Supplementary Material 2: Supplementary Figures and Tables

Dantas Oliveira et al. 2024. Secondary Amazon rainforest partially recovers tree cavities suitable for nesting birds in 18–34 years. Ornithological Applications

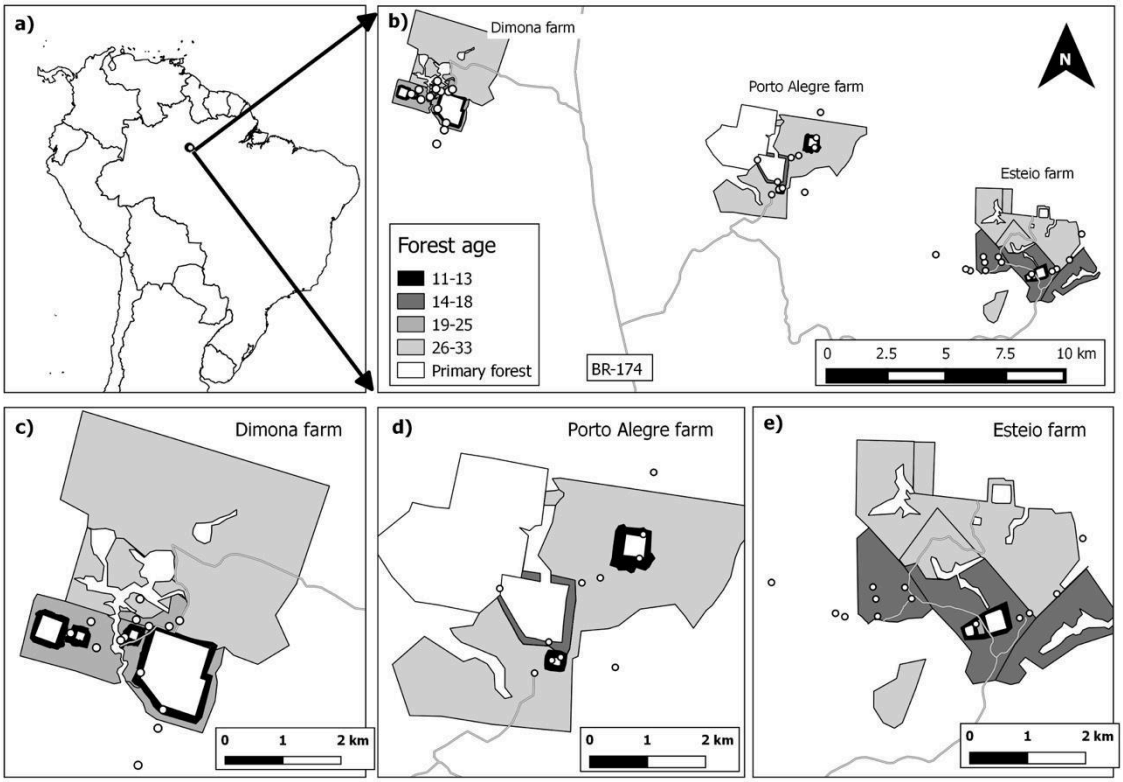

Figure S1. Location of Biological Dynamics of Forest Fragments Project (BDFFP) and map indicating forest age and location of 39 plots (white points).

Table S1. Parameter estimates for generalized linear models (quasi-Poisson family, log link) predicting cavity availability from secondary forest age, land use history (cut-and-burned vs. cut only) and their interaction.

Model	Parameter	$b \pm$ SE	t	P
Full	Intercept	-0.62 ± 1.2	-0.53	0.60
	Forest age	0.08 ± 0.04	1.94	0.06
	History (cut-and-burned)	-2.35 ± 2.65	-0.89	0.38
	Forest age × history	0.10 ± 0.11	0.97	0.34
All main effects	Intercept	-1.17 ± 1.12	-1.04	0.31
	Forest age	0.10 ± 0.04	-2.60	0.01
	History (cut-and-burned)	0.13 ± 0.52	0.25	0.80
Forest age	Intercept	-1.04 ± 0.95	-1.09	0.29
	Forest age	0.10 ± 0.04	2.78	0.01
Intercept-only	Intercept	1.33 ± 0.23	5.82	>0.001

Analysis of Deviance
Full model vs All main effects: Deviance = 6.2, df = 1, p = 0.30
All main effects vs. Forest age only: Deviance = 0.39, df = 1, p = 0.80
Forest age vs. intercept-only model: Deviance = 47.7, df = 1, p = 0.004

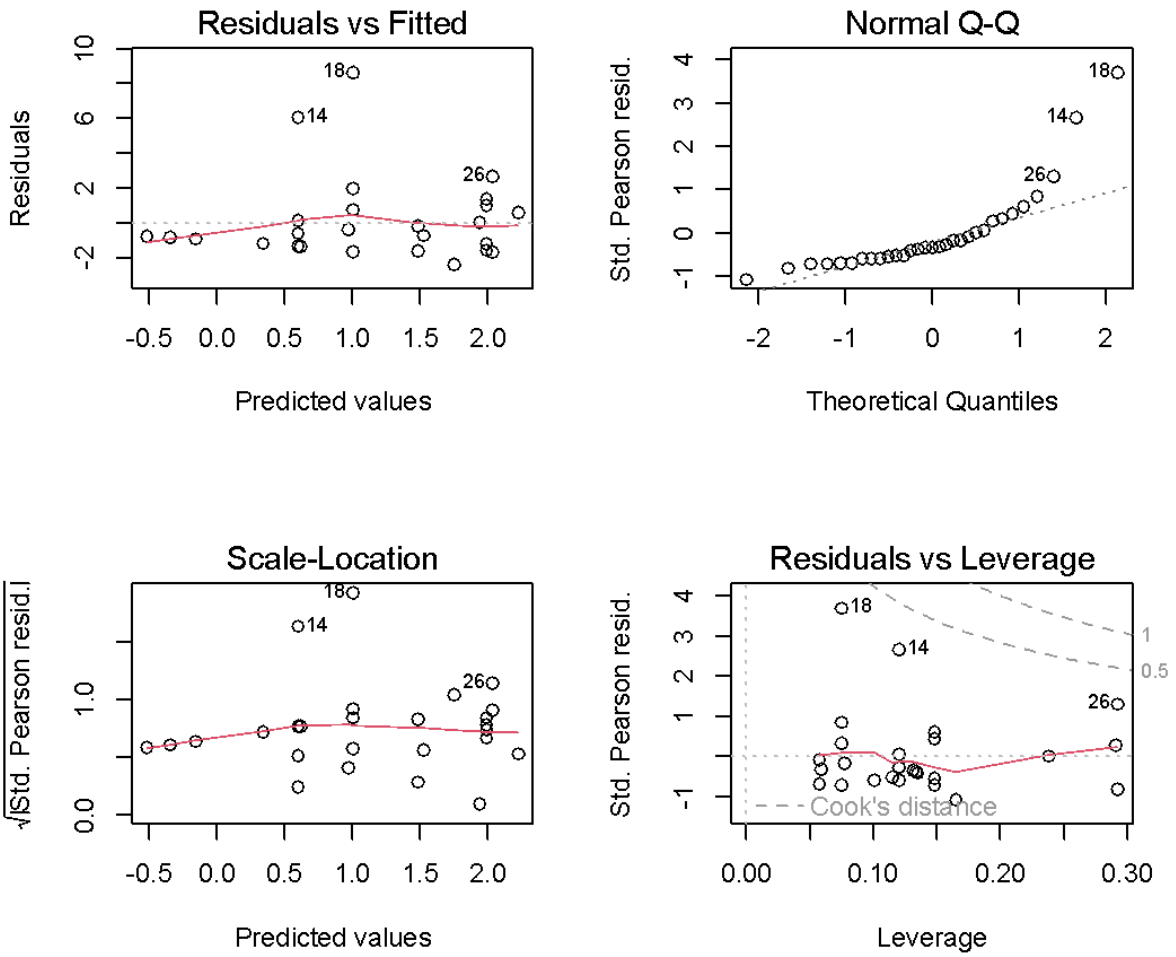

Figure S2. Model diagnostics for full generalized linear model (quasi-Poisson family, log link) predicting cavity availability from secondary forest age, land use history and their interaction.

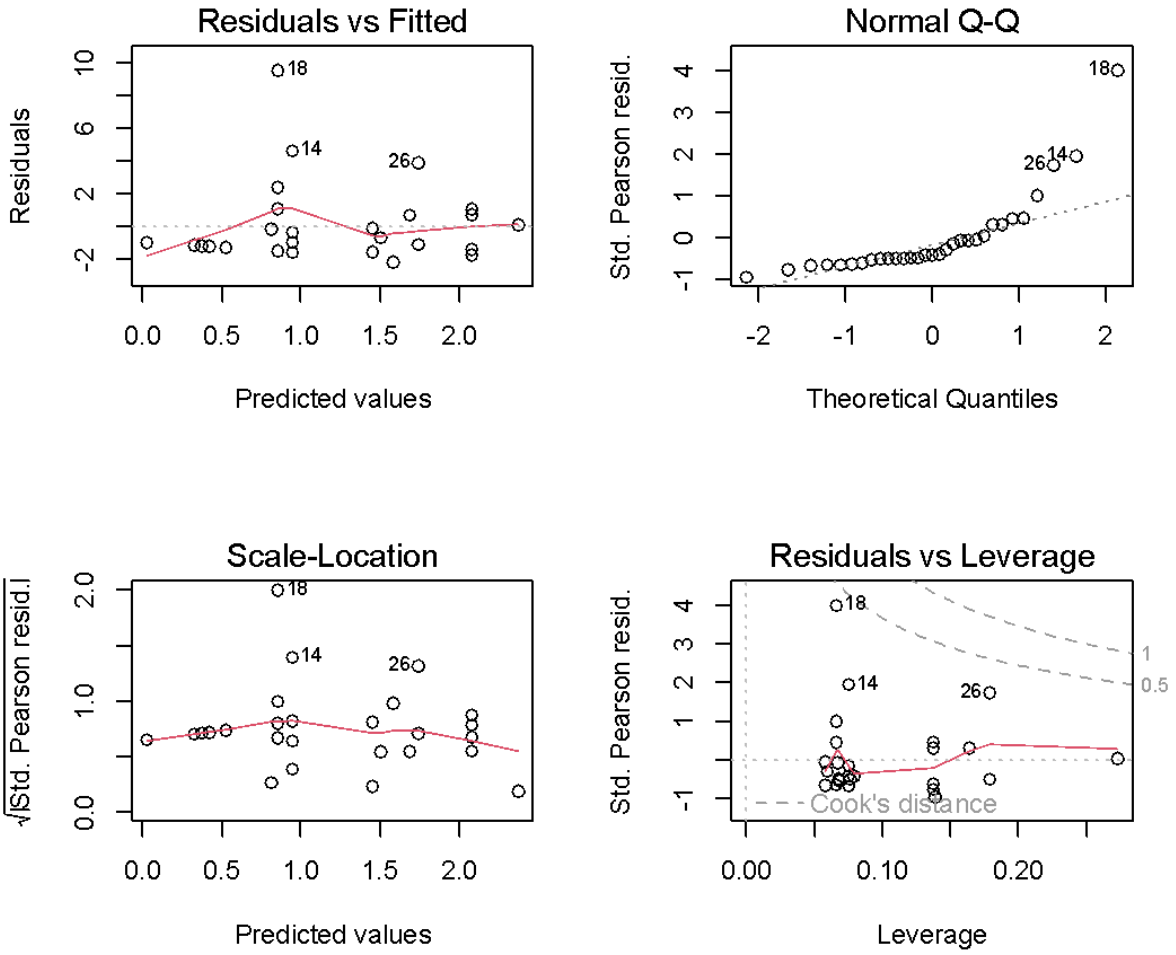

Figure S3. Model diagnostics for generalized linear model (quasi-Poisson family, log link) predicting cavity availability from secondary forest age and land use history (all main effects).

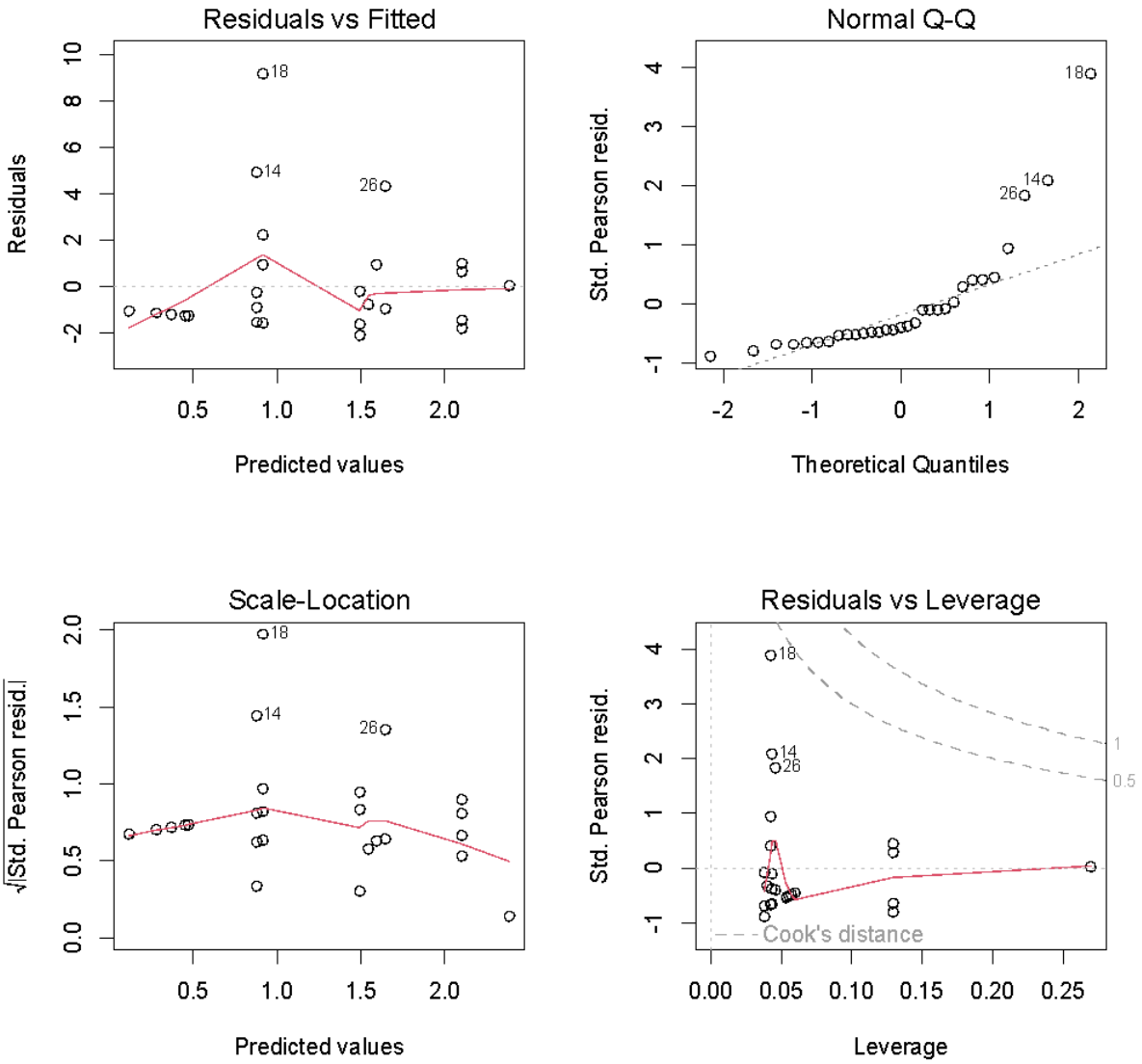

Figure S4. Model diagnostics for generalized linear model (quasi-Poisson family, log link) predicting cavity availability from secondary forest age alone.

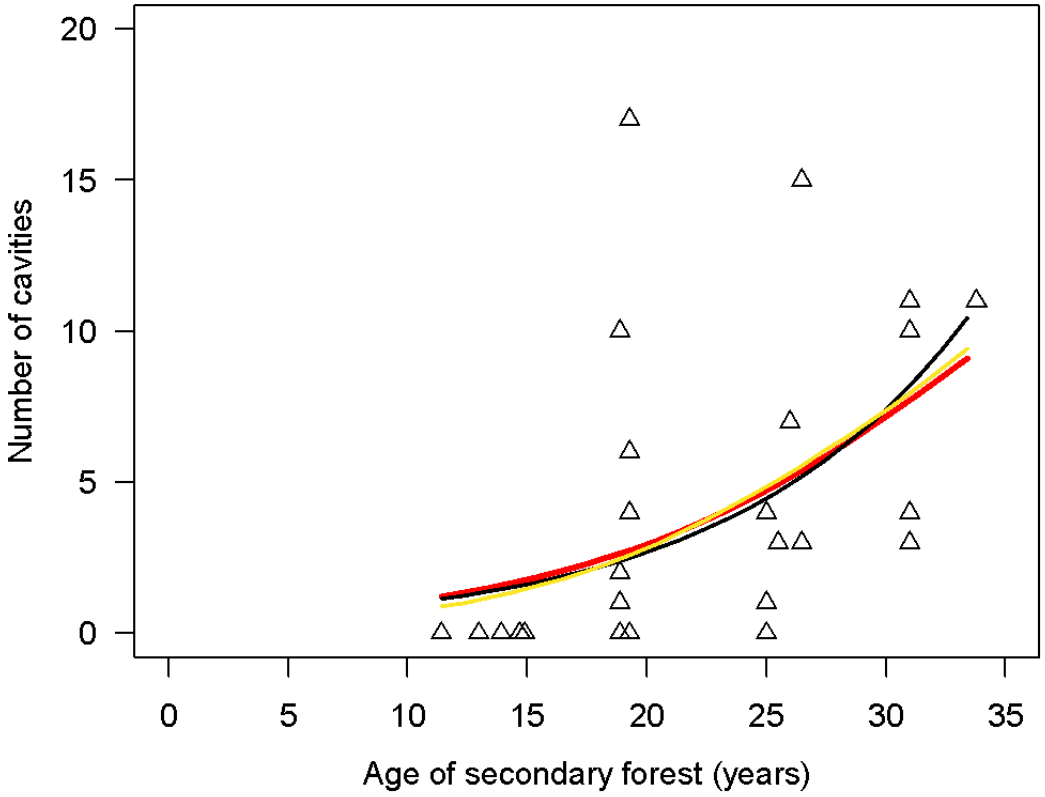

Figure S5. Relationships among forest age and cavity supply in 0.8-ha forest plots in the central Amazon (31 plots in secondary forest, 8 plots in old forest). (A) Number of cavities vs. forest age, in secondary forest (triangles). Raw data are the same as in manuscript Figure 1A. Solid lines indicate predictions of linear and non-linear models that predicted cavities as a function of forest age. The red line indicates predictions of a logistic growth curve implemented in the nls package using the nls command (asymptote = 21.7, inflection point when x = 36.3). The remaining lines are predicted values of quasi-Poisson models implemented in mgcv using the gam command. For the black line, we specified forest age to have only a linear (parametric) effect (no smoothing). Model gcv was 4.67, deviance explained was 27.3%, and the forest age parameter had $p = 0.012$. For the yellow line (generalized additive model), we specified a non-linear smoothing parameter with k = 3 for forest age. Model gcv was 4.65, deviance explained was 29.3%, and the forest age parameter had effective degrees of freedom = 1.33 and estimated $p = 0.028$. The generalized additive model (yellow) was not a significant improvement over the model without a smoothing parameter (black; Analysis of Deviance: $\chi^2 = -3.4$, $p = 0.265$).

Code

#Generalized Linear Models (quasi-Poisson family)

```
qp.IxF<-glm(Cavidades ~ Idade*Fogo, data=Ocos, family="quasipoisson")
summary(qp.IxF)
plot(qp.IxF)

qp.IF<-glm(Cavidades ~ Idade + Fogo, data=Ocos, family="quasipoisson")
summary(qp.IF)
plot(qp.IF)

qp.I<-glm(Cavidades ~ Idade, data=Ocos, family="quasipoisson")
summary(qp.I)
plot(qp.I)

qp.n<-glm(Cavidades ~ 1, data = Ocos, family = "quasipoisson")
summary(qp.n)

anova(qp.IF, qp.IxF, test="Chisq")
anova(qp.I, qp.IF, test="Chisq")
anova(qp.n, qp.I, test="Chisq")
```

#Models including non-linearities

```
#logistic growth curve
nls.I<-nls(Cavidades ~ SSlogis(Idade, Asym, xmid, scal), Ocos)
summary(nls.I)


#GAMs
library(mgcv)

gam.I.3<-gam(Cavidades ~ s(Idade, k = 3), family = quasipoisson, data=Ocos)
summary(gam.I.3)
plot(gam.I.3)

gam.I.2<-gam(Cavidades ~ s(Idade, k = 2), family = quasipoisson, data=Ocos)
summary(gam.I.2)
plot(gam.I.2)

gam.I.1<-gam(Cavidades ~ s(Idade, k = 1), family = quasipoisson, data = Ocos)
summary(gam.I.1)
plot(gam.I.1)

gam.I.0<-gam(Cavidades ~ Idade, family = quasipoisson, data = Ocos)
summary(gam.I.0)
plot(gam.I.0)

anova(gam.I.3, gam.I.0, test="Chisq")
```

```
anova(gam.I.2, gam.I.0, test="Chisq")
anova(gam.I.1, gam.I.0, test="Chisq")
```