	0.95384	0.08929			
1/8/2015	ZFB15 #6	M	0.146845	0.223395	0.184195	0.096345	1.041795	2.118095	0.272595	Angola		
1/8/2015	ZFB15 #7	M	0.31279	0.20124	-0.00195	-0.09978	0.31724	0.66074	-0.11266			
1/8/2015	ZFB15 #8	F	0.239985	0.261035	0.310435	0.246335	0.276085	0.701335	0.218585			
1/8/2015	ZFB15 #9	F	0.392735	0.307785	0.198035	0.133935	0.242985	0.734735	0.084985			
1/8/2015	ZFB15 #10	M	0.143395	0.153095	0.136245	0.454895	0.210945	0.998195	0.094845			
1/8/2015	ZFB15 #11	F	0.18026	0.19126	0.17666	0.13886	0.20041	1.95166	0.19381	Angola		
1/8/2015	ZFB15 #12	F	0.17163	0.25248	0.23813	0.18543	0.21708	0.64558	0.14708			
1/8/2015	ZFB15 #13	F	1.200915	0.398265	0.255715	0.212065	0.290865	1.626115	0.164865	Angola		
1/8/2015	ZFB15 #14	F	0.19213	0.10718	-0.00354	0.16388	0.45228	0.30798	-0.13966			
1/8/2015	ZFB15 #15	F	0.53733	1.19228	0.30443	0.28428	0.38503	1.07568	0.16418	Sudan		
1/8/2015	ZFB15 #16	M	0.264425	0.208825	0.789575	0.181825	0.258275	0.567075	0.164475		13/29	9/29
1/8/2015	ZFB15 #17	F					Sample missing					
1/8/2015	ZFB15 #18	M	0.201155	0.141755	0.181055	0.150755	1.840655	1.062305	0.022355	Reston		
1/8/2015	ZFB15 #19	F					Sample missing					
1/8/2015	ZFB15 #20	F	0.551955	1.734705	0.785205	0.289505	0.560955	1.044455	0.788055	Sudan		
1/8/2015	ZFB15 #21	M	0.28576	0.30011	0.33691	0.21991	0.33086	1.10761	0.44136	Angola		
1/8/2015	ZFB15 #22	F	0.137685	0.264285	0.277985	0.070485	0.278285	1.892685	0.021785	Angola		
1/8/2015	ZFB15 #23	M	0.53013	0.21278	0.07088	0.33233	0.29388	1.19138	-0.03034	Angola		
1/8/2015	ZFB15 #24	F	0.383055	0.339555	0.164905	0.121855	0.298855	0.224005	0.118355			
1/8/2015	ZFB15 #25	F	0.32287	0.34952	0.22772	1.06657	0.30862	0.41422	0.05027	Bundibugyo		
1/8/2015	ZFB15 #26	F	0.20549	0.11784	0.04879	0.05514	0.63219	1.25484	-0.04548	Angola		
1/8/2015	ZFB15 #27	M	-2.75E-05	0.060745	-0.00808	-0.0122	0.140345	0.779295	-0.028			
1/8/2015	ZFB15 #28	F	0.79808	0.20103	0.14823	0.03253	0.23488	0.51948	0.13158			
1/8/2015	ZFB15 #29	M	0.72766	0.56746	0.04136	-0.0309	0.24546	0.75926	-0.08187			
1/8/2015	ZFB15 #30	F	0.392525	0.333325	0.254175	0.316775	0.608075	1.679075	0.214425	Angola		
1/8/2015	ZFB15 #31	M	0.20312	0.22427	0.28127	0.22287	0.23402	0.55597	0.20552			
1/8/2015	ZFB15 #32	F	0.277035	0.314185	0.249435	0.286385	0.364035	1.857635	0.204935	Angola		
1/28/2015	ZFB15 #33	F	0.357555	0.340305	0.269505	0.212205	0.351255	2.276605	0.089955	Angola		
1/28/2015	ZFB15 #34	F	0.31426	0.32046	0.25086	0.21456	0.37691	1.20386	0.20436	Angola		
1/28/2015	ZFB15 #35	M	0.22489	0.24569	0.21669	0.24609	0.22459	0.35634	0.21824			
1/28/2015	ZFB15 #36	M	0.21581	0.23601	0.21311	0.23651	0.22591	0.34311	0.21951			
1/28/2015	ZFB15 #37	F	0.279595	0.280495	0.210245	0.241895	0.224295	0.373795	0.186595			
1/28/2015	ZFB15 #38	M				Sample missing						
1/28/2015	ZFB15 #39	M				Sample missing						
1/28/2015	ZFB15 #40	F	0.23432	0.32362	0.21862	0.20812	0.30702	0.79282	0.22132			
1/28/2015	ZFB15 #41	F	0.350635	0.571485	0.227335	0.239735	0.285135	1.286585	0.153035	Angola		
1/28/2015	ZFB15 #42	F	0.132765	0.173165	0.154815	0.155715	0.197165	1.303065	0.147865	Angola		
1/28/2015	ZFB15 #43	F	0.429505	0.299205	0.205755	0.185205	0.326005	0.852255	0.146155			
1/28/2015	ZFB15 #44	F	0.188515	0.388365	0.207965	0.205415	0.293015	0.894265	0.181965			
1/28/2015	ZFB15 #45	M	0.21208	0.24623	0.26193	0.24403	0.26653	1.51098	0.19488	Angola		
1/28/2015	ZFB15 #46	M	0.502395	0.945345	1.107145	0.005045	0.395445	1.067545	-0.08138	Tai Forest		
1/28/2015	ZFB15 #47	M	0.65046	0.34301	0.22461	0.24966	0.25671	0.86331	0.28176			
1/28/2015	ZFB15 #48	M	0.87787	0.24457	0.23487	0.24467	0.24617	0.31637	0.20787			
1/28/2015	ZFB15 #49	F	0.19481	0.18361	0.12291	0.04751	0.26571	1.15421	-0.0422	Angola		
1/28/2015	ZFB15 #50	F	0.749035	0.797035	1.071535	0.260935	0.289135	0.905035	0.149735	Tai Forest		
1/28/2015	ZFB15 #51	M	0.31292	0.31332	0.15622	0.14342	0.22622	1.09142	0.30042	Angola		
1/28/2015	ZFB15 #52	M	0.123735	0.162485	0.089635	0.134585	0.236085	1.136435	0.033785	Angola	22/37	20/37
1/28/2015	ZFB15 #53	F	0.22179	0.27814	0.24329	0.25049	0.26294	1.30209	0.21904	Angola		
1/28/2015	ZFB15 #54	F	0.265965	0.352065	0.241265	0.265015	0.258015	1.098615	0.221565	Angola		
1/28/2015	ZFB15 #55	F	0.29557	0.25517	0.22167	0.23857	0.27677	1.13472	0.20722	Angola		
1/28/2015	ZFB15 #56	F	0.265875	0.227975	0.138875	0.087475	0.2479425	1.444225	0.027325	Reston		
1/28/2015	ZFB15 #57	F	0.22061	0.20641	0.14116	0.15896	0.24031	1.43211	0.24061	Angola		
1/28/2015	ZFB15 #58	F	0.23624	0.25689	0.24274	0.23344	0.28319	1.25864	0.21959	Angola		
1/28/2015	ZFB15 #59	F	0.217955	0.726505	0.224405	0.415355	0.297305	0.584605	0.213605			
1/28/2015	ZFB15 #60	F	0.18301	0.21276	0.25011	0.20311	0.27151	1.42146	0.14981	Angola		
1/28/2015	ZFB15 #61	M	0.12584	0.19249	0.14354	0.15749	0.33899	2.11739	0.13114	Angola		
1/28/2015	ZFB15 #62	F	0.19572	0.22177	0.20442	0.20032	0.22622	1.58302	0.18737	Angola		
1/28/2015	ZFB15 #63	M	0.217155	0.281005	0.205455	0.207505	0.295705	0.823105	0.175405			
1/28/2015	ZFB15 #64	M	0.243055	0.230755	0.219805	0.221255	0.239655	1.057755	0.203305	Angola		
1/28/2015	ZFB15 #65	F	0.252905	0.318405	0.262805	0.259105	0.324505	1.291505	0.210805	Angola		
1/28/2015	ZFB15 #66	M	0.16312	0.23017	0.16547	0.14207	0.23817	0.37352	0.07072			
1/28/2015	ZFB15 #67	M	-0.085775	0.2814	-0.02755	-0.15358	0.25305	1.86785	-0.16178	Angola		
1/28/2015	ZFB15 #68	M	0.546645	0.272495	0.204295	0.223095	0.249145	0.518995	0.220045			

1/28/2015	ZFB15 #69	M	0.319475	0.733575	0.383475	0.347075	0.418775	0.845475	0.162375
1/28/2015	ZFB15 #70	M	0.29014	0.29664	0.26084	0.24734	0.32924	0.90504	0.16519
1/28/2015	ZFB15 #71	M	0.557315	0.466115	0.180115	0.202765	0.393365	1.717815	0.109915 Angola
2/12/2015	ZFB15 #72	M	0.390665	0.250265	0.162665	0.165615	0.262315	1.424365	0.124415 Angola
2/12/2015	ZFB15 #73	F	0.269025	0.280575	0.226225	0.220525	0.348025	1.282675	0.200275 Angola
2/12/2015	ZFB15 #74	F	0.216365	0.278465	0.182765	0.185615	0.329715	1.065315	0.152765 Angola
2/12/2015	ZFB15 #75	F	0.51091	0.577751	0.25671	0.22586	0.24136	0.75071	0.20326
2/12/2015	ZFB15 #76	M	0.4254	0.17905	0.08575	0.09205	0.1377	1.6418	0.11025 Angola
2/12/2015	ZFB15 #77	F	0.27067	0.24237	0.27522	0.13482	0.26742	0.39437	0.23397
2/12/2015	ZFB15 #78	F	0.24797	0.24232	0.21797	0.23177	0.44352	0.40747	0.21327
2/12/2015	ZFB15 #79	F	0.221225	0.278825	0.213875	0.208425	0.226425	0.696975	0.183325
2/12/2015	ZFB15 #80	M	0.433205	0.543755	0.233855	0.289755	0.371855	0.435655	0.316805
2/12/2015	ZFB15 #81	F	0.17255	0.16345	0.1563	0.1063	0.2342	-0.0132	-0.16785
2/12/2015	ZFB15 #82	F	0.22332	0.25832	0.22032	0.22087	0.25457	1.29237	0.20797 Angola
2/12/2015	ZFB15 #83	M	0.68578	0.30013	0.21683	0.26633	0.39808	1.19343	0.21898 Angola
2/12/2015	ZFB15 #84	M	-0.035375	-0.06923	-0.04225	-0.13903	0.24915	1.0013	-0.25398
2/12/2015	ZFB15 #85	F	0.130235	0.260485	0.240785	0.132485	0.351135	0.596285	0.083535
2/12/2015	ZFB15 #86	F	0.228015	0.218165	0.248465	0.201765	0.268265	0.855615	0.184665
2/12/2015	ZFB15 #87	M	0.282545	0.253595	0.236995	0.293895	0.257095	0.799945	0.214945
2/12/2015	ZFB15 #88	M	0.223505	0.234255	0.220455	0.181605	0.412955	0.277205	0.426455
2/12/2015	ZFB15 #89	M	0.18864	0.20789	0.17459	0.16284	0.22969	0.48649	0.11909
2/12/2015	ZFB15 #90	M	0.3239	0.26885	0.188	0.25975	1.19065	0.8312	0.18665 Reston
2/12/2015	ZFB15 #91	F	0.23128	0.25263	0.24363	0.29443	0.29433	2.10598	0.21473 Angola
2/12/2015	ZFB15 #92	F	0.169605	0.760055	0.169955	0.123555	0.315305	1.145855	0.210255 Angola
2/12/2015	ZFB15 #93	F	0.249635	0.254135	0.240735	0.236435	0.247535	0.703235	0.202885
2/12/2015	ZFB15 #94	M	0.30466	0.24291	0.22681	0.22751	0.23776	1.39186	0.20101 Angola
2/12/2015	ZFB15 #95	M	0.160725	0.214525	0.147275	0.388775	0.222475	0.595425	0.067725
2/12/2015	ZFB15 #96	F	0.25301	0.27661	0.22826	0.23576	0.49476	0.96556	0.25011
2/12/2015	ZFB15 #97	F	0.29985	0.5219	0.7196	0.25645	0.9206	0.7391	0.21255
2/12/2015	ZFB15 #98	F	0.31904	0.23914	0.23004	0.23164	0.33429	0.68734	0.23024
2/12/2015	ZFB15 #99	F	0.232705	0.237655	0.267505	0.211155	0.275655	0.305555	0.184655
2/12/2015	ZFB15 #100	M	0.22592	0.33457	0.23782	0.26027	0.23487	0.37382	0.27082
2/12/2015	ZFB15 #101	F	0.2562	0.2327	0.22315	0.3399	0.2433	0.48515	0.21935
2/12/2015	ZFB15 #102	F	0.23781	0.25301	0.24121	0.22271	0.25601	0.37931	0.23071
2/12/2015	ZFB15 #103	M	0.19397	0.24882	0.04687	0.12147	0.29602	0.70992	0.16002
2/12/2015	ZFB15 #104	M	0.24499	0.26464	0.28464	0.23499	0.50054	0.62429	0.22474
2/12/2015	ZFB15 #105	F	0.21212	0.22112	0.21037	0.20592	0.24257	0.55107	0.21037
2/12/2015	ZFB15 #106	M	0.20829	0.24954	0.20689	0.22124	0.30984	1.13499	0.17974 Angola
2/12/2015	ZFB15 #107	M	0.221235	0.274535	0.220685	0.256835	0.279435	0.594735	0.220835
2/12/2015	ZFB15 #108	F	0.16797	0.17957	0.15832	0.33032	0.23107	0.94427	0.13332
2/12/2015	ZFB15 #109	F	0.13887	0.22382	0.14632	0.58692	0.17657	0.33697	0.13882
2/12/2015	ZFB15 #110	M	0.22592	0.24567	0.22007	0.22822	0.25582	0.53287	0.22832
2/12/2015	ZFB15 #111	M	0.290345	0.460595	0.210295	0.215995	0.352345	2.905945	0.336895 Angola
7/15/2015	ZFB15 #112	M	0.2572	0.2068	0.2383	0.2007	0.42845	1.1915	0.17235 Angola
7/15/2015	ZFB15 #113	M	0.12794	0.19769	0.15469	0.19589	0.37964	0.10854	0.16284
7/15/2015	ZFB15 #114	F	0.21707	0.33692	0.22587	0.20147	0.49722	3.17572	0.15657 Angola
7/15/2015	ZFB15 #115	F	0.316405	0.205805	0.186955	0.154005	0.280105	2.607155	0.101755 Angola
7/15/2015	ZFB15 #116	M	0.35432	0.79037	0.29552	0.28227	0.52707	1.08417	0.27557 Angola
7/15/2015	ZFB15 #117	M	0.194615	0.104615	0.056115	0.067415	0.275115	0.093765	-0.13727
7/15/2015	ZFB15 #118	F	0.169545	2.801895	0.170645	0.152295	0.224945	0.964145	0.168745 Sudan
7/15/2015	ZFB15 #119	M	0.234915	0.352765	0.227715	0.256415	0.354965	1.128665	0.229065 Angola
7/15/2015	ZFB15 #120	F	0.201075	0.275975	0.318475	0.387575	0.295075	2.558475	0.174325 Angola
7/15/2015	ZFB15 #121	M	0.25896	0.25121	0.20531	0.20731	0.28291	1.31831	0.23741 Angola
7/15/2015	ZFB15 #122	F	1.36645	0.25635	0.18415	0.2237	0.31235	1.80305	0.44775 Angola
7/15/2015	ZFB15 #123	F	0.75503	0.47068	0.13638	0.14218	0.31643	0.09503	0.07213
7/15/2015	ZFB15 #124	F	-0.0926325	-0.05578	-0.06483	-0.16511	0.217435	-0.18398	0.466035
7/15/2015	ZFB15 #125	F	-0.1725175	0.343965	0.019215	-0.01297	0.199015	0.995015	-0.12754
7/15/2015	ZFB15 #126	M	0.67669	0.22979	0.15684	0.14074	0.58969	0.36529	0.68309
7/15/2015	ZFB15 #127	M	0.48469	0.98534	0.16499	0.26169	1.22859	1.08054	0.58074 Reston
7/15/2015	ZFB15 #128	F	0.406225	0.791075	1.213525	0.220475	0.540125	0.302225	0.180725 Tai Forest
7/15/2015	ZFB15 #129	F	0.152245	0.414095	0.107595	0.034445	0.376995	0.581795	-0.0807
7/15/2015	ZFB15 #130	F	0.18959	0.30714	0.20759	0.21664	0.21119	1.45389	0.22584 Angola
7/15/2015	ZFB15 #131	M	0.23484	0.36844	0.40609	0.23129	0.58709	0.25329	1.03879 LLOV
7/15/2015	ZFB15 #132	M	0.28541	0.22831	0.38561	0.20926	0.28266	0.33336	0.15526
7/15/2015	ZFB15 #133	F	0.201615	0.224215	0.229315	0.212415	0.321915	0.406265	0.231315
7/15/2015	ZFB15 #134	M	-0.06679	-0.04752	-0.08449	-0.21529	0.29097	0.32757	-0.31907
7/15/2015	ZFB15 #135	M	0.40279	0.41779	0.39364	0.21409	0.28069	1.49444	0.21489 Angola
7/15/2015	ZFB15 #136	F	-0.021175	0.03315	-0.02625	-0.11565	0.4611	-0.12895	-0.3165
7/15/2015	ZFB15 #137	F	0.38854	0.87409	0.27959	0.29939	0.64469	1.50249	0.32304 Angola
11/6/2015	ZFB15 #173	F	0.03225	0.15545	0.0216	-0.0119	0.33915	1.8843	0.0141 Angola
11/6/2015	ZFB15 #174	M	0.18335	0.266	0.18255	0.19925	0.24015	0.8783	0.1636 Angola
11/6/2015	ZFB15 #175	F	0.21495	0.4048	0.5246	0.20135	0.2758	2.21495	0.1306 Angola
11/6/2015	ZFB15 #176	M	0.1338	0.1898	0.13505	0.118	0.2136	0.9524	0.0707 Angola
11/6/2015	ZFB15 #177	M	-0.29555	-0.245	-0.66585	-0.65865	0.0689	0.23215	0.1
11/6/2015	ZFB15 #178	M	0.12455	0.1333	0.32995	0.09675	0.2297	1.3913	0.0376 Angola
11/6/2015	ZFB15 #179	M	0.17615	0.19725	0.19795	0.2032	0.20715	1.33605	0.1689 Angola
11/6/2015	ZFB15 #180	F	0.185	0.1842	0.22195	0.12325	0.1307	1.1629	0.05905 Reston
11/6/2015	ZFB15 #181	F	0.07565	0.1213	-0.0249	0.0123	0.21175	0.7452	-0.1375 Angola
11/6/2015	ZFB15 #182	M	0.31725	0.1918	0.21845	0.12755	0.1898	1.71235	0.07045 Angola
11/6/2015	ZFB15 #183	F	0.1872	0.20785	0.12605	0.14355	0.19205	0.78345	0.1184 Angola

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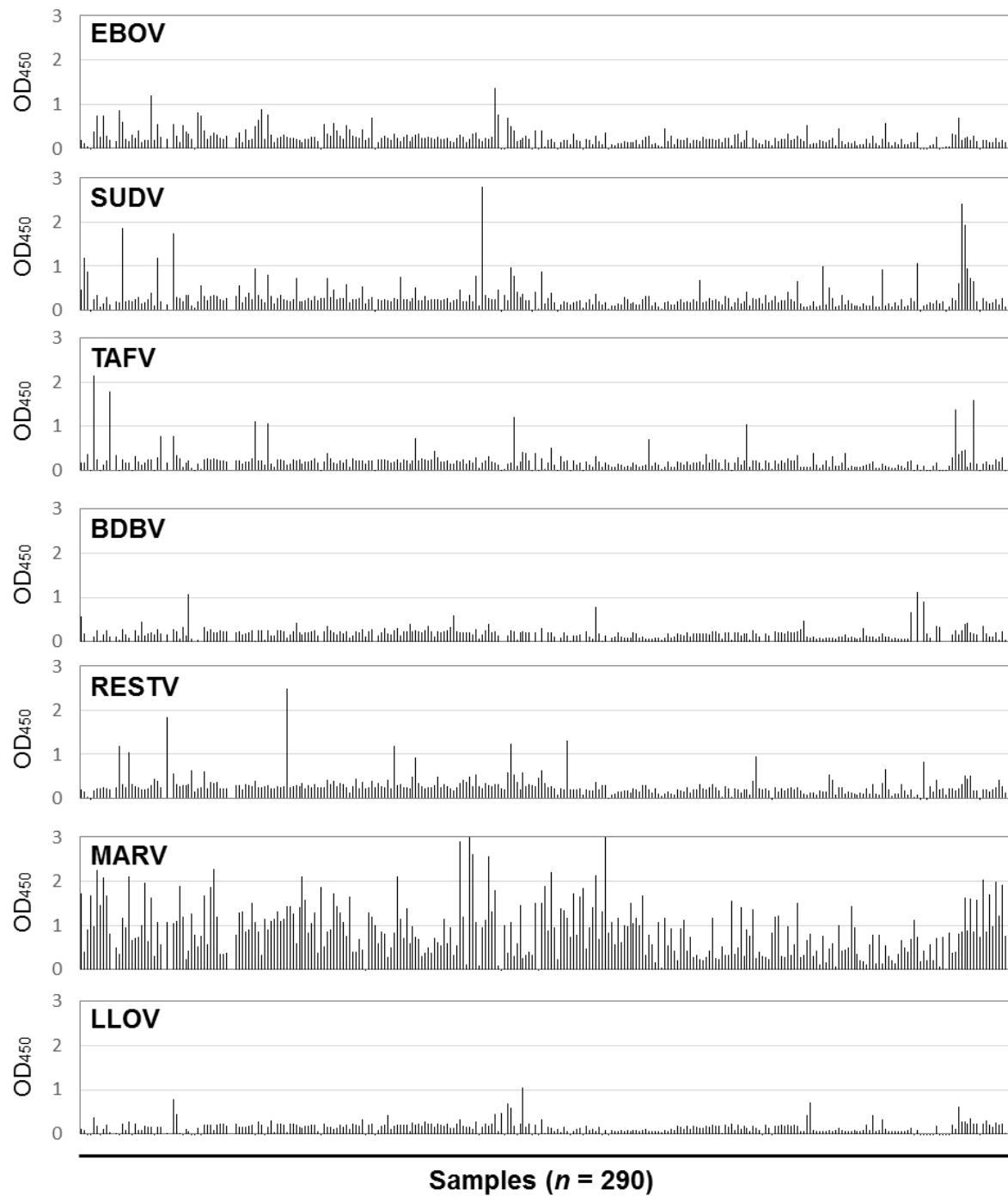
11/6/2015 ZFB15 #184	F	0.16235	0.22445	0.16985	0.1611	0.2127	1.6413	0.14325	Angola
11/6/2015 ZFB15 #185	F	-0.0454	0.0569	-0.10685	-0.06625	0.07055	1.85155	-0.20065	Angola
11/6/2015 ZFB15 #186	M	0.20195	0.1853	0.19625	0.2375	0.2018	0.46675	0.1871	
11/6/2015 ZFB15 #187	F	0.17935	0.2427	0.11995	0.11705	0.18175	0.9538	0.07515	Angola
11/6/2015 ZFB15 #188	F	0.08625	0.14055	0.0831	0.07155	0.1721	1.4046	0.10265	Angola
11/6/2015 ZFB15 #189	F	0.2816	0.36845	0.32535	0.78975	0.3782	2.14255	0.0658	Angola
11/6/2015 ZFB15 #190	M	0.16585	0.19715	0.20825	0.18285	0.1971	0.68565	0.1575	Angola
11/6/2015 ZFB15 #191	F	0.09675	0.1232	0.0817	0.0244	0.2955	1.3062	-0.0664	Angola
11/6/2015 ZFB15 #192	F	0.3509	0.1914	0.1649	0.14215	0.28655	3.23435	0.0881	Angola
12/3/2015 ZFB15 #249	F	-0.02475	0.01345	0.1303	-0.0778	-0.00735	0.83175	-0.10355	Angola
12/3/2015 ZFB15 #250	M	0.08675	0.10575	0.0683	0.0933	0.0799	1.0609	0.08005	Angola
12/3/2015 ZFB15 #251	F	0.06785	0.0992	0.0769	0.1046	0.0984	0.5633	0.06225	
12/3/2015 ZFB15 #252	M	0.1053	0.14395	0.1416	0.2133	0.1547	1.16315	0.0708	Angola
12/3/2015 ZFB15 #253	F	0.1113	0.13705	0.13345	0.1056	0.15085	0.6237	0.07455	
12/3/2015 ZFB15 #254	F	0.15265	0.30165	0.0877	0.08745	0.1866	0.9967	0.06435	Angola
12/3/2015 ZFB15 #255	F	0.14315	0.2589	0.10005	0.09165	0.1764	0.97465	0.07395	Angola
12/3/2015 ZFB15 #256	M	0.12535	0.1602	0.08715	0.0909	0.1276	1.51505	0.06595	Angola
12/3/2015 ZFB15 #257	F	0.12425	0.17875	0.178	0.20525	0.22085	1.0524	0.09205	Angola
12/3/2015 ZFB15 #258	F	0.17375	0.1248	0.1216	0.17365	0.20995	1.16895	0.08275	Angola
12/3/2015 ZFB15 #259	F	0.09395	0.1317	0.07105	0.074	0.15155	1.005	0.0601	Angola
12/3/2015 ZFB15 #260	F	0.17825	0.2418	0.10795	0.1107	0.29805	1.67885	0.0803	Angola
12/3/2015 ZFB15 #261	F	0.25115	0.3214	0.1217	0.06195	0.3024	0.3271	0.1096	
12/3/2015 ZFB15 #262	M	0.27545	0.3312	0.6964	0.0631	0.20135	0.7942	0.05785	Angola
12/3/2015 ZFB15 #263	F	0.09155	0.10245	0.1146	0.0685	0.11585	0.5564	0.0656	
12/3/2015 ZFB15 #264	F	0.1113	0.1734	0.18455	0.0836	0.22735	0.1695	0.0685	
12/3/2015 ZFB15 #265	F	0.06605	0.08735	0.1325	0.07975	0.09225	1.0735	0.0612	Angola
12/3/2015 ZFB15 #266	F	0.0424	0.0446	0.04245	0.0428	0.04455	0.04445	0.04325	
12/3/2015 ZFB15 #267	M	0.4359	0.16905	0.07825	0.0825	0.0973	1.1626	0.07455	Angola
12/3/2015 ZFB15 #268	M	0.1544	0.21035	0.1921	0.1849	0.13985	0.53155	0.06305	
12/3/2015 ZFB15 #269	F	0.28485	0.12725	0.0869	0.089	0.10205	0.9277	0.1	Angola
12/3/2015 ZFB15 #270	F	0.0804	0.1421	0.08095	0.09915	0.0761	0.4267	0.07615	
4/26/2016 ZFB16 #1	M	0.1941	0.1992	0.1927	0.1847	0.1903	0.2159	0.1792	
4/26/2016 ZFB16 #2	M	0.1919	0.258	0.171	0.164	0.1811	0.9294	0.1647	Angola
4/26/2016 ZFB16 #3	F	0.1749	0.1826	0.1325	0.1242	0.1474	1.1123	0.1113	Angola
4/26/2016 ZFB16 #4	F	0.2202	0.206	0.2	0.1996	0.2419	0.4178	0.1837	
4/26/2016 ZFB16 #5	F	0.1109	0.1713	0.1252	0.12	0.1299	0.7394	0.1213	Angola
4/26/2016 ZFB16 #6	F	0.1773	0.243	0.1823	0.1877	0.1976	0.2751	0.1708	
4/26/2016 ZFB16 #7	F	0.1854	0.2099	0.1654	0.1721	0.2105	0.3249	0.1645	
4/26/2016 ZFB16 #8	F	0.1599	0.6911	0.1905	0.1833	0.3089	0.2292	0.138	Sudan
4/26/2016 ZFB16 #9	F	0.2576	0.1803	0.1398	0.1801	0.2248	0.2179	0.1403	
4/26/2016 ZFB16 #10	F	0.2039	0.201	0.361	0.1921	0.1965	0.2865	0.1754	
4/26/2016 ZFB16 #11	M	0.2157	0.2849	0.1858	0.168	0.2571	0.426	0.1488	
4/26/2016 ZFB16 #12	F	0.206	0.2162	0.2596	0.2203	0.3209	1.1712	0.2014	Angola
4/26/2016 ZFB16 #13	M	0.1845	0.2478	0.2468	0.2421	0.2567	0.2639	0.1832	
4/26/2016 ZFB16 #14	M	0.2153	0.2108	0.1814	0.187	0.1839	0.2349	0.1772	
4/26/2016 ZFB16 #15	M	0.141	0.1295	0.0071	0.0575	0.0295	0.5131	0.0064	
4/26/2016 ZFB16 #16	F	0.2315	0.3303	0.2384	0.2045	0.2835	0.3215	0.2128	
4/28/2016 ZFB16 #17	F	0.2214	0.2645	0.1879	0.2167	0.2182	0.3324	0.1613	
4/28/2016 ZFB16 #18	M	0.0684	0.0851	-0.0163	0.0293	0.0152	1.5506	0.2312	Angola
4/28/2016 ZFB16 #19	F	0.307	0.1796	0.1867	0.2074	0.2137	0.3502	0.089	
4/28/2016 ZFB16 #20	F	0.3177	0.2829	0.2899	0.2027	0.2039	0.4856	0.2019	
4/28/2016 ZFB16 #21	M	0.1401	0.1491	0.1201	0.1343	0.1366	1.4105	0.1145	Angola
4/28/2016 ZFB16 #22	M	0.1844	0.1999	0.2278	0.1938	0.2114	0.2925	0.1843	
4/28/2016 ZFB16 #23	F	0.3915	0.4277	1.0511	0.1817	0.2011	0.9137	0.1294	Tai Forest
4/28/2016 ZFB16 #24	M	0.0241	0.0964	0.0792	0.0278	0.0881	0.7657	0.052	Angola
4/28/2016 ZFB16 #25	M	0.2271	0.2742	0.2334	0.2428	0.3815	1.3532	0.1903	Angola
4/28/2016 ZFB16 #26	F	0.1902	0.2417	0.2251	0.1792	0.9521	0.2497	0.1411	Reston
4/28/2016 ZFB16 #27	F	0.112	0.2755	0.1751	0.0985	0.2354	0.3882	0.0778	
4/28/2016 ZFB16 #28	F	0.0773	0.1461	0.0148	-0.0024	0.1955	0.3041	-0.0845	
4/28/2016 ZFB16 #29	F	0.1916	0.3596	0.2271	0.1929	0.2222	0.2862	0.2002	
4/28/2016 ZFB16 #30	F	0.1566	0.1758	0.1651	0.139	0.1749	0.2365	0.1272	
4/28/2016 ZFB16 #31	F	0.0596	0.2273	0.0057	-0.0278	-0.068	0.8302	-0.1674	Angola
4/28/2016 ZFB16 #32	F	0.2228	0.3147	0.2203	0.2217	0.2417	1.1892	0.1836	Angola
4/28/2016 ZFB16 #33	M	0.1588	0.1731	0.1429	0.1982	0.1548	1.2074	0.1777	Angola
4/28/2016 ZFB16 #34	F	0.2094	0.219	0.2282	0.2052	0.2355	0.2982	0.2017	
4/28/2016 ZFB16 #35	F	0.2027	0.2231	0.1861	0.1852	0.184	0.2711	0.1724	
4/28/2016 ZFB16 #36	F	0.3183	0.4215	0.2738	0.2252	0.2234	0.979	0.2167	Angola
4/28/2016 ZFB16 #37	F	0.1897	0.2405	0.2169	0.2016	0.2465	0.3378	0.1767	
4/28/2016 ZFB16 #38	F	0.2178	0.2027	0.2198	0.2004	0.2049	0.568	0.1963	
4/28/2016 ZFB16 #39	M	0.2718	0.6546	0.3402	0.2412	0.2478	1.5125	0.1768	Angola
12/7/2016 ZB16 #55	F	0.1954	0.1562	0.08635	0.28005	0.1839	0.275	0.0665	
12/7/2016 ZB16 #56	F	0.1649	0.0814	0.074	0.4749	0.09635	0.33795	0.0534	
12/7/2016 ZB16 #57	F	0.52525	0.0798	0.06955	0.11365	0.0814	0.6667	0.42095	Angola
12/7/2016 ZB16 #58	M	0.076	0.1012	0.09055	0.08725	0.12075	0.81445	0.7029	Angola
7/31/2017 ZB17 #1	M	0.1	0.2117	0.3906	0.11735	0.13895	0.30445	0.07545	
7/31/2017 ZB17 #2	F	0.0999	0.0857	0.12335	0.0689	0.0847	0.41385	0.05685	
7/31/2017 ZB17 #3	F	0.17765	0.11695	0.0595	0.08255	0.17415	0.0986	0.0667	
7/31/2017 ZB17 #4	F	0.1558	0.98965	0.119	0.07035	0.1445	0.77055	0.0624	Sudan
7/31/2017 ZB17 #5	F	0.1347	0.1303	0.22335	0.07825	0.15275	0.16595	0.0609	
7/31/2017 ZB17 #6	M	0.17705	0.52455	0.0876	0.07645	0.5445	0.46775	0.09115	

7/31/2017 ZB17 #7	F	0.2204	0.26875	0.3089	0.08485	0.41755	0.5819	0.05895
7/31/2017 ZB17 #8	M	0.07035	0.0796	0.1156	0.06205	0.0785	0.06865	0.0829
7/31/2017 ZB17 #9	M	0.43475	0.10325	0.1014	0.1059	0.2433	0.9925	0.13 Angola
7/31/2017 ZB17 #10	M	0.1505	0.36035	0.17845	0.11365	0.24885	0.4174	0.08025
7/31/2017 ZB17 #11	F	0.09335	0.1375	0.40185	0.16855	0.10365	0.44915	0.06595
7/31/2017 ZB17 #12	M	0.1274	0.2333	0.05325	0.09495	0.1472	0.4841	0.05425
7/31/2017 ZB17 #13	M	0.1189	0.1618	0.09925	0.1038	0.12345	1.43915	0.06955 Angola
7/31/2017 ZB17 #14	F	0.15275	0.112	0.091	0.09305	0.0917	0.961	0.07755 Angola
7/31/2017 ZB17 #15	F	0.07275	0.10295	0.0677	0.0733	0.07855	0.34785	0.05595
7/31/2017 ZB17 #16	F	0.08795	0.09505	0.07935	0.08065	0.1397	0.2022	0.0622
7/31/2017 ZB17 #17	F	0.0854	0.14805	0.1067	0.29705	0.1101	0.1722	0.09445
7/31/2017 ZB17 #18	M	0.2162	0.09715	0.11965	0.1327	0.231	0.1191	0.1978
7/31/2017 ZB17 #19	M	0.1078	0.11975	0.1418	0.1072	0.11255	0.57105	0.0791
7/31/2017 ZB17 #20	F	0.28375	0.32605	0.20775	0.11225	0.3239	0.7833	0.4273 Angola
7/31/2017 ZB17 #21	F	0.1212	0.0772	0.06065	0.0614	0.11155	0.1359	0.0565
7/31/2017 ZB17 #22	F	0.0582	0.0822	0.0584	0.10515	0.07065	0.79205	0.08705 Angola
7/31/2017 ZB17 #23	F	0.2026	0.9375	0.1624	0.19095	0.34425	0.1223	0.3176 Sudan
7/31/2017 ZB17 #24	F	0.57445	0.11965	0.10795	0.1182	0.6565	0.53165	0.11125 Reston
7/31/2017 ZB17 #25	M	0.1226	0.1482	0.06985	0.115	0.19285	0.29125	0.067
7/31/2017 ZB17 #26	M	0.07025	0.07365	0.05375	0.06115	0.06185	0.1976	0.0662
7/31/2017 ZB17 #27	F	0.1257	0.18945	0.06315	0.07775	0.09925	0.1286	0.0552
7/31/2017 ZB17 #28	M	0.091	0.1007	0.1339	0.05925	0.1005	0.3453	0.0616
7/31/2017 ZB17 #29	F	0.21265	0.2404	0.10455	0.06335	0.3122	0.6633	0.0664 Angola
7/31/2017 ZB17 #30	F	0.07995	0.0906	0.06075	0.06175	0.16645	0.48655	0.05625
7/31/2017 ZB17 #31	F	0.089	0.0992	0.1951	0.06695	0.0876	0.3978	0.08415
12/4/2017 ZB17 #73	M	0.1303	0.26945	0.2322	0.6621	0.18835	0.6846	0.12275 Angola
12/4/2017 ZB17 #74	F	0.1278	0.1991	-0.16795	-0.18105	0.00675	1.1272	-0.10755 Angola
12/4/2017 ZB17 #75	F	0.3386	1.07785	0.1164	1.1257	0.087	0.74565	0.09625 Bundibugyo
12/4/2017 ZB17 #76	M	-0.162	-0.11595	-0.502	-0.4385	-0.0797	0.1926	-0.54515
12/4/2017 ZB17 #77	M	-0.02845	0.1118	0.09255	0.9115	0.83175	0.42775	-0.1509 Bundibugyo
12/4/2017 ZB17 #78	M	-0.1069	0.12735	-0.25285	0.1804	-0.174	0.21675	-0.01175
12/4/2017 ZB17 #79	F	0.0497	0.18985	-0.0504	0.0816	0.27205	0.56655	-0.04155
12/4/2017 ZB17 #80	M	0.0909	0.1625	0.0961	-0.15875	0.15625	0.20155	-0.0709
12/4/2017 ZB17 #81	M	0.25735	0.2222	0.17385	0.3591	0.42595	0.72135	0.1886 Angola
12/4/2017 ZB17 #82	M	-0.22005	0.1513	-0.6712	0.33	0.20605	0.0596	-0.57435
12/4/2017 ZB17 #83	M	0.00655	0.20585	-0.06645	-0.1437	0.22665	0.74655	-0.01255 Angola
12/4/2017 ZB17 #84	M	0.03325	-0.0323	-0.5075	-0.5911	0.0681	0.0006	-0.46645
12/4/2017 ZB17 #85	F	0.0365	0.07375	0.10695	-0.1168	0.23225	0.83335	-0.10205 Angola
12/4/2017 ZB17 #86	M	0.3281	0.2756	0.3026	0.16605	0.2141	0.36535	0.211
12/4/2017 ZB17 #87	F	0.2942	0.2314	1.38035	0.2618	0.17375	0.4067	0.1028 Tai Forest
12/4/2017 ZB17 #88	M	0.6903	0.62	0.364	0.14685	0.2238	0.81025	0.6168 Angola
12/4/2017 ZB17 #89	F	0.19335	2.4266	0.44105	0.26445	0.3282	0.8613	0.27985 Sudan
12/4/2017 ZB17 #90	M	0.2391	1.94285	0.46805	0.3928	0.50805	1.6209	0.28285 Sudan
12/4/2017 ZB17 #91	F	0.2656	0.9425	0.0885	0.41595	0.44955	0.8812	0.2377 Sudan
12/4/2017 ZB17 #92	F	0.1852	0.74235	0.17425	0.21775	0.5091	1.6111	0.3442 Angola
12/4/2017 ZB17 #93	F	0.2763	0.65535	1.6006	0.1868	0.1843	0.85315	0.2346 Tai Forest
12/4/2017 ZB17 #94	F	0.16465	0.2144	0.15175	0.1644	0.16585	1.58305	0.23355 Angola
12/4/2017 ZB17 #95	F	-0.07645	-0.04995	-0.12475	-0.08305	-0.04615	0.7332	-0.0065 Angola
12/4/2017 ZB17 #96	F	0.17115	0.2646	0.1519	0.339	0.205	2.03625	0.23705 Angola
12/4/2017 ZB17 #97	F	0.18525	0.21255	0.19095	0.18105	0.19775	0.86245	0.29165 Angola
12/4/2017 ZB17 #98	F	0.13555	0.15845	0.12805	0.12045	0.15765	1.68775	0.20515 Angola
12/4/2017 ZB17 #99	F	0.14115	0.1752	0.12415	0.09845	0.18845	0.9781	0.16685 Angola
12/4/2017 ZB17 #100	M	0.2233	0.24245	0.2573	0.1987	0.25905	1.9921	0.26105 Angola
12/4/2017 ZB17 #101	F	0.12875	0.12105	0.2038	0.0459	0.4089	1.22385	0.19935 Angola
12/4/2017 ZB17 #102	F	0.19195	0.28025	0.2885	0.23395	0.27655	1.9267	0.2309 Angola
12/4/2017 ZB17 #103	F	0.1387	0.08765	-0.05975	0.02705	0.12005	0.75525	0.0249 Angola
12/4/2017 ZB17 #104	M	0.38415	0.1643	0.13235	0.2255	0.15805	1.46435	0.19975 Angola

9/31 6/31

25/32 18/32

Numbers in red and orange are significantly higher OD values.



Supplementary Figure 1. Immunoglobulin G (IgG) antibodies detected in the sera collected from fruit bats in Zambia. Serum samples were tested (1:100 dilution) for IgG antibodies specific to EBOV, SUDV, TAFV, BDBV, RESTV, MARV, and LLOV GPs by enzyme-linked immunosorbent assay. All optical density (OD) values were subjected to the Smirnov-Grubbs rejection test to discriminate the positive (i.e. significantly higher OD values) from the negative population.