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Changes in soil carbon and nutrients following 6 years of litter removal and addition in a tropical semi-evergreen rain forest

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Tanner, Sheldrake & Turner, Supplementary material. R models.

Model in R to predict concentrations and confidence intervals (calcium example)

GLIMP_soil_nutrients_CALCIUM

Here we show only the output of the final model. For full description of methods see associated methods document. For full analysis including model selection, see associated script ('calcium.R').

In brief: Calcium is modelled against litter treatment (C, L-, L+) and depth, with plot specified as a random effect to control for the repeated sampling (at each depth) within each plot. We use the R package nlme. The response does not vary linearly with depth, and so we use splines. The variance tends to vary with depth (heterskedasticity) and so we use a variance covariate to model the change in variance with depth. Depth is logged prior to analysis. Significance of fixed effects is ascertained using likelihood ratio tests of nested models. Where there is a significant treatment*depth interaction, we re-run the model to contrast each of L- and L+ treatments with the controls.

Final model

```
zfin=lme(calcium~treatment*ns(mlogdepth,3), random=(~1|plot), data=nutrient
s, na.action=na.exclude,method="ML", weights=varExp(form=~mlogdepth|treatme
nt))
```

Testing for significance - full model

```
zfin=lme(calcium~treatment*ns(mlogdepth,3), random=(~1|plot), data=nutrient
s, na.action=na.exclude,method="ML", weights=varExp(form=~mlogdepth|treatme
nt))


zfin1=lme(calcium~treatment+ns(mlogdepth,3), random=(~1|plot), data=nutrien
ts, na.action=na.exclude,method="ML", weights=varExp(form=~mlogdepth|treatm
ent))


zfin2=lme(calcium~treatment, random=(~1|plot), data=nutrients, na.action=na
.exclude,method="ML", weights=varExp(form=~mlogdepth|treatment))


zfin3=lme(calcium~ns(mlogdepth,3), random=(~1|plot), data=nutrients, na.act
ion=na.exclude,method="ML", weights=varExp(form=~mlogdepth|treatment))


anova(zfin,zfin1) # significance of interaction
```

```
##       Model df      AIC      BIC    logLik   Test  L.Ratio p-value
## zfin      1 17 1724.975 1773.723 -845.4876
```

```
## zfin1     2 11 1737.412 1768.954 -857.7058 1 vs 2 24.43638   4e-04
```

```
anova(zfin1,zfin2) # significance of depth
```

```
##       Model df      AIC      BIC    logLik   Test  L.Ratio p-value
## zfin1     1 11 1737.412 1768.954 -857.7058
## zfin2     2  8 1912.036 1934.976 -948.0181 1 vs 2 180.6245  <.0001
```

```
anova(zfin1,zfin3) # significance of treatment
```

```
##       Model df      AIC      BIC    logLik   Test   L.Ratio p-value
## zfin1     1 11 1737.412 1768.954 -857.7058
## zfin3     2  9 1734.279 1760.087 -858.1396 1 vs 2 0.8677126   0.648
```

Testing for significance - litter removal versus control

```
nutrients_Lrem = subset(nutrients, treatment != 'L+')


Lrem_zfin=lme(calcium~treatment*ns(mlogdepth,3), random=(~1|plot), data=nut
rients_Lrem, na.action=na.exclude,method="ML", weights=varExp(form=~mlogdep
th|treatment))


Lrem_zfin1=lme(calcium~treatment+ns(mlogdepth,3), random=(~1|plot), data=nu
trients_Lrem, na.action=na.exclude,method="ML", weights=varExp(form=~mlogde
pth|treatment))


Lrem_zfin2=lme(calcium~treatment, random=(~1|plot), data=nutrients_Lrem, na
.action=na.exclude,method="ML", weights=varExp(form=~mlogdepth|treatment))


Lrem_zfin3=lme(calcium~ns(mlogdepth,3), random=(~1|plot), data=nutrients_Lr
em, na.action=na.exclude,method="ML", weights=varExp(form=~mlogdepth|treatm
ent))


anova(Lrem_zfin,Lrem_zfin1) # significance of interaction term
```

```
##            Model df      AIC      BIC    logLik   Test L.Ratio p-value
## Lrem_zfin      1 12 1138.961 1168.552 -557.4803
## Lrem_zfin1     2  9 1139.584 1161.777 -560.7921 1 vs 2 6.62353  0.0849
```

```
anova(Lrem_zfin1,Lrem_zfin2) # significance of depth term
```

```
##            Model df      AIC      BIC    logLik   Test  L.Ratio p-value
## Lrem_zfin1     1  9 1139.584 1161.777 -560.7921
## Lrem_zfin2     2  6 1268.803 1283.598 -628.4014 1 vs 2 135.2186  <.0001
```

```
anova(Lrem_zfin1,Lrem_zfin3) # significance of treatment term
```

```
##            Model df      AIC      BIC    logLik   Test   L.Ratio p-value
## Lrem_zfin1     1  9 1139.584 1161.777 -560.7921
```

```
## Lrem_zfin3     2  8 1137.727 1157.455 -560.8638 1 vs 2 0.1433615   0.705
```

Testing for significance - litter addition versus control

```
nutrients_Ladd = subset(nutrients, treatment != 'L-')


Ladd_zfin=lme(calcium~treatment*ns(mlogdepth,3), random=(~1|plot), data=nut
rients_Ladd, na.action=na.exclude,method="ML", weights=varExp(form=~mlogdep
th|treatment))


Ladd zfin1=lme(calcium~treatment+ns(mlogdepth,3), random=(~1|plot), data=nu
trients_Ladd, na.action=na.exclude,method="ML", weights=varExp(form=~mlogde
pth|treatment))


Ladd_zfin2=lme(calcium~treatment, random=(~1|plot), data=nutrients_Ladd, na
.action=na.exclude,method="ML", weights=varExp(form=~mlogdepth|treatment))


Ladd_zfin3=lme(calcium~ns(mlogdepth,3), random=(~1|plot), data=nutrients_La
dd, na.action=na.exclude,method="ML", weights=varExp(form=~mlogdepth|treatm
ent))


anova(Ladd_zfin,Ladd_zfin1) # significance of interaction term
##            Model df      AIC      BIC    logLik   Test  L.Ratio p-value
## Ladd_zfin      1 12 1155.764 1185.216 -565.8820
## Ladd_zfin1     2  9 1158.173 1180.263 -570.0867 1 vs 2 8.409344  0.0383
anova(Ladd_zfin1,Ladd_zfin2) # significance of depth term
##            Model df      AIC      BIC    logLik   Test  L.Ratio p-value
## Ladd_zfin1     1  9 1158.173 1180.263 -570.0867
## Ladd_zfin2     2  6 1270.398 1285.124 -629.1987 1 vs 2 118.2241  <.0001
anova(Ladd_zfin1,Ladd_zfin3) # significance of treatment term
##            Model df      AIC      BIC    logLik   Test   L.Ratio p-value
## Ladd_zfin1     1  9 1158.173 1180.263 -570.0867
## Ladd_zfin3     2  8 1157.048 1176.683 -570.5242 1 vs 2 0.8749981  0.3496
```

Plot showing partial residuals and 95% CIs against log(depth)

Plots showing 95% CIs at each depth

Validation of final model

```
# plot residuals against fitted values to examine variance
```

```
zvar=resid(zfin, type='normalized')

zfit=fitted(zfin)

plot(x=zfit,y=zvar, col=nutrients$treatment)
```

```
#plot boxplot of residuals by treatment and mlogdepth to examine patterns i
n the variance and examine independence

par(mfrow=c(1,2))

plot(resid(zfin, type='normalized') ~ nutrients$treatment, xlab='treatment'
, ylab='residuals');

boxplot(resid(zfin, type='normalized') ~ nutrients$mlogdepth, xlab='log dep
th', ylab='residuals')
```

```
#plot q q plot by depth and treatment - to look at normality of fixed effec
t

qqnorm(resid(zfin, type = 'p'))
```

Model in R for confidence intervals for cumulative nutrients with cumulative depth

```
setwd("C://Users//Tommaso//Desktop")
data <- read.csv("caforR.csv",header=T)

library(lme4)
library(merTools)

M<-lmer(log(Ca)~depth*treat+(1|plot),data)
summary(M)

new.dat<-data.frame(treat=c("Con","LA","LR"),plot="Other",depth=0)


## Predictions using bootstrapping
predFun <- function(fit) {
  predict(fit,new.dat,allow.new.levels =T,re.form=NA)
}

preds <- bootMer(M,nsim=100,FUN=predFun)

Control<-exp(preds$t[,1])
LA<-exp(preds$t[,2])
LR<-exp(preds$t[,3])

quantile(Control,c(0.025,0.975))
quantile(LA,c(0.025,0.975))
quantile(LR,c(0.025,0.975))

## Plot
```

```
plot(Ca~depth,data,col=treat,pch=16,xlab="Soil depth
(cm)",ylab="Ca",xlim=c(0,200),ylim=c(0,3000))
legend("topright",c("Control","Litter addition","Litter
removal"),pch=16,col=c("black","red","green"))
```

Tanner, Sheldrake & Turner, Supplementary Table 1 original soils data.
Measured bulk density (only one replicate below 5 cm) and nutrient concentrations
LR = litter removal, Con = control, LA = litter addition, # = plot

Depth							
	Bulk density (g cm-3)	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13	'extra' pit
0-5 cm		0.68	0.73	0.7	0.67	0.75	
5-10 cm							0.84
10-15 cm							0.83
15-20 cm							0.89
20-30 cm							1.06
30-50 cm							1.21
50-100 cm							1.21
100-150 cm							1.24
150-200 cm							1.24
	Bulk density (g cm-3)	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15	
0-5 cm		0.66	0.6	0.55	0.73	0.74	
	Bulk density (g cm-3)	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14	
0-5 cm		0.49	0.63	0.55	0.53	0.7	

Depth						
	Calcium (Mehlich III cmol kg-1)	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13
0-5 cm		5.03	4.66	2.72	5.38	4.50
5-10 cm		3.93	2.70	2.32	5.51	4.01
10-15 cm		3.58	2.60	2.71	4.05	4.83
15-20 cm		2.80	1.98	1.74	6.00	3.85
20-30 cm		1.80	1.34	1.50	4.09	2.86
30-50 cm		1.21	0.42	0.55	2.01	1.98
50-100 cm		0.56	0.21	0.42	1.93	1.84
100-150 cm		0.08	0.08	0.29	1.87	0.27
150-200 cm		0.05	0.06	ND	1.18	0.28
	Calcium (Mehlich III cmol kg-1)	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15
0-5 cm		3.81	5.44	5.82	6.11	9.87
5-10 cm		2.55	2.93	5.14	3.73	6.15
10-15 cm		1.85	2.62	3.66	5.45	6.27
15-20 cm		1.71	1.62	2.60	2.18	5.91
20-30 cm		1.57	0.97	1.90	1.56	4.38
30-50 cm		0.59	0.49	0.59	0.92	3.22
50-100 cm		0.48	0.35	0.41	0.44	1.67
100-150 cm		ND	0.12	0.23	0.11	1.09
150-200 cm		ND	0.12	0.19	0.06	0.60
	Calcium (Mehlich III cmol kg-1)	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14
0-5 cm		10.89	10.17	8.34	13.94	10.84
5-10 cm		4.34	7.09	4.43	5.19	8.92
10-15 cm		3.46	5.19	4.06	3.61	6.31
15-20 cm		2.58	5.27	3.17	1.39	7.44
20-30 cm		1.57	2.69	2.36	1.27	3.51
30-50 cm		0.41	1.75	1.84	0.70	2.90
50-100 cm		0.26	1.38	1.69	0.33	1.56
100-150 cm		0.14	0.70	1.18	ND	0.69
150-200 cm		0.13	0.33	0.64	ND	0.68

Depth	Carbon total (%)	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13
0-5 cm		4.14	4.5	4.61	3.61	4.1
5-10 cm		2.59	2.79	2.91	2.93	2.72
10-15 cm		1.94	2.17	2.6	2.6	2.3
15-20 cm		1.63	1.76	1.89	2.18	1.84
20-30 cm		1.35	1.2	1.48	1.53	1.45
30-50 cm		0.99	0.78	1.08	1.05	0.86
50-100 cm		0.6	0.54	0.74	0.62	0.57
100-150 cm		0.34	0.24	0.51	0.4	0.23
150-200 cm		0.24	0.25	ND	0.29	0.19
	Carbon total (%)	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15
0-5 cm		4.68	5.57	5.84	4.86	4.81
5-10 cm		2.96	3.29	3.63	2.68	2.55
10-15 cm		2.28	2.88	2.69	2.46	2.07
15-20 cm		1.97	2.48	2.19	1.98	1.52
20-30 cm		1.66	1.67	1.62	1.46	0.99
30-50 cm		1.05	0.99	0.77	0.89	0.56
50-100 cm		0.64	0.66	0.49	0.42	0.55
100-150 cm		ND	0.29	0.29	0.29	0.32
150-200 cm		ND	0.25	0.26	0.22	0.32
	Carbon total (%)	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14
0-5 cm		6.69	5.87	6.51	4.69	5.95
5-10 cm		3.3	3.7	3.31	3.01	3.63
10-15 cm		2.64	2.76	2.86	2.44	3.01
15-20 cm		2.17	2.42	2.02	2.42	2.39
20-30 cm		1.51	1.61	1.42	1.52	1.49
30-50 cm		0.95	0.91	0.84	0.82	0.98
50-100 cm		0.68	0.75	0.57	0.53	0.56
100-150 cm		0.28	0.36	0.36	ND	0.26
150-200 cm		0.24	0.31	0.35	ND	0.2

Depth	Magnesium (Mehlich III cmol kg-1)	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13
0-5 cm		2.43	2.46	1.64	2.90	2.57
5-10 cm		2.14	1.77	1.52	3.08	2.43
10-15 cm		2.07	2.20	1.67	2.80	2.96
15-20 cm		1.80	1.99	1.38	3.63	2.83
20-30 cm		1.47	1.73	1.48	3.45	2.62
30-50 cm		1.52	1.33	1.04	1.74	2.53
50-100 cm		1.38	1.03	0.95	2.59	2.14
100-150 cm		0.96	0.51	0.93	2.47	0.78
150-200 cm		0.69	0.29	ND	1.57	0.78

Magnesium (Mehlich III cmol kg-1)	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15
0-5 cm	2.16	2.45	3.23	4.01	4.38
5-10 cm	1.78	1.83	3.10	3.28	3.23
10-15 cm	1.44	1.89	2.63	3.23	3.58
15-20 cm	1.43	1.43	2.30	2.57	3.43
20-30 cm	1.43	1.46	2.26	2.43	3.20
30-50 cm	0.91	1.67	1.16	1.62	2.76
50-100 cm	0.93	1.56	0.93	1.26	1.66
100-150 cm	ND	0.92	0.81	0.63	1.26
150-200 cm	ND	0.69	0.62	0.40	0.78
Magnesium (Mehlich III cmol kg-1)	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14
0-5 cm	4.33	2.78	3.44	4.68	3.63
5-10 cm	2.78	2.48	2.27	2.33	3.35
10-15 cm	2.52	2.20	2.31	1.89	2.94
15-20 cm	2.33	2.33	2.21	1.05	3.02
20-30 cm	2.20	2.27	2.15	0.92	2.42
30-50 cm	1.72	2.18	2.03	1.17	3.38
50-100 cm	1.10	1.83	2.10	0.91	1.77
100-150 cm	0.70	1.29	1.68	ND	1.13
150-200 cm	0.63	0.92	1.04	ND	0.97

Depth

Manganese (Mehlich III ppm)	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13
0-5 cm	249	199	310	198	292
5-10 cm	219	122	273	256	312
10-15 cm	152	62	279	265	347
15-20 cm	143	35	213	307	308
20-30 cm	105	20	166	214	252
30-50 cm	53	4	155	87	114
50-100 cm	8	2	46	32	42
100-150 cm	2	1	18	18	4
150-200 cm	1	1	ND	5	4
Manganese (Mehlich III ppm)	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15
0-5 cm	274	336	301	122	288
5-10 cm	215	289	298	104	359
10-15 cm	145	262	238	346	335
15-20 cm	150	219	150	49	306
20-30 cm	169	186	98	26	229
30-50 cm	94	114	34	6	120
50-100 cm	29	34	21	2	59
100-150 cm	ND	5	22	0	2
150-200 cm	ND	5	9	1	3

Manganese (Mehlich III ppm)	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14
0-5 cm	248	257	283	334	248
5-10 cm	252	282	276	207	268
10-15 cm	221	235	277	149	360
15-20 cm	193	220	249	143	351
20-30 cm	193	220	260	167	168
30-50 cm	165	131	196	65	130
50-100 cm	44	50	31	40	45
100-150 cm	8	7	17	ND	4
150-200 cm	4	6	4	ND	4

Depth

Nitrogen - ammonium (KCl ppm)	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13
0-5 cm	0.46	0.09	0.52	0.45	0.17
5-10 cm	0.35	0.08	0.39	0.27	0.16
10-15 cm	0.23	0.11	0.66	0.11	0.27
15-20 cm	0.16	0.06	0.26	0.08	0.21
20-30 cm	0.21	0.12	0.31	0.36	0.26
30-50 cm	0.12	0.06	0.10	0.29	0.23
50-100 cm	0.23	0.05	0.09	0.30	0.08
100-150 cm	0.09	0.07	0.08	0.27	0.20
150-200 cm	0.15	0.13	ND	0.19	0.07
Nitrogen - ammonium (KCl ppm)	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15
0-5 cm	0.15	0.14	0.36	0.48	0.23
5-10 cm	0.47	0.12	0.26	0.20	0.14
10-15 cm	0.12	0.06	0.24	0.21	0.25
15-20 cm	0.22	0.04	0.25	0.19	0.20
20-30 cm	0.36	0.01	0.26	0.21	0.30
30-50 cm	0.14	0.01	0.24	0.19	0.29
50-100 cm	0.04	0.02	0.16	0.10	0.17
100-150 cm	ND	0.01	0.49	0.05	0.17
150-200 cm	ND	0.03	0.33	0.07	0.11
Nitrogen - ammonium (KCl ppm)	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14
0-5 cm	0.63	0.40	0.14	0.25	0.88
5-10 cm	0.33	0.50	0.11	0.19	0.30
10-15 cm	0.35	0.18	0.10	0.15	0.21
15-20 cm	0.27	0.16	0.09	0.19	0.17
20-30 cm	0.47	0.34	0.15	0.20	0.28
30-50 cm	0.12	0.14	0.12	0.15	0.23
50-100 cm	0.18	0.12	0.09	0.11	0.22
100-150 cm	0.07	0.13	0.07	ND	0.25
150-200 cm	0.05	0.07	0.06	ND	0.13

Depth	Nitrogen - nitrate (KCl ppm)	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13
0-5 cm		0.081	0.028	0.051	0.063	0.158
5-10 cm		0.031	0.018	0.034	0.015	0.062
10-15 cm		0.031	0.016	0.038	0.006	0.041
15-20 cm		0.014	0.015	0.033	0.005	0.014
20-30 cm		0.017	0.012	0.025	0.008	0.013
30-50 cm		0.009	0.011	0.024	0.008	0.008
50-100 cm		0.002	0.015	0.018	0.013	0.008
100-150 cm		0.008	0.014	0.02	0.008	0.003
150-200 cm		0.01	0.021	ND	0.013	0.005
	Nitrogen - nitrate (KCl ppm)	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15
0-5 cm		0.125	0.105	0.161	0.079	0.319
5-10 cm		0.057	0.115	0.111	0.024	0.162
10-15 cm		0.073	0.142	0.085	0.039	0.102
15-20 cm		0.028	0.157	0.068	0.017	0.053
20-30 cm		0.009	0.287	0.064	0.017	0.036
30-50 cm		-0.001	0.046	0.147	0.038	0.008
50-100 cm		0.009	0.13	0.134	0.006	0.008
100-150 cm		ND	0.029	0.034	0.007	0.003
150-200 cm		ND	0.056	0.028	0.004	0.014
	Nitrogen - nitrate (KCl ppm)	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14
0-5 cm		0.411	0.617	0.232	0.311	0.889
5-10 cm		0.209	0.26	0.128	0.527	0.319
10-15 cm		0.125	0.157	0.09	0.243	0.27
15-20 cm		0.073	0.159	0.049	0.148	0.4
20-30 cm		0.024	0.045	0.032	0.091	0.07
30-50 cm		0.013	0.05	0.023	0.105	0.245
50-100 cm		0.016	0.11	0.025	ND	0.237
100-150 cm		0.028	0.069	0.026	ND	0.231
150-200 cm		0.024	0.056	0.016	ND	0.032

Depth	Nitrogen total (%)	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13
0-5 cm		0.383	0.382	0.443	0.341	0.399
5-10 cm		0.238	0.250	0.304	0.281	0.280
10-15 cm		0.164	0.200	0.262	0.262	0.238
15-20 cm		0.132	0.158	0.192	0.216	0.187
20-30 cm		0.110	0.111	0.147	0.144	0.144
30-50 cm		0.089	0.072	0.115	0.103	0.086
50-100 cm		0.054	0.046	0.076	0.061	0.057
100-150 cm		0.034	0.023	0.050	0.040	0.025
150-200 cm		0.026	0.024	ND	0.026	0.017

	Nitrogen total (%)	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15
0-5 cm		0.431	0.470	0.513	0.445	0.464
5-10 cm		0.290	0.302	0.340	0.254	0.258
10-15 cm		0.214	0.264	0.258	0.227	0.220
15-20 cm		0.190	0.219	0.214	0.176	0.153
20-30 cm		0.157	0.139	0.157	0.134	0.101
30-50 cm		0.105	0.082	0.083	0.082	0.061
50-100 cm		0.066	0.051	0.052	0.046	0.060
100-150 cm		ND	0.028	0.034	0.033	0.034
150-200 cm		ND	0.020	0.031	0.019	0.027
	Nitrogen total (%)	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14
0-5 cm		0.561	0.493	0.507	0.415	0.556
5-10 cm		0.329	0.326	0.305	0.283	0.375
10-15 cm		0.262	0.248	0.260	0.227	0.298
15-20 cm		0.214	0.209	0.194	0.229	0.240
20-30 cm		0.130	0.151	0.127	0.142	0.151
30-50 cm		0.083	0.082	0.078	0.083	0.104
50-100 cm		0.068	0.070	0.053	0.057	0.061
100-150 cm		0.027	0.041	0.041	ND	0.029
150-200 cm		0.024	0.030	0.036	ND	0.019

Depth

	pH CaCl2	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13
0-5 cm		4.5	4.6	4.3	4.6	4.4
5-10 cm		4.5	4.6	4.4	4.7	4.5
10-15 cm		4.4	4.4	4.5	4.9	4.6
15-20 cm		4.4	4.4	4.4	4.8	4.7
20-30 cm		4.3	4.3	4.4	4.9	4.5
30-50 cm		4.3	4.2	4.4	4.6	4.4
50-100 cm		4.2	4.2	4.3	4.4	4.3
100-150 cm		4.2	4.2	4.3	4.3	4.2
150-200 cm		4.2	4.2	ND	4.2	4.1
	pH CaCl2	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15
0-5 cm		4.4	5.0	4.8	4.7	4.9
5-10 cm		4.5	4.7	4.9	4.4	4.9
10-15 cm		4.4	4.6	4.7	4.2	4.8
15-20 cm		4.4	4.4	4.4	4.2	4.7
20-30 cm		4.4	ND	4.4	4.1	4.5
30-50 cm		4.3	4.2	4.2	4.1	4.5
50-100 cm		4.3	4.2	4.2	4.2	4.3
100-150 cm		ND	4.2	4.3	4.1	4.3
150-200 cm		ND	4.1	4.3	4.1	4.2

	pH CaCl2	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14
0-5 cm		5.3	5.2	5.2	5.3	5.3
5-10 cm		5.3	5.2	5.1	4.9	5.3
10-15 cm		5.3	5.1	5.0	4.4	5.3
15-20 cm		5.4	5.1	4.9	4.1	5.4
20-30 cm		4.8	4.7	4.6	4.2	4.8
30-50 cm		4.4	4.5	4.6	4.1	4.4
50-100 cm		4.3	4.4	4.5	4.2	4.3
100-150 cm		4.2	4.3	4.5	ND	4.2
150-200 cm		4.1	4.1	4.4	ND	4.1

Depth

	pH H2O	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13
0-5 cm		5.2	4.8	4.9	5.3	4.9
5-10 cm		5.1	5.1	5.0	5.4	5.1
10-15 cm		5.1	4.8	5.2	5.6	5.2
15-20 cm		5.1	5.0	5.0	5.6	5.2
20-30 cm		4.9	4.9	5.1	5.5	5.0
30-50 cm		4.8	4.8	4.8	5.1	4.8
50-100 cm		4.6	4.6	4.8	4.9	4.8
100-150 cm		4.6	4.6	4.9	4.7	4.6
150-200 cm		4.6	4.6	ND	4.7	4.5
	pH H2O	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15
0-5 cm		4.9	5.6	5.4	5.2	5.5
5-10 cm		5.1	5.2	5.5	5.2	5.5
10-15 cm		5.0	5.1	5.3	4.9	5.4
15-20 cm		5.0	5.0	4.9	5.0	5.3
20-30 cm		5.0	4.9	4.9	5.0	5.0
30-50 cm		4.9	4.9	4.7	5.0	5.0
50-100 cm		4.9	4.9	4.6	4.9	4.8
100-150 cm		ND	4.7	4.6	4.9	4.7
150-200 cm		ND	4.7	4.7	4.7	4.6
	pH H2O	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14
0-5 cm		5.7	5.7	5.8	5.8	5.7
5-10 cm		5.9	5.9	5.8	5.4	5.9
10-15 cm		5.8	5.7	5.7	5.1	5.8
15-20 cm		6.0	5.7	5.5	4.8	6.0
20-30 cm		5.2	5.3	5.3	4.8	5.2
30-50 cm		4.8	5.1	5.3	4.7	4.8
50-100 cm		4.7	5.0	5.2	4.7	4.7
100-150 cm		4.6	4.9	5.1	ND	4.6
150-200 cm		4.6	4.8	5.0	ND	4.6

Depth Phosphorus (Mehlich III ppm)	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13
0-5 cm	1.85	1.44	1.59	1.95	1.53
5-10 cm	1.55	1.09	1.29	1.97	1.27
10-15 cm	1.32	1.09	1.14	1.20	1.22
15-20 cm	1.22	0.99	0.99	1.47	1.11
20-30 cm	1.01	0.83	0.87	1.13	0.93
30-50 cm	0.86	0.60	0.57	0.68	0.87
50-100 cm	0.71	0.36	0.55	0.75	0.72
100-150 cm	0.47	0.27	0.34	0.67	0.37
150-200 cm	0.31	0.16	ND	0.46	0.27
Phosphorus (Mehlich III ppm)	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15
0-5 cm	1.58	1.76	1.84	2.15	2.33
5-10 cm	1.18	1.30	1.39	1.44	1.57
10-15 cm	1.10	1.22	1.14	1.39	1.39
15-20 cm	1.09	1.05	1.00	1.16	1.26
20-30 cm	0.97	0.82	0.97	1.02	1.22
30-50 cm	0.67	0.76	0.53	0.59	1.04
50-100 cm	0.49	0.51	0.34	0.43	0.60
100-150 cm	ND	0.30	0.24	0.11	0.43
150-200 cm	ND	0.18	0.24	0.06	0.24
Phosphorus (Mehlich III ppm)	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14
0-5 cm	2.92	2.44	2.28	3.02	2.52
5-10 cm	1.98	1.86	1.46	1.96	1.79
10-15 cm	1.68	1.52	1.20	1.75	1.26
15-20 cm	1.56	1.48	1.05	0.99	1.18
20-30 cm	1.15	1.16	0.95	0.92	0.92
30-50 cm	0.87	0.95	0.93	0.66	0.87
50-100 cm	0.64	0.75	0.68	0.41	0.57
100-150 cm	0.35	0.49	0.53	ND	0.27
150-200 cm	0.37	0.30	0.36	ND	0.26

Depth Phosphorus total (ppm)	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13
0-5 cm	271	308	319	309	377
5-10 cm	239	240	232	338	318
10-15 cm	194	189	220	299	245
15-20 cm	164	161	192	249	221
20-30 cm	170	145	155	217	206
30-50 cm	126	114	115	185	140
50-100 cm	85	104	94	184	110
100-150 cm	84	164	66	87	113
150-200 cm	67	144	ND	90	130

Phosphorus total (ppm)	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15
0-5 cm	313	327	330	368	436
5-10 cm	242	277	251	296	276
10-15 cm	210	281	202	257	264
15-20 cm	195	271	199	270	211
20-30 cm	179	200	148	163	160
30-50 cm	157	136	116	106	125
50-100 cm	119	85	106	60	153
100-150 cm	ND	54	159	74	178
150-200 cm	ND	57	129	93	131

Phosphorus total (ppm)	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14
0-5 cm	302	332	329	294	398
5-10 cm	214	252	238	248	325
10-15 cm	212	227	212	193	282
15-20 cm	169	236	193	207	250
20-30 cm	138	167	140	157	174
30-50 cm	96	148	94	106	136
50-100 cm	70	112	73	86	109
100-150 cm	33	94	62	ND	126
150-200 cm	35	95	54	ND	112

Depth

Potassium (Mehlich III cmol kg-1)	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13
0-5 cm	0.399	0.180	0.153	0.168	0.181
5-10 cm	0.209	0.021	0.066	0.181	0.089
10-15 cm	0.150	0.438	0.067	ND	0.088
15-20 cm	0.147	0.137	0.057	0.174	0.076
20-30 cm	0.204	0.090	0.031	0.107	0.052
30-50 cm	0.116	0.065	0.042	0.028	0.037
50-100 cm	0.082	0.046	0.038	0.021	0.018
100-150 cm	0.064	0.061	ND	0.019	0.059
150-200 cm	0.067	0.057	ND	0.018	0.020

Potassium (Mehlich III cmol kg-1)	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15
0-5 cm	0.128	0.209	0.196	0.236	0.354
5-10 cm	0.072	0.183	0.144	0.170	0.330
10-15 cm	0.072	0.138	0.144	0.177	0.302
15-20 cm	0.074	0.110	0.077	ND	0.263
20-30 cm	0.072	0.078	0.131	0.157	0.212
30-50 cm	0.041	0.064	0.057	0.112	0.146
50-100 cm	0.034	0.068	0.034	0.151	0.128
100-150 cm	ND	0.035	0.024	0.116	0.132
150-200 cm	ND	0.025	0.012	0.136	0.140

Potassium (Mehlich III cmol kg-1)	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14
0-5 cm	0.337	0.161	0.332	0.150	0.196
5-10 cm	0.298	0.166	0.306	0.076	0.147
10-15 cm	0.350	0.125	0.288	0.070	0.145
15-20 cm	0.309	0.115	0.226	0.059	0.108
20-30 cm	0.344	0.089	0.153	0.051	0.076
30-50 cm	0.313	0.077	0.156	0.038	0.035
50-100 cm	0.104	0.126	0.089	0.027	0.034
100-150 cm	0.008	0.012	0.061	ND	0.017
150-200 cm	0.063	0.016	0.055	ND	0.020

Depth

Zinc (Mehlich III cmol 1000 kg-1)	LR # 4	LR # 6	LR # 8	LR # 12	LR # 13
0-5 cm	5.450	4.046	7.272	5.107	4.850
5-10 cm	4.159	0.333	3.648	5.281	3.040
10-15 cm	2.807	0.000	4.612	2.180	2.859
15-20 cm	3.664	0.768	2.902	4.419	1.902
20-30 cm	2.859	0.000	1.190	1.239	0.664
30-50 cm	1.765	0.000	0.321	0.725	0.505
50-100 cm	1.963	0.000	0.844	0.000	0.508
100-150 cm	1.679	0.199	0.000	0.801	0.000
150-200 cm	1.667	0.000	0.000	0.703	0.535
Zinc (Mehlich III cmol 1000 kg-1)	Con # 1	Con # 5	Con # 7	Con # 11	Con # 15
0-5 cm	2.037	6.080	7.370	5.214	12.223
5-10 cm	0.554	2.642	3.823	1.942	6.379
10-15 cm	0.000	1.651	1.544	4.801	4.780
15-20 cm	0.092	1.086	0.138	1.526	3.187
20-30 cm	0.477	0.000	0.000	1.810	2.596
30-50 cm	0.202	0.428	0.000	0.049	1.052
50-100 cm	0.000	0.865	0.000	1.006	1.098
100-150 cm	0.000	0.000	0.000	0.404	0.131
150-200 cm	ND	0.000	0.000	0.657	0.612
Zinc (Mehlich III cmol 1000 kg-1)	LA # 2	LA # 3	LA # 9	LA # 10	LA # 14
0-5 cm	6.911	8.691	9.765	12.602	11.465
5-10 cm	1.557	4.223	4.807	2.911	7.419
10-15 cm	0.511	2.049	3.180	2.058	4.865
15-20 cm	1.187	1.884	0.000	0.251	0.966
20-30 cm	1.009	1.287	0.000	0.538	0.920
30-50 cm	0.896	0.716	0.000	0.000	1.844
50-100 cm	0.000	0.511	0.000	0.000	0.416
100-150 cm	0.300	0.743	0.000	0.000	0.370
150-200 cm	0.214	0.636	0.000	0.000	0.443

Tanner, Sheldrake & Turner, Supplementary Table S2

Modelled soil mineral concentration and confidence intervals, for Figures 1 and 2.

CT = control, LA = litter addition, LR = litter removal,

CI = 95% confidence interval, ave. = average,

	Calcium (Mehlich III cmol kg-1)					
mid depth (cm)	Ca_CT_ave.	Ca_CT_CI	Ca_LA_ave.	Ca_LA_CI	Ca_LR_ave.	Ca_LR_CI
2.5	6.07	1.75	10.72	1.81	4.30	1.67
7.5	4.62	0.87	6.64	0.90	4.04	0.83
12.5	3.79	0.79	4.94	0.82	3.63	0.75
17.5	3.16	0.74	3.93	0.77	3.19	0.71
25	2.42	0.68	2.98	0.70	2.58	0.66
40	1.50	0.68	1.95	0.70	1.74	0.65
75	0.65	0.67	1.00	0.69	0.91	0.65
125	0.27	0.63	0.50	0.64	0.51	0.61
175	0.09	0.67	0.22	0.69	0.31	0.63
	Carbon total (%)					
mid depth (cm)	C_CT_ave.	C_CT_CI	C_LA_ave.	C_LA_CI	C_LR_ave.	C_LR_CI
2.5	5.37	0.45	6.16	0.39	4.64	0.34
7.5	3.22	0.20	3.63	0.18	2.89	0.16
12.5	2.34	0.13	2.61	0.12	2.18	0.10
17.5	1.85	0.11	2.03	0.10	1.76	0.08
25	1.40	0.11	1.52	0.09	1.38	0.07
40	0.96	0.10	1.01	0.08	0.99	0.07
75	0.56	0.08	0.58	0.07	0.61	0.06
125	0.35	0.07	0.36	0.06	0.38	0.06
175	0.23	0.09	0.24	0.07	0.24	0.06
	Magnesium (Mehlich III cmol kg-1)					
mid depth (cm)	Mg_CT_ave.	Mg_CT_CI	Mg_LA_ave.	Mg_LA_CI	Mg_LR_ave.	Mg_LR_CI
2.5	3.22	0.57	3.63	0.57	2.35	0.57
7.5	2.74	0.49	2.84	0.49	2.35	0.49
12.5	2.48	0.49	2.49	0.49	2.29	0.48
17.5	2.29	0.49	2.27	0.49	2.21	0.49
25	2.06	0.49	2.04	0.49	2.09	0.49
40	1.71	0.48	1.76	0.48	1.86	0.48
75	1.20	0.48	1.40	0.48	1.45	0.48
125	0.75	0.51	1.13	0.51	1.07	0.51
175	0.45	0.54	0.95	0.54	0.81	0.54
	Nitrogen - ammonium (KCl ppm)					
mid depth (cm)	NH4_CT_ave.	NH4_CT_CI	NH4_LA_ave.	NH4_LA_CI	NH4_LR_ave.	NH4_LR_CI
2.5	0.276	0.151	0.381	0.151	0.342	0.151
7.5	0.227	0.079	0.291	0.079	0.265	0.079
12.5	0.205	0.067	0.251	0.067	0.233	0.067
17.5	0.191	0.065	0.226	0.065	0.214	0.065
25	0.177	0.065	0.201	0.065	0.196	0.065
40	0.160	0.064	0.171	0.064	0.177	0.064
75	0.139	0.061	0.134	0.061	0.156	0.060
125	0.122	0.065	0.106	0.064	0.142	0.063
175	0.112	0.073	0.088	0.072	0.133	0.070

Nitrogen - nitrate (KCl ppm)

mid depth (cm)	NO3_CT_ave.	NO3_CT_CI	NO3_LA_ave.	NO3_LA_CI	NO3_LR_ave.	NO3_LR_CI
2.5	0.141	0.077	0.487	0.096	0.068	0.042
7.5	0.100	0.045	0.274	0.053	0.037	0.035
12.5	0.082	0.039	0.192	0.047	0.025	0.034
17.5	0.072	0.038	0.147	0.047	0.019	0.033
25	0.061	0.038	0.110	0.047	0.014	0.033
40	0.049	0.037	0.079	0.046	0.011	0.033
75	0.034	0.036	0.064	0.043	0.010	0.033
125	0.024	0.036	0.065	0.047	0.012	0.033
175	0.017	0.038	0.068	0.054	0.014	0.033

Nitrogen total (%)

mid depth (cm)	Ntot_CT_ave.	Ntot_CT_CI	Ntot_LA_ave.	Ntot_LA_CI	Ntot_LR_ave.	Ntot_LR_CI
2.5	0.458	0.046	0.505	0.048	0.393	0.046
7.5	0.315	0.017	0.348	0.019	0.284	0.017
12.5	0.248	0.013	0.273	0.015	0.230	0.013
17.5	0.204	0.012	0.224	0.013	0.194	0.012
25	0.158	0.010	0.172	0.010	0.154	0.009
40	0.104	0.009	0.111	0.010	0.106	0.009
75	0.056	0.009	0.058	0.009	0.060	0.008
125	0.034	0.007	0.036	0.007	0.037	0.007
175	0.024	0.008	0.025	0.009	0.024	0.008

pH in calcium chloride

mid depth (cm)	pH_CT_ave.	pH_CT_CI	pH_LA_ave.	pH_LA_CI	pH_LR_ave.	pH_LR_CI
2.5	4.81	0.20	5.24	0.23	4.45	0.20
7.5	4.63	0.13	5.18	0.15	4.56	0.13
12.5	4.54	0.12	5.07	0.15	4.56	0.12
17.5	4.47	0.12	4.94	0.14	4.54	0.12
25	4.40	0.11	4.76	0.13	4.49	0.11
40	4.30	0.11	4.51	0.15	4.41	0.12
75	4.23	0.11	4.29	0.14	4.30	0.11
125	4.20	0.11	4.21	0.14	4.22	0.11
175	4.18	0.12	4.17	0.17	4.16	0.12

pH in water

mid depth (cm)	pH_CT_ave.	pH_CT_CI	pH_LA_ave.	pH_LA_CI	pH_LR_ave.	pH_LR_CI
2.5	5.35	0.23	5.75	0.26	4.97	0.23
7.5	5.23	0.14	5.78	0.16	5.18	0.14
12.5	5.15	0.14	5.67	0.16	5.19	0.13
17.5	5.09	0.13	5.53	0.15	5.15	0.13
25	5.01	0.12	5.33	0.14	5.07	0.12
40	4.91	0.13	5.05	0.15	4.93	0.12
75	4.79	0.12	4.80	0.15	4.76	0.12
125	4.70	0.12	4.73	0.14	4.66	0.12
175	4.65	0.13	4.70	0.17	4.60	0.12

Phosphorus (Mehlich III ppm)

mid depth (cm)	Pmeh_CT_ave.	Pmeh_CT_CI	Pmeh_LA_ave.	Pmeh_LA_CI	Pmeh_LR_ave.	Pmeh_LR_CI
2.5	1.91	0.14	2.42	0.14	1.74	0.14
7.5	1.45	0.12	1.83	0.12	1.37	0.12
12.5	1.23	0.11	1.55	0.11	1.19	0.11
17.5	1.09	0.11	1.37	0.11	1.08	0.11
25	0.94	0.11	1.18	0.11	0.96	0.11
40	0.75	0.11	0.93	0.11	0.80	0.11
75	0.49	0.12	0.59	0.12	0.59	0.12
125	0.27	0.13	0.32	0.13	0.42	0.13
175	0.13	0.13	0.14	0.13	0.30	0.13

Phosphorus total (ppm)

mid depth (cm)	Ptot_CT_ave.	Ptot_CT_CI	Ptot_LA_ave.	Ptot_LA_CI	Ptot_LR_ave.	Ptot_LR_CI
2.5	340	28	325	28	315	28
7.5	270	24	253	24	254	24
12.5	237	23	219	23	225	23
17.5	216	22	197	22	207	22
25	193	22	173	22	187	22
40	163	23	142	23	160	22
75	122	24	101	24	125	24
125	90	25	67	25	97	25
175	68	27	45	27	78	26

Potassium (Mehlich III cmol kg-1)

mid depth (cm)	K_CT_ave.	K_CT_CI	K_LA_ave.	K_LA_CI	K_LR_ave.	K_LR_CI
2.5	0.254	0.072	0.239	0.091	0.220	0.086
7.5	0.182	0.053	0.203	0.058	0.154	0.056
12.5	0.152	0.049	0.182	0.054	0.125	0.052
17.5	0.135	0.049	0.166	0.054	0.108	0.052
25	0.118	0.048	0.147	0.054	0.092	0.052
40	0.100	0.048	0.118	0.053	0.073	0.051
75	0.081	0.047	0.072	0.051	0.052	0.049
125	0.068	0.047	0.032	0.052	0.037	0.050
175	0.061	0.048	0.005	0.056	0.028	0.052

Zinc (Mehlich III cmol kg-1)

mid depth (cm)	Zn_CT_ave.	Zn_CT_CI	Zn_LA_ave.	Zn_LA_CI	Zn_LR_ave.	Zn_LR_CI
2.5	6.11	1.95	8.52	1.78	6.48	2.28
7.5	3.22	1.05	4.17	0.99	3.49	1.16
12.5	2.07	0.83	2.48	0.80	2.32	0.90
17.5	1.43	0.77	1.56	0.75	1.68	0.84
25	0.88	0.76	0.81	0.73	1.15	0.83
40	0.39	0.74	0.17	0.72	0.69	0.81
75	0.03	0.71	-0.15	0.70	0.42	0.74
125	-0.10	0.70	-0.15	0.69	0.39	0.73
175	-0.14	0.72	-0.09	0.70	0.41	0.77

Supplementary Figure 1. Expanded versions of parts of Figures 1 & 2 showing significant differences for various elements and depths; only graphs with significant differences are plotted. Data are modelled means and 95% confidence intervals. Litter removal ●, control ○, litter addition ▼.