

Soil Quality Restoration during the Natural Succession of Abandoned Cattle Pastures in Deforested Landscapes in the Colombian Amazon

**Carlos H. Rodríguez-León ^{1,2}, Clara P. Peña-Venegas ^{3,*}, Armando Sterling ², Daniel Castro ³,
Lizeth K. Mahecha-Virguez ², Yeny R. Virguez-Díaz ² and Adriana M. Silva-Olaya ⁴**

¹ Doctoral Program in Natural Sciences and Sustainable Development, Faculty of Agricultural Sciences, Universidad de la Amazonía, Florencia 180001, Caquetá, Colombia; crodriguez@sinchi.org.co

² Laboratory of Phytopathology, Amazonian Scientific Research Institute Sinchi–Faculty of Basic Sciences, Universidad de la Amazonía, Florencia 180001, Caquetá, Colombia; asterling@sinchi.org.co (A.S.); karinamahechavirguez1999@gmail.com (L.K.M.-V.); ynyro-17@hotmail.com (Y.R.V.-D.)

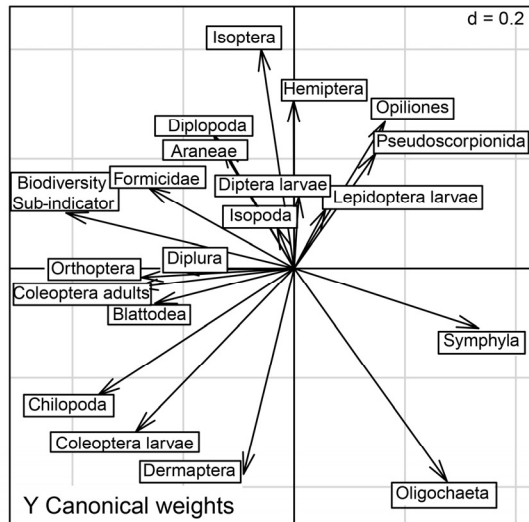
³ Laboratory of Microbiology, Amazonian Scientific Research Institute Sinchi, Leticia 910001, Amazonas, Colombia; danielkaz80@gmail.com

⁴ Laboratory of Biogeochemical Processes, Amazonian Research Center CIMAZ-MACAGUAL, Universidad de la Amazonía, Florencia 180001, Caquetá, Colombia; adr.silva@udla.edu.co

* Correspondence: cpena@sinchi.org.co; Tel.: +57-3108149907

Supplementary Figures

(a) Macrofauna communities



(b) Soil macroaggregates

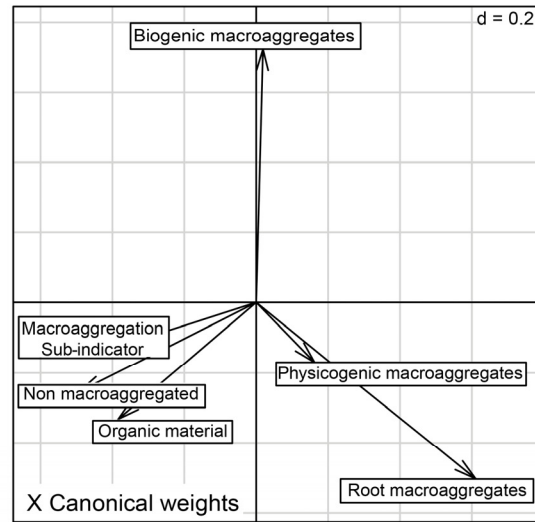
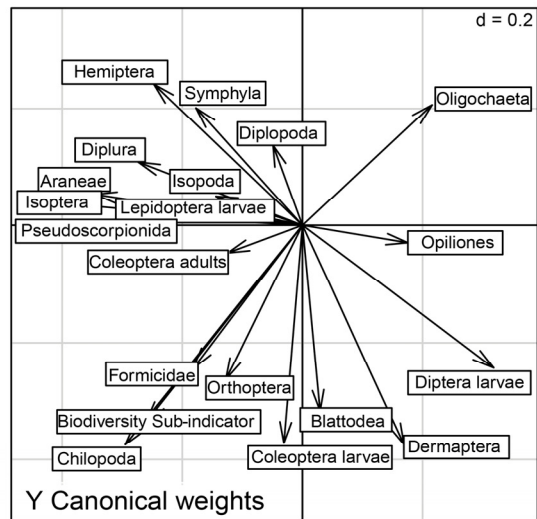


Figure S1. Coinertia analysis PC1/PC2 plane with the projection of macrofauna communities (a) and soil macroaggregates (b).

(a) Macrofauna communities



(b) Soil physical properties

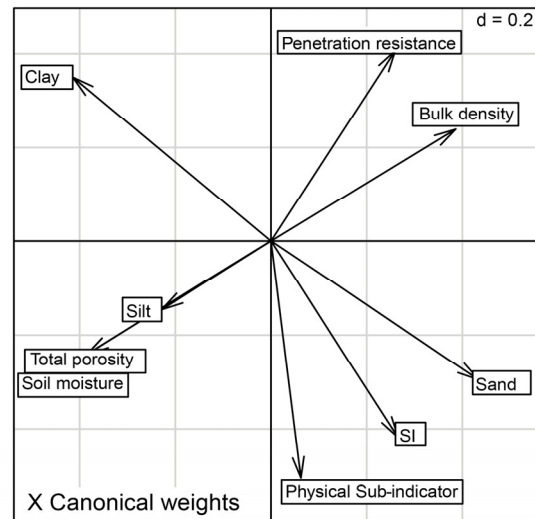
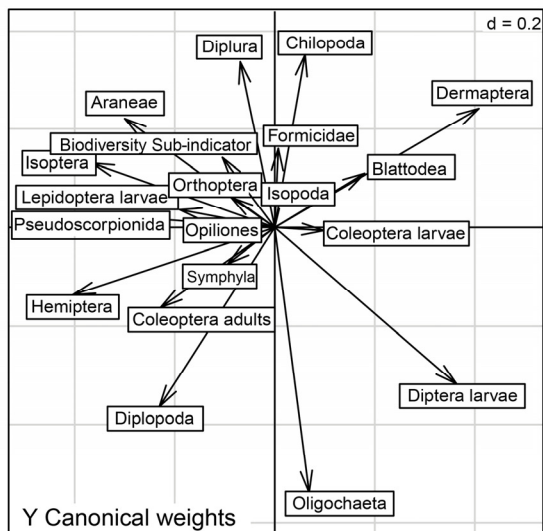


Figure S2. Coinertia analysis PC1/PC2 plane with the projection of macrofauna communities (a) and soil physical properties (b).

(a) Macrofauna communities



(b) Soil chemical properties

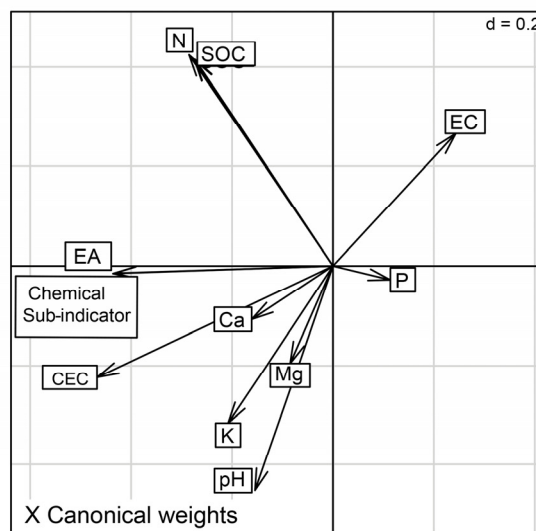
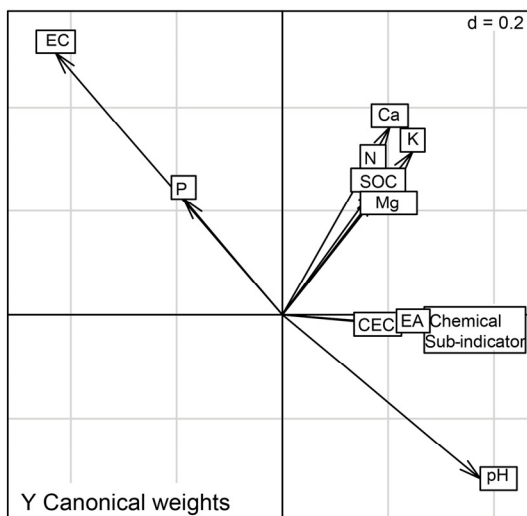


Figure S3. Coinertia analysis PC1/PC2 plane with the projection of macrofauna communities (a) and soil chemical properties (b).

(a) Soil chemical properties



(b) Soil macroaggregates

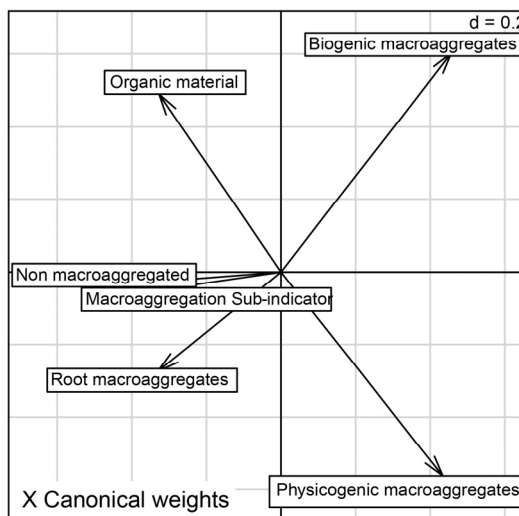
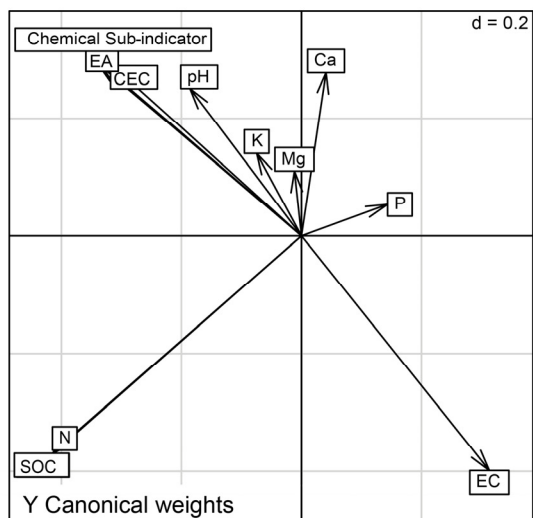


Figure S4. Coinertia analysis PC1/PC2 plane with the projection of soil chemical properties (a) and soil macroaggregates (b).

(a) Soil chemical properties



(b) Soil physical properties

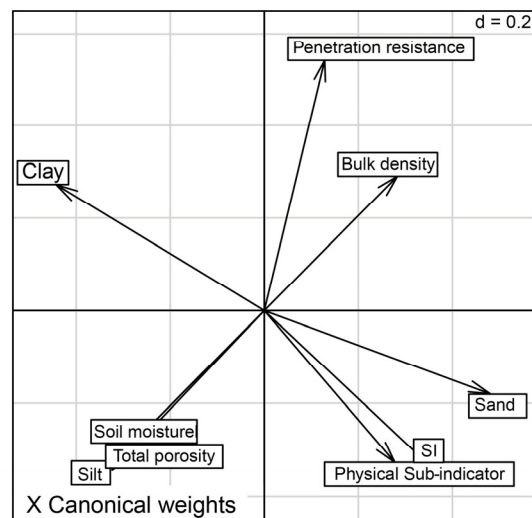
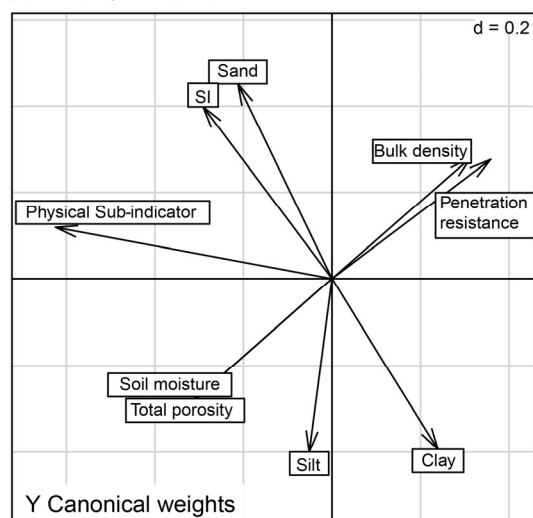


Figure S5. Coinertia analysis PC1/PC2 plane with the projection of soil chemical properties (a) and soil physical properties (b).

(a) Soil physical properties



(b) Soil macroaggregates

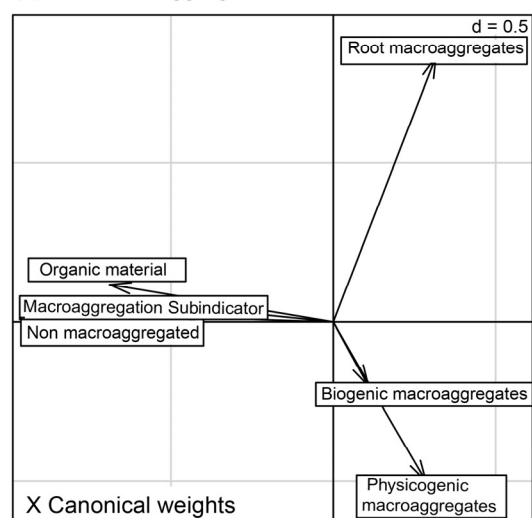


Figure S6. Coinertia analysis PC1/PC2 plane with the projection of soil physical properties (a) and soil macroaggregates (b).

Supplementary Tables

Table S1. Details of plots and soil samples collected and analyzed.

Municipality	Location	N	W	Ecosystem	Landscape	Chronosequence	Plot	No. soil macrofauna samples	No. soil macroaggregation samples	^a No. soil physical samples	^b No. soil chemical samples
Morelia	Caldas	1°30'31.41"	75°44'9.57"	Disturbed	Hill	Degraded pasture	DM11	20	5	3	3
Belén de los Andaquíes	Aletones	1°29'32.57"	75°52'20.63"	Disturbed	Hill	Degraded pasture	DM15	20	5	3	3
Florencia	Bajo caldas	1°39'39.45"	75°37'54.36"	Disturbed	Hill	Degraded pasture	DM6	20	5	3	3
Morelia	Caldas	1°30'36.47"	75°44'35.56"	Disturbed	Hill	10–20	DM10	20	5	3	3
Florencia	Bajo caldas	1°38'53.46	75°38'9.79"	Disturbed	Hill	10–20	DM16	20	5	3	3
Florencia	Palmichal	1°42'27.6"	75°35'59.8"	Disturbed	Hill	10–20	DM2	20	5	3	3
Florencia	Palmichal	1°43'1.70"	75°36'45.40"	Disturbed	Hill	10–20	DM1	20	5	3	3
Morelia	Caldas	1°30'37.05"	75°44'27.01"	Disturbed	Hill	25–40	DM12	20	5	3	3
San José del Fragua	Bellavista	1°19'16.21"	76°00'21.30"	Disturbed	Hill	25–40	DM13	20	5	3	3
Belén de los Andaquíes	El chocho	1°27'20.25"	75°48'43.93"	Disturbed	Hill	25–40	DM14	20	5	3	3
Belén de los Andaquíes	San Antonio de Padua	1°29'24.66"	75°53'23.74"	Disturbed	Hill	25–40	DM17	20	5	3	3
Florencia	Bajo caldas	1°39'23.7"	75°38'6.0"	Disturbed	Hill	25–40	DM7	20	5	3	3
Belén de los Andaquíes	San Antonio de Padua	1°29'26.91"	75°53'40.34"	Disturbed	Hill	25–40	DM8	20	5	3	3
Belén de los Andaquíes	El porvenir	1°28'22.9"	75°52'6.7"	Undisturbed	Hill	Forest	RM11	20	5	3	3
San José del Fragua	Bellavista	1°18'52.2"	76°00'53.6"	Undisturbed	Hill	Forest	RM13	20	5	3	3
Belén de los Andaquíes	Chocho alto	1°27'38.2"	75°48'28.4"	Undisturbed	Hill	Forest	RM14	20	5	3	3
Florencia	Bajo caldas	1°39'17.9"	75°38'26.6"	Undisturbed	Hill	Forest	RM3	20	5	3	3

Florencia	Caraño	1°44'38.4"	75°39'34.2"	Undisturbed	Hill	Forest	RM8	20	5	3	3
Belén de los Andaquíes	El porvenir	1°28'32.7"	75°52'3.8"	Undisturbed	Hill	Forest	RM9	20	5	3	3
Morelia	Caldas	1°24'13.68"	75°45'9.24"	Disturbed	Mountain	Degraded pasture	DL11	20	5	3	3
Morelia	Morelia	1°20'10.96"	75°41'55.32"	Disturbed	Mountain	Degraded pasture	DL10	20	5	3	3
Morelia	San Marcos	1°23'9.3"	75°39'10.38"	Disturbed	Mountain	10–20	DL12	20	5	3	3
Morelia	Lagunilla	1°26'23.6"	75°39'20.4"	Disturbed	Mountain	10–20	DL2	20	5	3	3
Belén de los Andaquíes	Puerto Torres	1°15'59.9"	75°47'23.4"	Disturbed	Mountain	10–20	DL6	20	5	3	3
Morelia	San Marcos	1°23'24.2"	75°39'4.0"	Disturbed	Mountain	25–40	DL13	20	5	3	3
Florencia	Balcanes	1°26'39.1"	75°31'29.1"	Disturbed	Mountain	25–40	DL16	20	5	3	3
Morelia	Lagunilla	1°27'21.63"	75°39'48.10"	Disturbed	Mountain	25–40	DL3	20	5	3	3
Belén de los Andaquíes	El chocho	1°25'26.6"	75°46'43.27"	Disturbed	Mountain	25–40	DL5	20	5	3	3
Belén de los Andaquíes	Puerto Torres	1°16'8.3"	75°47'17.6"	Disturbed	Mountain	25–40	DL7	20	5	3	3
Morelia	Lagunilla	1°26'28.8"	75°39'10.3"	Undisturbed	Mountain	Forest	RL2	20	5	3	3
Morelia	Lagunilla	1°27'27.9"	75°39'58.9"	Undisturbed	Mountain	Forest	RL3	20	5	3	3
San José del Fragua	El Triunfo	1°11'38.4"	75°58'19.7"	Undisturbed	Mountain	Forest	RL4	20	5	3	3

^{a,b} Soil samples obtained from the pooling of five sampling points (one pooled sample per each soil layer: 0–10, 10–20 and 20–30 cm).

Table S2. Density of soil macrofauna communities (individuals·m⁻²) in the 0–30 cm layer for the significant interaction between chronosequence and landscape.

Landscape	Chronosequence	Araneae	Coleoptera larvae	Isoptera	Pseudoscorpionida
Hill	Degraded pasture	8.00 ± 3.35 c	16.00 ± 6.74 b	364.00 ± 178.10 d	32.00 ± 4.00 ab
	10–20	122.67 ± 34.19 ab	80.00 ± 25.52 a	6048.44 ± 2409.88 ab	32.00 ± 3.27 ab
	25–40	136.00 ± 26.76 a	77.33 ± 17.46 a	6790.22 ± 1912.99 a	29.33 ± 2.21 b
	Forest	112.00 ± 31.27 ab	96.00 ± 30.52 a	5659.56 ± 2254.97 ab	18.67 ± 2.49 c
Mountain	Degraded pasture	77.33 ± 21.77 ab	106.67 ± 33.86 a	1457.00 ± 580.83 c	16.00 ± 2.31 c
	10–20	76.00 ± 18.54 ab	59.58 ± 16.58 a	2201.00 ± 759.69 bc	16.00 ± 2.00 c
	25–40	72.00 ± 14.36 b	96.00 ± 21.58 a	3402.22 ± 958.65 abc	41.33 ± 2.62 a
	Forest	104.00 ± 20.56 ab	114.67 ± 25.71 a	4186.67 ± 1179.61 ab	18.33 ± 1.75 c

Values corresponded to mean and standard error. Values in columns followed by the same letter do not differ statistically (Fisher's least significant difference LSD test, $p < 0.05$). Degraded pasture, 10–20 and 25–40: <3, 10–20 and 25–40 years of abandonment, respectively; Forest: Mature forest.