

Erratum to: Seed predation by red leaf monkeys
Hanya and Bernard

Erratum to: **Functional response to fruiting seasonality by a primate seed predator,
red leaf monkey (*Presbytis rubicunda*)**

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In the published paper, the number of fruiting trees was erroneously scored as zero for March-May 2008, rather than as missing data due to the incomplete phenology recording. The authors apologize sincerely for this error. Due to the removal of the data, there have been some minor changes in the results. Final conclusion remains unchanged.

The following changes correct this error, with new text underlined:

On page 383, Abstract

The predator satiation hypothesis is one plausible explanation for masting in lowland dipterocarp forests in SE Asia. Hence, evaluation of behavioral patterns of seed predators have the potential to provide support for the predator satiation hypothesis. In order to evaluate possible mechanisms that could result in predator satiation, we studied the functional response in the seed predation behavior to fruiting seasonality of red leaf monkeys (*Presbytis rubicunda* Müller, 1838, Colobinae) in Danum Valley, Sabah, northern Borneo. Specifically, we sought to answer the two questions: (1) when fruit availability increases, to what extent do red leaf monkeys increase their seed eating? and (2) do red leaf monkeys change the degree to which they pursue one species of seeds in response to the changes in community-level fruit availability? In response to the increased fruit availability, red leaf monkeys extended their time spent feeding on seeds as much as 18 fold. This large functional response resulted from the elongated total feeding time and the preference for seeds by red leaf monkeys. Feeding time tended to increase, up to 28% of the observation time, with increasing fruit availability. In response to increased fruiting seasonality, the monkeys increased the number of species but not

plant individuals upon whose seeds they depredated. Time spent feeding on seeds per species or individual, or for the most frequently eaten species or individual, was not affected by fruit availability. Similarly, the duration of one seed-feeding event was unaffected by the fruit availability. Hence, while our results demonstrate a functional response to mast fruiting, we found no support for the predator satiation hypothesis. The existence of an abundant alternative resource (young leaves) is one of several likely reasons for the weak persistence toward seeds shown by red leaf monkeys, which is contradictory to the assumption of the predator satiation hypothesis.

On page 386-387, Methods subsection 'Phenology' should read:

Fruiting activities of trees of ≥ 10 cm dbh were monitored monthly since July 2004 by the DVFC, using the same plot set by Norhayati (2001) and the same protocol used in the census conducted from August 1997 to December 2000 (Wong *et al.* 2005). Five transects, each 20 \times 100 m, were established in a primary forest within the home range of the subject group. The transects were placed every 400 m along the 2-km trail. Trees with ≥ 10 cm dbh inside the transects were tagged, numbered and identified to species level when possible. Total number of monitored stems in the five transects was 511-533, changing due to the death of monitored stems. We included only the genera that were actually eaten by leaf monkeys in the analysis. This analysis of only species consumed did not effect the results significantly because food and total fruiting trees positively correlated significantly ($r = 0.97$, $p < 0.0001$). We excluded data of March-May 2008 due to the incomplete recording of species composition. Both ripe and unripe foods were included because red leaf monkeys ate both.

On page 387, third paragraph in Methods subsection '*Data analysis*' should read:

Using a generalized linear model (GLM), we investigated the effect of monthly fruiting phenology on (1) total feeding time, (2) feeding time on seeds, (5) average feeding time spent on seeds per species, (6) average feeding time on seeds per individual plant, (7) feeding time on seeds for the most frequently eaten species, (8) feeding time on seeds for the most frequently eaten individual plants, and (9) duration of one seed-feeding event. As an independent variable, we examined a null model (a model with only constant), a model including the proportion of fruiting trees, and a model including values of both the proportion of fruiting trees and its square. We selected the best-fit model among these three using Akaike's Information Criterion corrected for small samples (AICc) (Burnham & Anderson 2002). Dependent variables were normally distributed according to the Kolmogorov-Smirnov test ($p > 0.1$). Because (3) number of species whose seeds are eaten and (4) number of individuals whose seeds are eaten, (count data) did not fit the Poisson distribution (Kolmogorov-Smirnov test, $p < 0.0001$, respectively), we examined the effect of fruiting seasonality on these factors by the nonparametric Spearman's rank correlation. We used R 2.13.2. (© 2011 The R Foundation for Statistical Computing) for all of the statistical analyses.

On page 388, third paragraph of Results should read:

Red leaf monkeys increased their time consuming seeds (Fig. 2a, Table 1a) and their total feeding time (Fig. 2b, Table 1b) in response to the increased fruit availability. For the time spent consuming seeds, the best fit model included the square of the fruit availability (Table 1a). However, in the range of the current data

set, time spent on seed consumption increased almost monotonously with increasing fruit availability (Fig. 2a). Maximum feeding time was 28% of the observation time, which is 2.9 times the lowest value (9.7%, July 2008). The time spent consuming seeds was 18 times greater during the highest (July 2007, 22%) month compared to the lowest (February 2008, 1.2%) month. Monthly fruit availability and the number of species whose seeds were depredated by red leaf monkeys were almost significantly positively correlated ($r = 0.47$, $p = 0.055$), but not for plant individuals ($r = 0.36$, $p = 0.16$; Fig. 3). On the other hand, there were no relationships between monthly fruit availability and the time spent depredating seeds per species or per individual plant (Fig. 4). Null models were the best-fit models for both cases (Table 2). When the fruiting was highest (May through October 2007), seed-predation time per species or individual was intermediate. Outside of these six months, seed-predation time per species or individual was variable. Seed-predation time for the most frequently eaten species tended to be long in the months when fruit availability was high (Fig. 5a, Table 3a) and there was no relationships in case of the seed-predation time for the most frequently eaten plant individual (Fig. 5b, Table 3b). Average duration of seed-feeding events was not affected by the fruit availability of the month (Fig. 6; Table 4).

On pages 391-392, first paragraph of Discussion subsection '*Do the red leaf monkeys change the degree to which they persist in pursuing one species/individual of seeds in response to the changes in community-level fruit availability?*' should read:

We found no support for this question. We showed that red leaf monkeys did not change their average seed-predation time for each species or individual in response to the changes in fruit availability (Table 5). The duration of one seed-predation

event was also unaffected by fruit availability in the same month. While seed-predation times for the most frequently eaten species tended to be long, or did not change for the most frequently eaten plant individuals when fruit availability was high, these result were opposite to what would be expected if monkeys tried to persist in eating one particular species/individual when overall fruit availability decreased. This must be a natural consequence of the larger number of species in the months of high fruit availability. Hence, contrary to the expectations of the predator satiation hypothesis, our findings show that red leaf monkeys do not persist on one species and/or increase their seed-feeding time per species or per individual plant. Although seeds seem to be preferred foods for red leaf monkeys, they do not increase their feeding effort on seeds when availability decreases.

On page 389, replace Table 1 with the following table:

Table 1. Generalized linear model on the effect of fruiting seasonality on proportion of (a) feeding time spent on seed and whole fruit feeding and (b) total feeding time to the observation time of red leaf monkeys

(a) Effect on the proportion of feeding time spent on seed and whole fruit feeding

Intercept	Coefficient			R ²	-2LL	K	AIC	AICc	ΔAICc	w _i	p	
	#Trees fruiting	#Trees fruiting ^{^2}	#Trees fruiting ^{^2}								#Trees fruiting	#Trees fruiting ^{^2}
<u>0.10</u>	=	=	=	<u>-43.6</u>	<u>0</u>	<u>-43.6</u>	<u>-42.7</u>	<u>5.2</u>	<u>0.04</u>	=	=	
<u>0.06</u>	<u>1.78</u>	=	<u>0.34</u>	<u>-47.7</u>	<u>1</u>	<u>-49.7</u>	<u>-47.9</u>	<u>0.0</u>	<u>0.48</u>	<u>0.01</u>	=	
<u>0.03</u>	<u>4.61</u>	<u>-41.75</u>	<u>0.42</u>	<u>-47.2</u>	<u>2</u>	<u>-51.2</u>	<u>-47.9</u>	<u>0</u>	<u>0.48</u>	<u>0.02</u>	<u>0.10</u>	

(b) Effect on the proportion of total feeding time

Intercept	Coefficient			R ²	-2LL	K	AIC	AICc	ΔAICc	w _i	p	
	#Trees fruiting	#Trees fruiting ^{^2}	#Trees fruiting ^{^2}								#Trees fruiting	#Trees fruiting ^{^2}
<u>0.19</u>	=	=	=	<u>-50.41</u>	<u>0</u>	<u>-50.4</u>	<u>-49.6</u>	<u>2.8</u>	<u>0.12</u>	=	=	
<u>0.16</u>	<u>1.26</u>	=	<u>0.24</u>	<u>-52.16</u>	<u>1</u>	<u>-54.2</u>	<u>-52.3</u>	<u>0</u>	<u>0.48</u>	<u>0.03</u>	=	
<u>0.17</u>	<u>0.31</u>	<u>14.09</u>	<u>0.21</u>	<u>-48.64</u>	<u>2</u>	<u>-52.6</u>	<u>-49.3</u>	<u>3.0</u>	<u>0.11</u>	<u>0.85</u>	<u>0.54</u>	
<u>0.03</u>	<u>4.61</u>	<u>-41.75</u>	<u>0.42</u>	<u>-47.2</u>	<u>2</u>	<u>-51.2</u>	<u>-47.9</u>	<u>0</u>	<u>0.48</u>	<u>0.02</u>	<u>0.10</u>	

R²: the proportion of variations explained in this model, -2LL: -2*Log likelihood, K:

number of parameters, AIC: Akaike's Information Criterion (indicator of model fitness),
AICc: corrected AIC for small sample size (AIC=AICc for null model), Δ AICc=
difference in AICc with the best-fit model, w_i : Akaike weight. **Bold** indicates the
best-fit model.

On page 389, replace the Table 2 with the following table:

Table 2. Generalized linear model on the effect of fruiting seasonality on seed-predation time (a) per species and (b) per individual plant

(a) Seed predation time per species

Intercept	Coefficient			R ²	-2LL	K	AIC	AICc	ΔAICc	w _i	p	
	#Trees fruiting	#Trees fruiting ²	#Trees fruiting ²								#Trees fruiting	#Trees fruiting ²
<u>0.02</u>	∶	∶	∶	<u>-114.5</u>	<u>0</u>	<u>-114.5</u>	<u>-113.6</u>	<u>0</u>	<u>0.65</u>	∶	∶	
<u>0.01</u>	<u>0.09</u>	∶	<u>0.002</u>	<u>-111.6</u>	<u>1</u>	<u>-113.6</u>	<u>-111.7</u>	<u>1.86</u>	<u>0.26</u>	<u>0.33</u>	∶	
<u>0.01</u>	<u>0.38</u>	<u>-4.28</u>	<u>0.020</u>	<u>-109.1</u>	<u>2</u>	<u>-113.1</u>	<u>-109.7</u>	<u>3.86</u>	<u>0.09</u>	<u>0.18</u>	<u>0.28</u>	

(b) Seed predation time per individual plant

Intercept	Coefficient			R ²	-2LL	K	AIC	AICc	ΔAICc	w _i	p	
	#Trees fruiting	#Trees fruiting ²	#Trees fruiting ²								#Trees fruiting	#Trees fruiting ²
<u>0.01</u>	∶	∶	∶	<u>-117.5</u>	<u>0</u>	<u>-117.5</u>	<u>-116.67</u>	<u>0</u>	<u>0.65</u>	∶	∶	
<u>0.01</u>	<u>0.09</u>	∶	<u>0.023</u>	<u>-115.0</u>	<u>1</u>	<u>-117.0</u>	<u>-115.17</u>	<u>1.5001</u>	<u>0.31</u>	<u>0.2596</u>	∶	
<u>0.01</u>	<u>0.34</u>	<u>-3.59</u>	<u>0.028</u>	<u>-112.3</u>	<u>2</u>	<u>-116.3</u>	<u>-112.95</u>	<u>3.7199</u>	<u>0.10</u>	<u>0.1929</u>	<u>0.3155</u>	

On page 391, replace Table 3 with the following table:

Table 3. Generalized linear model on the effect of fruiting seasonality on the feeding time on most frequently eaten (a) seed species and (b) plant individuals

(a) Most frequently eaten species

Intercept	Coefficient			R ²	-2LL	K	AIC	AICc	ΔAICc	w _i	p	
	#Trees fruiting	#Trees fruiting ²	#Trees fruiting ²								#Trees fruiting	#Trees fruiting ²
<u>0.04</u>	=	=	=	<u>-74.3</u>	<u>0</u>	<u>-74.3</u>	<u>-73.4</u>	<u>1.3</u>	<u>0.26</u>	=	=	
<u>0.03</u>	<u>0.55</u>	=	<u>0.17</u>	<u>-74.5</u>	<u>1</u>	<u>-76.5</u>	<u>-74.7</u>	<u>0</u>	<u>0.48</u>	<u>0.06</u>	=	
<u>0.02</u>	<u>1.60</u>	<u>-15.49</u>	<u>0.22</u>	<u>-72.8</u>	<u>2</u>	<u>-76.8</u>	<u>-73.4</u>	<u>1.2</u>	<u>0.26</u>	<u>0.11</u>	<u>0.31</u>	

(b) Most frequently eaten plant individuals

Intercept	Coefficient			R ²	-2LL	K	AIC	AICc	ΔAICc	w _i	p	
	#Trees fruiting	#Trees fruiting ²	#Trees fruiting ²								#Trees fruiting	#Trees fruiting ²
<u>0.03</u>	=	=	=	<u>-52.0</u>	<u>0</u>	<u>-71.2</u>	<u>-70.4</u>	<u>0</u>	<u>0.48</u>	=	=	
<u>0.02</u>	<u>0.49</u>	=	<u>0.09</u>	<u>-69.9</u>	<u>1</u>	<u>-71.9</u>	<u>-70.1</u>	<u>0.3</u>	<u>0.41</u>	<u>0.13</u>	=	
<u>0.01</u>	<u>1.60</u>	<u>-16.39</u>	<u>0.13</u>	<u>-67.8</u>	<u>2</u>	<u>-71.8</u>	<u>-68.5</u>	<u>1.6</u>	<u>0.22</u>	<u>0.09</u>	<u>0.23</u>	

On page 391, replace Table 4 with the following table:

Table 4. Generalized linear model on the effect of fruiting seasonality on average duration of seed-feeding event in the month

Intercept	Coefficient			R ²	-2LL	K	AIC	AICc	ΔAICc	w _i	p	
	#Trees fruiting	#Trees fruiting ²	#Trees fruiting ²								#Trees fruiting	#Trees fruiting ²
<u>3.01</u>	<u>:</u>	<u>:</u>	<u>:</u>	<u>66.3</u>	<u>0</u>	<u>66.3</u>	<u>67.2</u>	<u>0</u>	<u>0.67</u>	<u>:</u>	<u>:</u>	
<u>2.60</u>	<u>17.72</u>	<u>:</u>	<u>-0.004</u>	<u>69.3</u>	<u>1</u>	<u>67.3</u>	<u>69.1</u>	<u>2.0</u>	<u>0.25</u>	<u>0.35</u>	<u>:</u>	
<u>2.14</u>	<u>69.89</u>	<u>-769.82</u>	<u>-0.006</u>	<u>72.1</u>	<u>2</u>	<u>68.1</u>	<u>71.5</u>	<u>4.3</u>	<u>0.08</u>	<u>0.23</u>	<u>0.34</u>	

On page 391, replace Table 5 with the following table:

Table 5. Summary of the results on the effect of fruiting seasonality on seed predation behavior

Behavioral index	Predictions		Applied analysis	Figure	Table
	under predator satiation hypothesis	Effect			
(1) Total feeding time	-	Positive	GLM	Fig. 2b	Table 1b
(2) Feeding time on seeds	-	Positive	GLM	Fig. 2a	Table 1a
(3) Number of species whose seeds are eaten	Positive	<u>Marginally positive</u>	Correlation	Fig. 3a	
(4) Number of individuals whose seeds are eaten	Positive	<u>None</u>	Correlation	Fig. 3b	
(5) Average feeding time spent on seeds per species	Negative	None	GLM	Fig. 4a	Table 2a
(6) Average feeding time on seeds per individual plant	Negative	None	GLM	Fig. 4b	Table 2b
(7) Feeding time on seeds for the most frequently eaten species	Negative	Positive	GLM	Fig. 5a	Table 3a
(8) Feeding time on seeds for the most frequently eaten individual plants	Negative	<u>None</u>	GLM	Fig. 5b	Table 3b
(9) Duration of one seed-feeding event	Negative	None	GLM	Fig. 6	Table 4

On page 388, replace Fig. 1 with the following figure:

Fig. 1. Percentage of trees fruiting (including both ripe and unripe) between July 2004 and December 2008 for all the monitored trees (closed diamond) and only species eaten by red leaf monkey (open square). Data for food species were not available in March-May 2008.

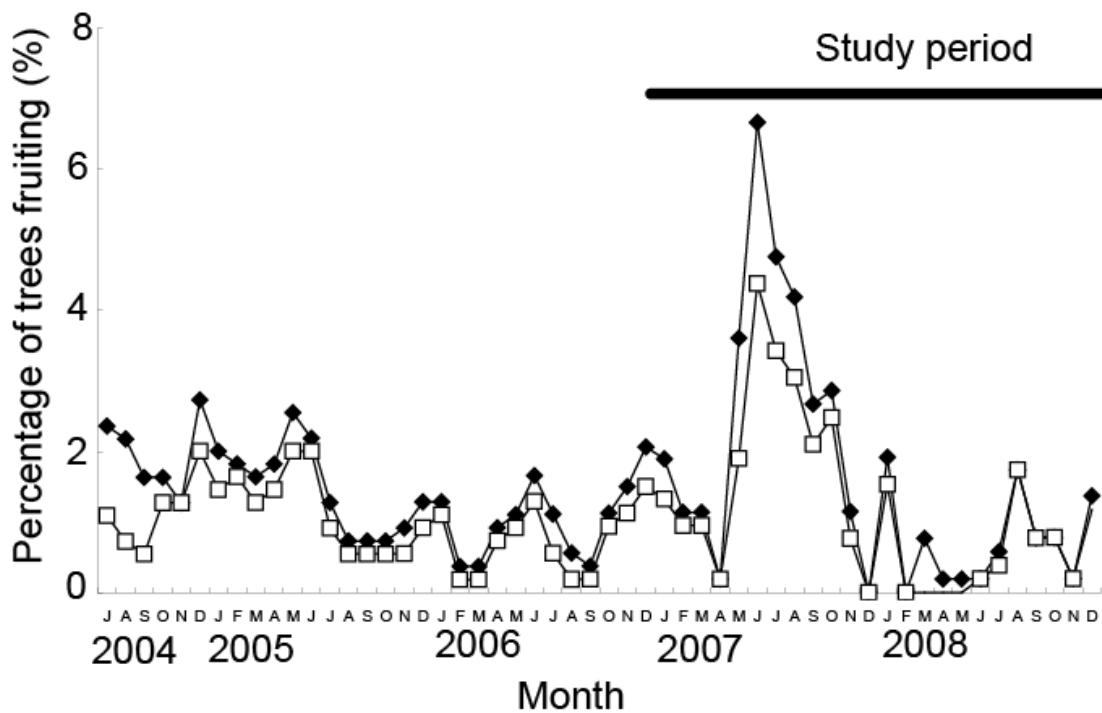


Fig. 1

On page 388, replace Fig. 2 with the following figure:

Fig. 2. The proportion of trees producing fruit eaten by red leaf monkeys in relation to (a) the proportion of time spent feeding on seeds and whole fruits and, (b) the proportion of total feeding time to total observation time of red leaf monkeys.

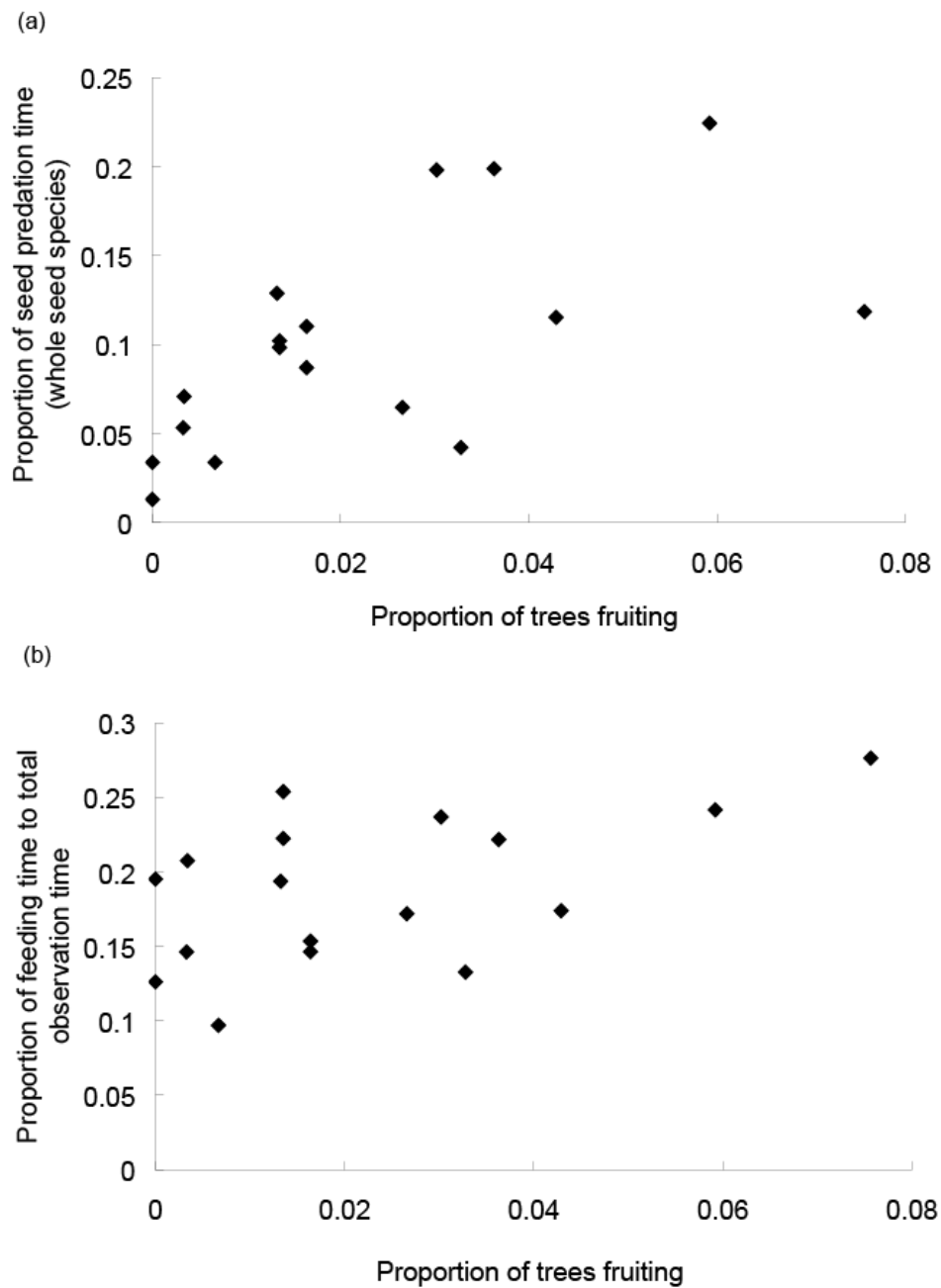


Fig. 2

On page 390, replace the Fig. 3 with the following figure:

Fig. 3. The proportion of trees producing fruit eaten by red leaf monkeys in relation to the (a) number of species and (b) number of plant individuals from which seeds were depredated by red leaf monkeys.

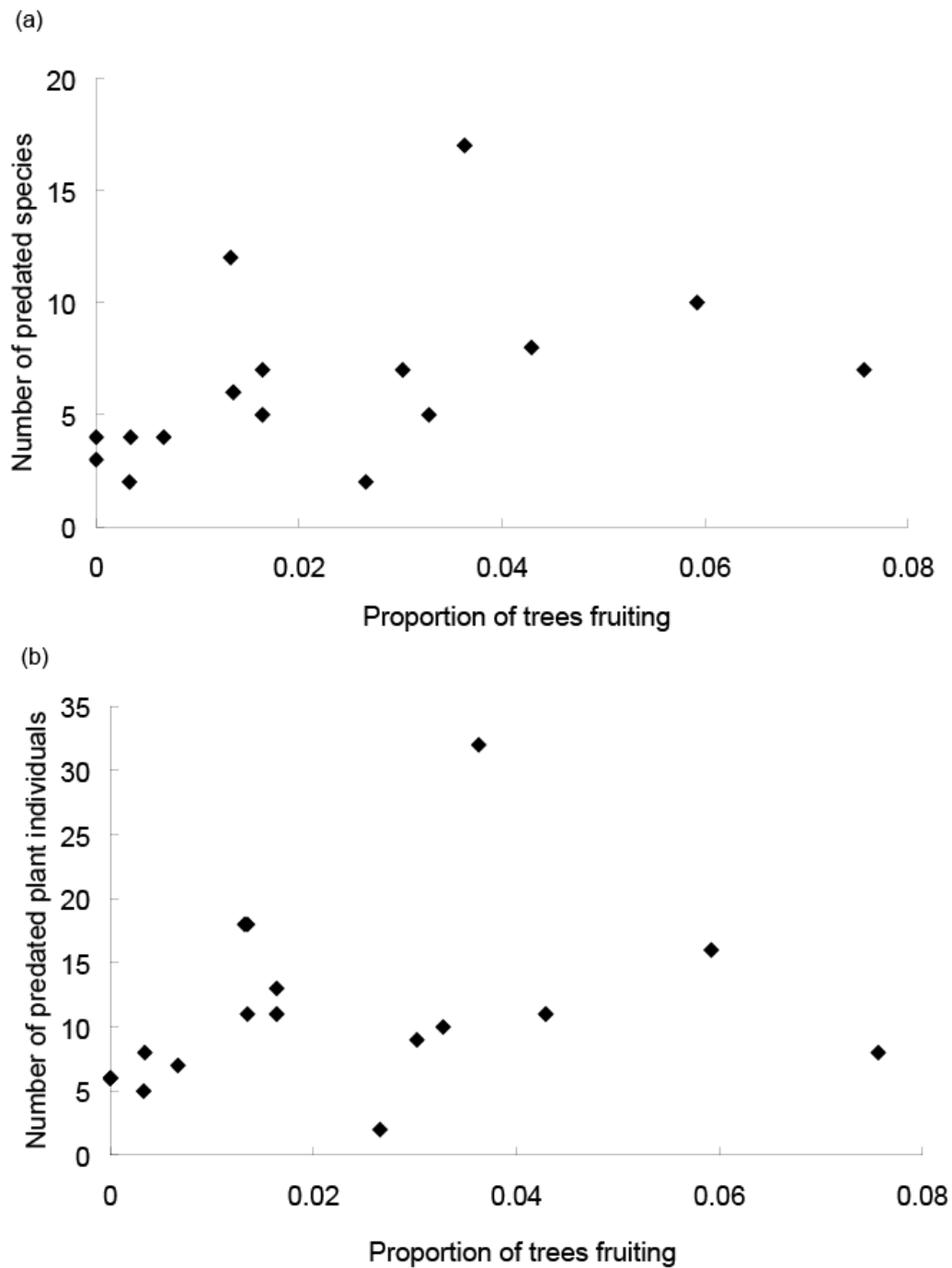


Fig. 3

On page 390, replace the Fig. 4 with the following figure:

Fig. 4. The proportion of trees producing fruit eaten by red leaf monkeys in relation to the proportion of time spent feeding on seeds and whole fruits divided by the number of (a) plant species or (b) plant individuals.

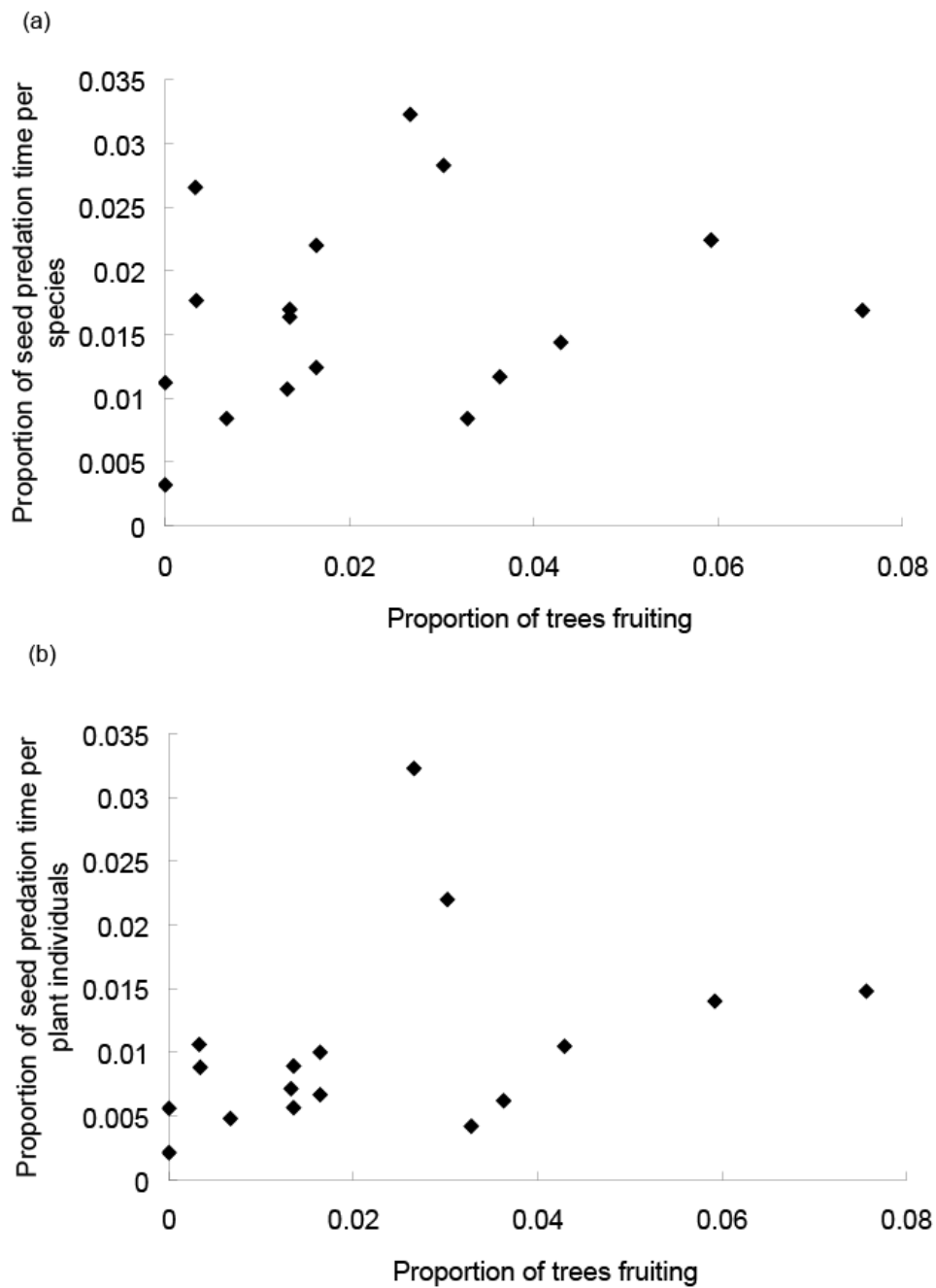


Fig. 4

On page 392, replace the Fig. 5 with the following figure:

Fig. 5. The proportion of trees producing fruit eaten by red leaf monkeys in relation to the proportion of time spent feeding on most frequently eaten seed food (a) species seeds and (b) plant individuals.

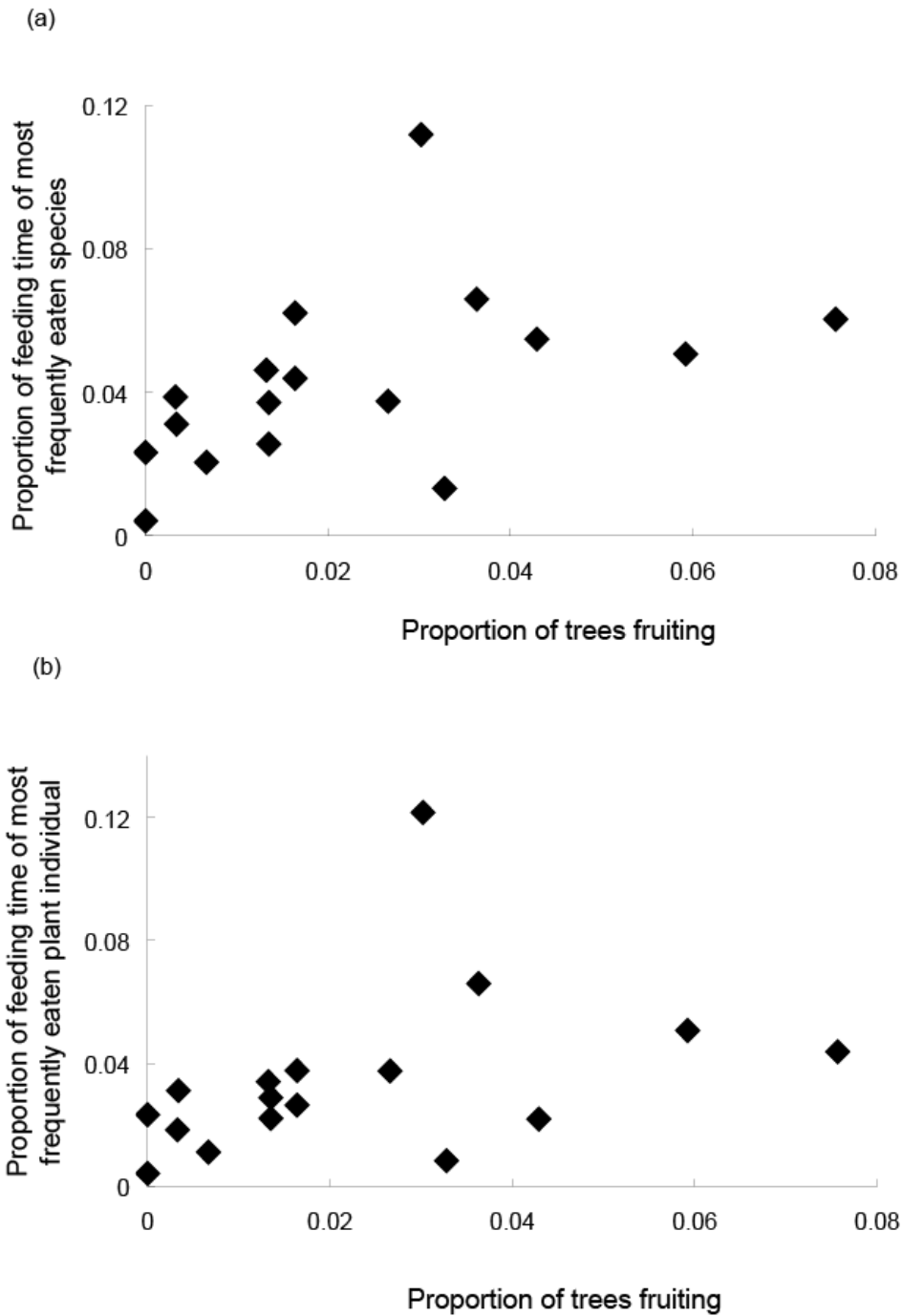


Fig. 5

On page 392, replace the Fig. 6 with the following figure:

Fig. 6. The proportion of trees producing fruit eaten by red leaf monkeys in relation to the average duration of one seed-feeding event (unit: number of scans, conducted every 10 minutes) in that month.

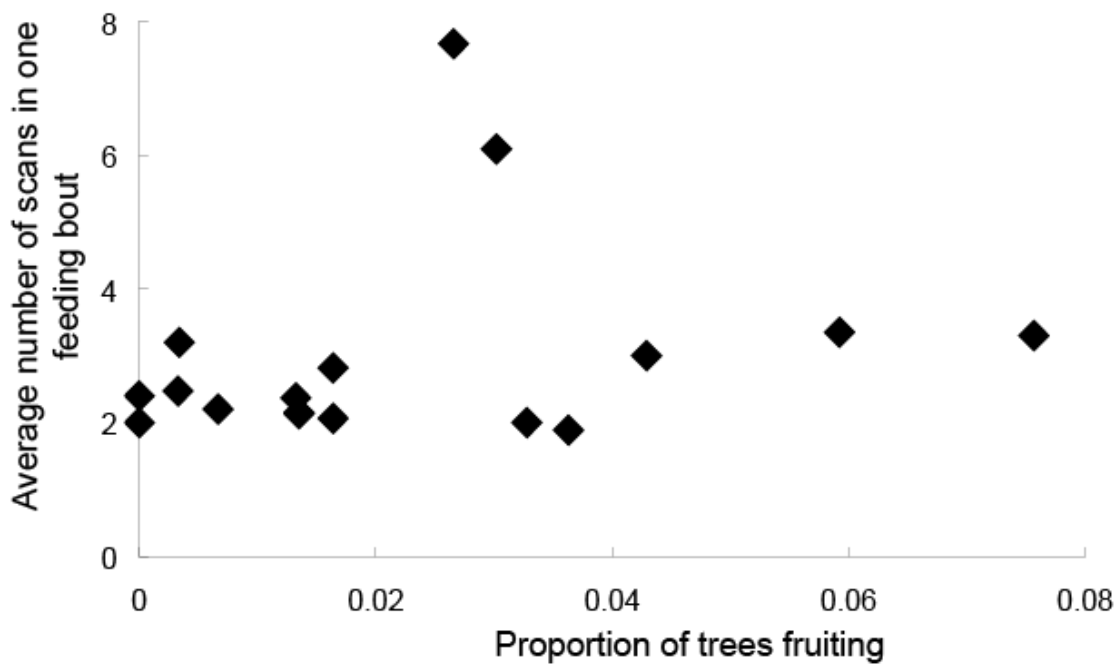


Fig. 6