Supplemental Materials

The *aynuqa and sayaña systems* in the Bolivian Altiplano

Two types of traditional land use predominate in the Bolivian Altiplano. The *aynuqa* system consists of extensive lands that are managed collectively; and the *sayaña* consists of field plots that are managed individually (Rivière, 1994; Hervé et al., 2002). The *aynuqa* system comprised the greatest area, and is usually divided in sectors for potato, quinoa, barley, sheep grazing, and collective fallow each year, with management decisions made by the community (Pacheco Fernández, 1994; Hervé et al., 2002). The *sayaña* are small field plots located in close proximity to the farm households (Rivière, 1994). These are private lands where the management decisions, including planting time and fallowing, are made by individual farmers (Hervé et al., 2002). The fallow periods are usually short, 1-4 years, because *sayañas* are usually cultivated permanently either for grazing or for agriculture (Pacheco Fernández, 1994; Hervé et al., 2002). Formerly, sectors within the *aynuqa* were separated by fields never cropped (*puruma* fields), but the population increase since the 1950s changed this traditional system. In a study in the Pumani area, all puruma fields were occupied, and each family began to open *sayaña* fields in *puruma* soils. This process pushed the expansion of the *sayaña* fields toward the *aynuqa* (Pacheco Fernández, 1994). Today, the *sayaña* fields are mixed with the fields in the *aynuqa*.

References

Hervé D, Genin D, Migueis J. 2002. A modelling approach for analysis of agro pastoral activity at the one-farm level. *Agricultural Systems* **71**, 187-206.

Pacheco Fernández L. 1994. El sistema de *aynuqa* en Pumani dinámicas y tendencias, in: D. Hervé, et al. (Eds.), Dinámicas del descanso de la tierra en los Andes, IBTA-ORSTOM, La Paz, Bolivia. pp. 271-289.

Rivière G. 1994. El sistema de *aynuqa*: memoria e historia de la comunidad (comunidades aymara del Altiplano Boliviano), in: D. Hervé, et al. (Eds.), Dinámicas del dencanso de la tierra en los Andes, IBTA-ORSTOM, La Paz, Bolivia. pp. 89-105.

Tables

Table S1

Fields sampled at two locations in the Bolivian Altiplano representing a range of fallow periods. Some fields included both samples under thola (CT; 'thola samples') and samples away from thola (ST; 'non-thola samples). The total number of sequences obtained from 454-pyrosequencing, prior to removing singletons, is indicated. Puruma is a term for a field that has 'never' been planted to agricultural crops.

Municipality	Field Name	Thola	Fallow period (years)	Total number of sequences for Fungi	Total number of sequences for Bacteria
Umala	Campo A	ST	1	484	1005
Umala	SJC 4C	ST	2	472	1207
Umala	SJC 4	ST	3	477	957
Umala	Campo B	ST	3	462	1001
Umala	Campo C	ST	4	513	1177
Umala	Campo D	ST	5	511	894
Umala	Campo E	ST	6	403	986
Umala	Campo F	ST	7	544	996
Umala	Campo G	ST	8	521	1041
Umala	Campo H	ST	9	576	322
Umala	Campo I	ST	10	586	1106
Umala	Campo J	CT	12	577	1042
Umala	Campo J	ST	12	589	1095
Umala	Campo K	CT	15	548	1034
Umala	Campo K	ST	15	506	1151
Umala	SJC 4B	CT	20	468	1021
Umala	SJC 4B	ST	20	528	1056
Umala	Campo L	CT	25	582	1090

Umala	Campo L	ST	25	104	1316
Umala	SJC 13	ST	30	475	1008
Umala	SJC 13	CT	30	492	1121
Umala	Puruma	CT	30	530	1109
Umala	Puruma	ST	30	433	1002
Ancoraimes	Cohani 0	ST	0	464	1159
Ancoraimes	Cohani 1	ST	1	463	1181
Ancoraimes	Cohani 2B	ST	2	439	1002
Ancoraimes	Cohani 2C	ST	2	355	1082
Ancoraimes	Cohani 3	ST	3	495	959
Ancoraimes	Cohani 3B	ST	3	428	1187
Ancoraimes	Cohani 4	ST	4	468	1059
Ancoraimes	Cohani 6	ST	6	404	1102
Ancoraimes	Cohani 7	ST	7	351	1049
Ancoraimes	Cohani 10	CT	10	436	1145
Ancoraimes	Cohani 10	ST	10	391	947
Ancoraimes	Cohani 15	CT	15	496	1020
Ancoraimes	Cohani 15	ST	15	391	1024
Ancoraimes	Cohani 20	ST	20	473	1119

Table S2

The percentage of the overall most frequent fungal phyla recovered in pyrosequencing of soils ('non-thola samples') from two municipalities (Umala and Ancoraimes) in the Bolivian Altiplano.

Note that the OTU frequencies reported in Gomez-Montano et al. 2013 were calculated as frequencies of the total high-quality sequences, while the frequencies reported here were calculated as frequencies of the total high quality sequences excluding singletons. This results in a slight difference in frequencies.

Phylum	Umala (%)	Ancoraimes (%)
Ascomycota	84.52	65.21
Basidiomycota	3.81	10.85
Chytridiomycota	0.06	0.00
Glomeromycota	0.09	0.04

Table S3

Overall most frequent fungal orders recovered in pyrosequencing of soils (‘non-thola samples’) from two municipalities in the Bolivian Altiplano. The percentage of sequences grouped in each of the top 12 orders for Umala and Ancoraimes are given.

Order	Umala (%)	Order	Ancoraimes (%)
Hypocreales	44.57	Hypocreales	37.56
Pleosporales	30.39	Pleosporales	19.18
Mortierellales	3.33	Mortierellales	12.73
Sordariales	2.30	mitosporic_Filobasidiales	3.98
Capnodiales	1.68	Tremellales	3.53
Filobasidiales	1.56	Sordariales	3.23
mitosporic_Filobasidiales	1.06	Filobasidiales	2.25
Helotiales	0.86	Microascales	0.68
Eurotiales	0.82	Capnodiales	0.53
Thelebolales	0.80	Chaetothyriales	0.53
Tremellales	0.74	Helotiales	0.38
Xylariales	0.73	Eurotiales	0.23

Table S4

Overall most frequent OTUs assigned to fungal genera recovered in pyrosequencing of soils ('non-thola samples') from two municipalities in the Bolivian Altiplano. Percentage of sequences grouped in each of the top 12 OTUs assigned to fungal genera for Umala and Ancoraimes.

Genus	Umala (%)	Genus	Ancoraimes (%)
Fusarium	40.67	*Fusarium*	18.82
Didymella	27.74	*Didymella*	16.34
Mortierella	3.33	*Mortierella*	12.73
Cryptococcus	2.63	*Verticillium*	7.62
Cladosporium	1.68	*Cryptococcus*	6.41
Chaetomium	1.55	*Chaetomium*	2.97
Paecilomyces	1.28	*Neonectria*	2.33
Alternaria	1.16	*Bionectria*	1.75
Verticillium	0.99	*Clonostachys*	1.14
Penicillium	0.82	*Paraphoma*	0.93
Thelebolus	0.80	*Acremonium*	0.69
Microdochium	0.73	*Pyrenochaeta*	0.42

Table S5

Overall most frequent bacterial phyla recovered in pyrosequencing of soils ('non-thola samples') from two municipalities in the Bolivian Altiplano. The percentage sequences grouped in each of the top 12 bacteria phyla for Umala and Ancoraimes.

Phylum	Umala (%)	Phylum	Ancoraimes (%)
Proteobacteria	22.84	Proteobacteria	26.30
Actinobacteria	10.67	Firmicutes	15.79
Firmicutes	8.38	Verrucomicrobia	6.34
Acidobacteria	6.40	Actinobacteria	5.87
Verrucomicrobia	4.66	Acidobacteria	5.17
Bacteroidetes	2.87	Bacteroidetes	3.28
Planctomycetes	2.06	Planctomycetes	2.76
Chloroflexi	1.80	Chloroflexi	0.80
Cyanobacteria	0.43	Cyanobacteria	0.34
Crenarchaeota	0.40	TM7	0.18
Nitrospira	0.22	Nitrospira	0.09
OP10	0.11	OP10	0.07

Table S6

Overall most frequent OTUs assigned to bacterial genera (and strains such as Gp3) recovered in pyrosequencing of soils ('non-thola samples') from two municipalities in the Bolivian Altiplano. Percentage sequences grouped in each of the top 12 OTUs assigned to bacteria genera for Umala and Ancoraimes.

Genus	Umala (%)	Genus	Ancoraimes (%)
Paenibacillus	2.76	*Pseudomonas*	2.93
Gp4	2.57	*Bradyrhizobium*	1.94
Streptomyces	1.39	*Gp3*	1.50
Bradyrhizobium	1.24	*Singulisphaera*	0.56
Methylobacterium	1.23	*Streptomyces*	0.43
Gp3	1.04	*Segetibacter*	0.34
Segetibacter	1.03	*Modestobacter*	0.31
Modestobacter	0.80	*Dokdonella*	0.30
Singulisphaera	0.36	*Gp5*	0.25
Cystobacter	0.33	*Paenibacillus*	0.22
Pseudomonas	0.30	*Methylobacterium*	0.22
Actinoplanes	0.26	*Gemmata*	0.20

Table S7

No fungal phyla significantly increased in frequency with increasing fallow period ('non-thola samples') in either municipality of the Bolivian Altiplano (results of a GLM).

Table S8

Fungal orders significantly **increasing** in frequency with increasing fallow period ('non-thola samples') in two municipalities of the Bolivian Altiplano. Results from a GLM are shown for those taxa for which $p < 0.05$ and $q < 0.05$.

	Umala				Ancoraimes			
Order	Slope p-value	Slope q-value	Slope estimate	Intercept estimate	Slope p-value	Slope q-value	Slope estimate	Intercept estimate
Agaricales	0.015	0.009	0.103	-7.088				
Boletales	0.004	0.004	0.088	-6.293				
Capnodiales	7E-05	1E-04	0.101	-6.036				
Eurotiales	0.012	0.008	0.097	-6.844	0.070	0.043	0.022	-4.962
Hypocreales	4E-07	1E-06	0.024	-0.658				
Mortierellales	3E-06	7E-06	0.030	-2.136	5E-39	3E-38	0.078	-4.486
Onygenales	0.004	0.004	0.090	-6.369				
Saccharomycetales	0.011		0.062	-5.489				
Pleosporales					0.051	0.036	0.005	-0.916

Table S9

OTUs assigned to fungal genera significantly **increasing** in frequency with increasing fallow period ('non-thola samples') in two municipalities of the Bolivian Altiplano. Results from a GLM are shown for those taxa for which $p < 0.05$ and $q < 0.05$.

	Umala				Ancoraimes			
Genus	Slope p-value	Slope q-value	Slope estimate	Intercept estimate	Slope p-value	Slope q-value	Slope estimate	Intercept estimate
Beauveria	0.039	0.074	0.050	-5.330				
Boletus	0.049	0.085	0.066	-6.196				
Cladosporium	2E-05	1E-04	0.125	-6.551				
Fusarium	4E-04	0.002	0.020	-1.578				
Microsporum	0.004	0.019	0.090	-6.369				
Mortierella	3E-06	3E-05	0.030	-2.136	5E-39	4E-38	0.078	-4.486
Penicillium	0.012	0.041	0.097	-6.844	0.070	0.047	0.022	-4.962
Preussia	0.019	0.053	0.070	-6.019				
Schwanniomyces	0.022	0.055	0.097	-7.029				
Volutella	1E-04	6E-04	0.052	-4.132				
Didymella					7E-04	0.001	0.009	-1.096

Table S10

Fungal phyla significantly **decreasing** in frequency with increasing fallow period ('non-thola samples') in two municipalities of the Bolivian Altiplano. Results from a GLM are shown for those taxa for which $p < 0.05$.

	Umala			Ancoraimes		
Phylum	Slope p-value	Slope estimate	Intercept estimate	Slope p-value	Slope estimate	Intercept estimate
Ascomycota				0.004	-0.009	1.809
Basidiomycota	4E-06	-0.039	-1.876	1E-05	-0.034	-2.881

Table S11

Fungal orders significantly **decreasing** in frequency with increasing fallow period ('non-thola samples') in two municipalities of the Bolivian Altiplano. Results from a GLM are shown for those taxa for which $p < 0.05$ and $q < 0.05$.

	Umala				Ancoraimes			
Order	Slope p-value	Slope q-value	Slope estimate	Intercept estimate	Slope p-value	Slope q-value	Slope estimate	Intercept estimate
Microascales	0.005	0.005	-0.146	-4.359				
Phyllachorales	0.007	0.006	-0.635	-4.713	0.008	0.011	-0.053	-4.419
Pleosporales	3E-19	2E-18	-0.064	-1.075				
Capnodiales					0.015	0.013	-0.027	-3.753
Filobasidiales					0.011	0.012	-0.030	-3.817
Thelebolales					0.045	0.035	-0.034	-4.487

Table S12

OTUs assigned to fungal genera significantly **decreasing** in frequency with increasing fallow period ('non-thola samples') in two municipalities of the Bolivian Altiplano. Results from a GLM are shown for those taxa for which $p < 0.05$ and $q < 0.05$.

	Umala				Ancoraimes			
Genus	Slope p-value	Slope q-value	Slope intercept	Intercept estimate	Slope p-value	Slope q-value	Slope intercept	Intercept estimate
Acremonium	0.037	0.074	-0.082	-4.549				
Bionectria	0.033	0.074	-0.047	-3.832	0.005	0.006	-0.064	-4.502
Clonostachys	0.018	0.053	-0.071	-4.150				
Didymella	1E-20	5E-19	-0.074	-1.227				
Plectosphaerella	0.007	0.029	-0.635	-4.713	0.004	0.005	-0.061	-4.412
Alternaria					6E-06	1E-05	-0.089	-3.715
Articulospora					3E-08	1E-07	-0.343	-3.238
Chaetomium					1E-06	4E-06	-0.072	-3.477
Cladosporium					0.015	0.014	-0.027	-3.753

Table S13

Bacterial phyla significantly **increasing** in frequency with increasing fallow period ('non-thola samples') in two municipalities of the Bolivian Altiplano. Results from a GLM are shown for those taxa for which $p < 0.05$.

	Umala			Ancoraimes		
Phylum	Slope p-value	Slope estimate	Intercept estimate	Slope p-value	Slope estimate	Intercept estimate
Proteobacteria	6E-10	0.034	-2.945			
Acidobacteria				0.009	0.010	-3.271

Table S14

OTUs assigned to bacterial genera significantly **increasing** in frequency with increasing fallow period ('non-thola samples') in two municipalities of the Bolivian Altiplano. Results from a GLM are shown for those taxa for which $p < 0.05$, with corresponding q-value also indicated.

	Umala				Ancoraimes			
Genus	Slope p-value	Slope q-value	Slope estimate	Intercept estimate	Slope p-value	Slope q-value	Slope estimate	Intercept estimate
Pseudomonas	2E-27	3E-26	0.078	-4.036				
Sporosarcina	0.007	0.019	0.139	-8.789				
Gp4	8E-05	4E-04	0.065	-5.660	0.053	0.323	0.009	-3.717

Table S15

Bacterial phyla significantly **decreasing** in frequency with increasing fallow period ('non-thola samples') in two municipalities of the Bolivian Altiplano. Results from a GLM are shown for those taxa for which $p < 0.05$.

	Umala			Ancoraimes		
Phylum	Slope p-value	Slope estimate	Intercept estimate	Slope p-value	Slope estimate	Intercept estimate
Acidobacteria	0.021	-0.020	-3.199			
Actinobacteria	0.042	-0.033	-4.321	0.067	-0.008	-3.366
Planctomycetes	0.042	-0.040	-4.622			
Verrucomicrobia	0.002	-0.035	-3.608			
Bacteroidetes				0.005	-0.022	-4.126
Firmicutes				2E-12	-0.042	-3.147

Table S16

OTUs assigned to bacterial genera significantly **decreasing** in frequency with increasing fallow period ('non-thola samples') in two municipalities of the Bolivian Altiplano. Results from a GLM are shown for those taxa for which $p < 0.05$, with q-values also indicated.

	Umala				Ancoraimes			
Genus	Slope p-value	Slope q-value	Slope estimate	Intercept estimate	Slope p-value	Slope q-value	Slope estimate	Intercept estimate
Bradyrhizobium	0.019	0.036	-0.028	-3.760	0.045	0.323	-0.015	-4.195
Dokdonella	0.010	0.021	-0.111	-5.289				
Gp2	0.004	0.019	-0.048	-4.220				
Gp3	0.007	0.019	-0.037	-3.984				
Gp5	0.047	0.073	-0.082	-5.564				
Modestobacter	0.007	0.019	-0.115	-5.227				
Singulisphaera	0.031	0.054	-0.052	-4.879				
Paenibacillus					2E-12	8E-11	-0.042	-3.156
Pseudomonas					7E-06	1E-04	-0.179	-4.619
Segetibacter					0.002	0.036	-0.026	-4.266

Table S17

Comparison of fungal phyla in paired samples collected under the common fallow-period shrub species (thola; Asteraceae), 'thola samples', and at least one m away from thola, 'non-thola samples'. The p-value from a generalized linear model comparing the means is given (where NA indicates that phylum was present in fewer than three samples). Bold font indicates which had higher frequency, non-thola or thola samples.

		Mean frequency (%)	
Phylum	p-value	Non-thola samples	Thola samples
Basidiomycota	**9E-06**	1.83	**4.06**
Chytridiomycota	NA	0.03	**0.11**
Glomeromycota	NA	**0.17**	0.03

Table S18

The most frequent fungal orders in paired samples collected under the common fallow-period shrub species (thola; Asteraceae), 'thola samples', and at least one m away from thola, 'non-thola samples'. The p-value from a generalized linear model comparing the means is given (where NA indicates that an order was present in fewer than three samples), along with associated q-value. Bold font indicates which had the higher frequency, non-thola or thola samples.

			Mean frequency (%)	
Order	p-value	q-value	Non-thola samples	Thola samples
Agaricales	0.985	0.999	0.20	**0.35**
Botryosphaeriales	1.000	0.999	0.00	**0.47**
Capnodiales	1E-06	**3E-05**	0.49	**2.15**
Chaetothyriales	0.361	0.575	**0.35**	0.24

Coniochaetales	0.670	0.909	**0.10**	0.06
Cystofilobasidiales	NA	NA	0.00	**0.03**
Dothideales	0.994	0.999	**0.28**	0.23
Entylomatales	NA	NA	0.07	**0.14**
Erythrobasidiales	NA	NA	0.00	**0.12**
Eurotiales	0.133	0.281	**0.86**	0.56
Filobasidiales	3E-06	**3E-05**	0.53	**2.20**
Glomerales	NA	NA	**0.08**	0.03
Helotiales	0.031	**0.098**	0.23	**0.62**
Microascales	0.077	0.210	**0.43**	0.17
Mortierellales	2E-05	**1E-04**	**5.71**	3.76
Ophiostomatales	NA	NA	**0.04**	0.03
Phyllachorales	0.387	0.575	**0.54**	0.42
Sordariales	0.003	**0.016**	**1.87**	0.70
Spizellomycetales	NA	NA	0.03	**0.11**
Thelebolales	0.394	0.575	**0.37**	0.24
Tilletiales	NA	NA	0.00	**0.06**
Tremellales	1.000	0.999	0.00	**0.41**
Ustilaginales	NA	NA	**0.04**	0.03
Xylariales	0.196	0.372	**0.46**	0.26

Table S19

The most frequent OTUs assigned to fungal genera in paired samples collected under the common fallow-period shrub species (thola; Asteraceae), 'thola samples', and at least one m away from thola, 'non-thola samples'. The p-value from a generalized linear model comparing the means is given, along with associated q-value. Bold font indicates which had the higher frequency, non-thola or thola samples.

			Mean frequency (%)	
Genus	p-value	q-value	Non-thola samples	Thola samples
Alternaria	0.12	0.40	0.20	**0.45**
Bionectria	0.18	0.40	0.24	**0.44**
Cercophora	0.03	**0.10**	**0.58**	0.12
Chaetomium	0.03	0.11	**0.78**	0.35
Cladosporium	4E-06	**1E-04**	0.46	**1.41**
Cryptococcus	9E-04	**6E-03**	1.47	**2.77**
Didymella	1E-03	**6E-03**	**31.80**	26.28
Fusarium	0.45	0.62	42.05	**43.92**
Microdochium	0.20	0.40	**0.46**	0.26
Mortierella	2E-05	**3E-04**	**5.28**	3.65
Paecilomyces	1E-04	**1E-03**	**1.12**	0.28
Paraphoma	0.02	0.10	0.35	**0.89**
Penicillium	0.13	0.35	**0.48**	0.20
Plectosphaerella	0.48	0.63	**0.47**	0.39
Preussia	0.70	0.84	0.09	**0.10**
Stagonospora	0.09	0.31	0.14	**0.34**
Verticillium	0.01	**0.05**	**1.07**	0.50

Table S20

The most frequent bacterial phyla in paired samples collected under the common fallow-period shrub species (thola; Asteraceae), 'thola samples', and at least one m away from thola, 'non-thola samples'. The p-value from a generalized linear model comparing the means is given (where NA indicates that a phylum was present in fewer than three samples). Bold font indicates which had the higher frequency, non-thola or thola samples.

		Mean frequency (%)	
Phylum	p-value	Non-thola samples	Thola samples
Bacteroidetes	**1E-07**	2.10	**3.65**
Chlamydiae	0.101	0.05	**0.14**
Chloroflexi	**0.084**	**1.90**	1.50
Crenarchaeota	0.430	**0.43**	0.34
Cyanobacteria	**3E-05**	**0.58**	0.09
Deinococcus-Thermus	NA	**0.03**	0.02
Euryarchaeota	NA	**0.05**	0.02
Gemmatimonadetes	NA	0.01	**0.03**
Nitrospira	0.178	**0.21**	0.11
OP10	0.471	**0.13**	0.09
Planctomycetes	0.203	**2.05**	1.77
TM7	0.331	0.04	**0.09**
Verrucomicrobia	**1E-05**	**4.35**	2.90

Table S21

The most frequent OTUs assigned to bacterial genera in paired samples collected under the common fallow-period shrub species (thola; Asteraceae), 'thola samples', and at least one m away from thola, 'non-thola samples'. The p-value from a generalized linear model comparing the means is given, along with associated q-value (where NA indicates that a genus was present in fewer than three samples). Bold font indicates which had the higher frequency, non-thola or thola samples.

			Mean frequency (%)	
Genus	p-value	q-value	Non-thola samples	Thola samples
Actinoplanes	0.449	0.200	0.18	**0.24**
Amycolatopsis	0.756	0.247	**0.09**	0.08
Anaeromyxobacter	0.420	0.200	**0.06**	0.03
Aquicella	NA	NA	0.00	**0.03**
Bacillariophyta	NA	NA	**0.06**	0.01
Belnapia	0.357	0.195	**0.19**	0.12
Bradyrhizobium	0.078	**0.091**	1.08	**1.42**
Burkholderia	NA	NA	0.02	0.02
Chitinophaga	NA	NA	0.02	0.02
Chryseobacterium	NA	NA	0.02	0.02
Cystobacter	0.185	0.139	0.27	**0.40**
Deinococcus	NA	NA	**0.03**	0.02
Devosia	NA	NA	0.00	**0.03**
Dokdonella	0.666	0.236	**0.05**	0.03
Dyadobacter	NA	NA	0.00	**0.03**
Ferruginibacter	NA	NA	0.00	**0.03**
Gemmata	0.414	0.200	0.08	**0.13**
Gemmatimonas	NA	NA	0.01	**0.03**
Gp2	NA	NA	**0.02**	0.01

Gp3	0.002	**0.004**	**1.07**	0.56
Gp4	0.060	**0.084**	**3.01**	2.46
Gp5	0.649	0.236	**0.15**	0.13
Gp7	0.992	0.309	0.38	**0.39**
Haloferula	NA	NA	0.01	**0.02**
Herpetosiphon	0.519	0.201	**0.06**	0.03
Hymenobacter	0.491	0.200	**0.14**	0.09
Iamia	0.240	0.161	**0.08**	0.03
Kineosporia	NA	NA	0.01	**0.06**
Lentzea	0.263	0.168	**0.10**	0.05
Methylobacterium	0.002	**0.004**	1.13	**1.81**
Modestobacter	0.095	**0.098**	0.80	**1.08**
Mucilaginibacter	0.146	0.117	0.02	**0.08**
Nitrospira	0.108	**0.098**	**0.16**	0.06
Opitutus	0.559	0.210	**0.07**	0.05
Paenibacillus	1E-12	**1E-11**	**2.12**	0.58
Parachlamydia	NA	NA	**0.03**	0.02
Phenylobacterium	0.716	0.240	**0.21**	0.19
Pseudomonas	5E-05	**3E-04**	0.05	**0.54**
Pseudonocardia	0.494	0.200	**0.14**	0.09
Ralstonia	0.059	**0.084**	**0.13**	0.03
Rhodopila	0.147	0.117	**0.08**	0.02
Rickettsia	NA	NA	0.00	**0.02**
Roseomonas	NA	NA	**0.03**	0.02
Rubellimicrobium	0.502	0.200	**0.13**	0.09
Rubrobacter	NA	NA	0.00	**0.03**
Sandaracinobacter	NA	NA	0.00	**0.02**
Segetibacter	0.057	**0.084**	0.78	**1.09**
Singulisphaera	0.066	**0.084**	**0.29**	0.14
Solirubrobacter	0.367	0.195	**0.10**	0.06

Sorangium	0.714	0.240	0.22	**0.25**
Sphingobium	0.016	**0.033**	0.03	**0.19**
Sporosarcina	0.955	0.305	0.03	0.03
Stigmatella	0.499	0.200	**0.08**	0.05
Streptomyces	0.007	**0.018**	**1.24**	0.78
Xanthomonas	0.196	0.139	0.01	**0.06**

Supplemental Figures

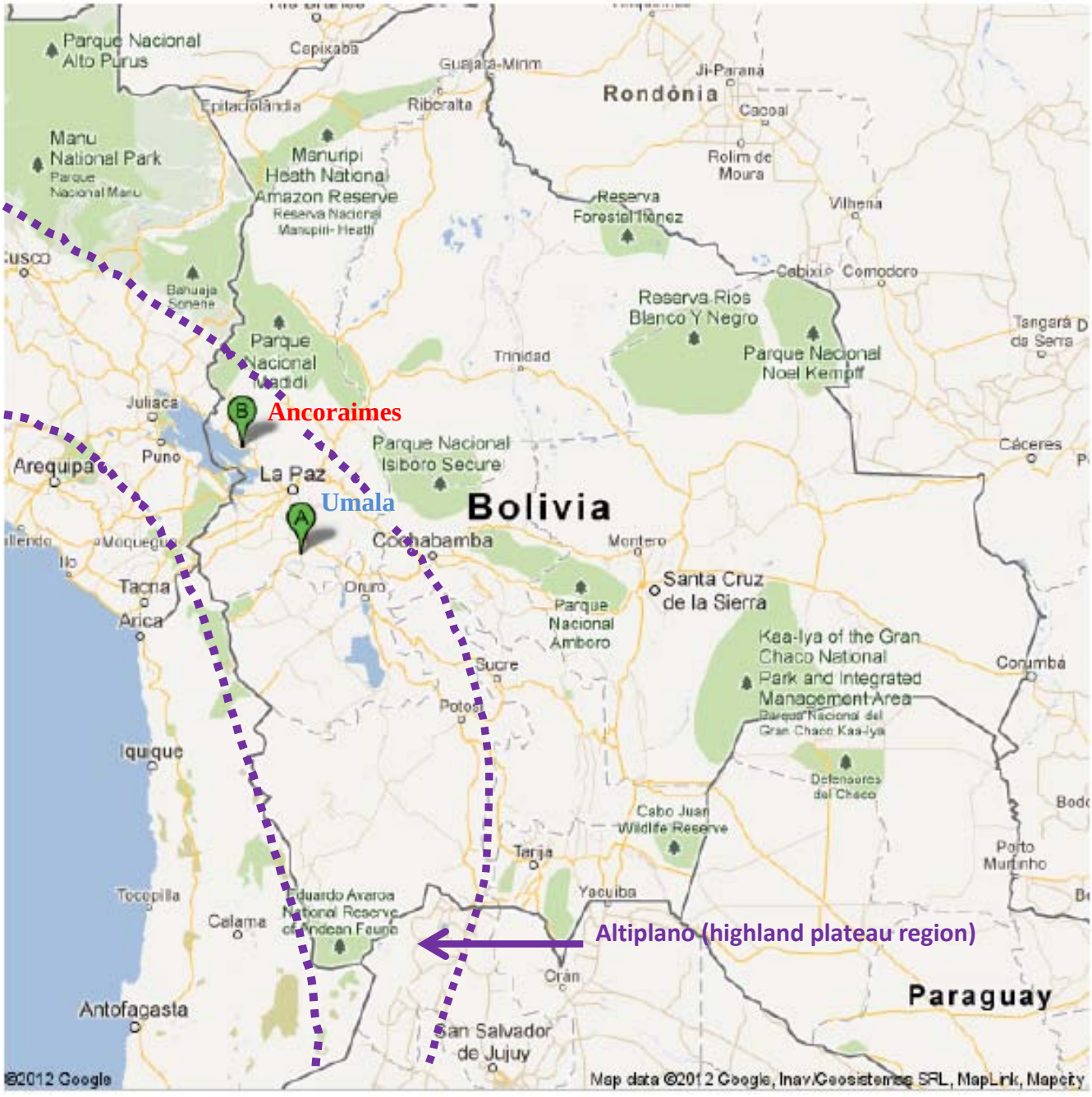


Fig. S1. The Bolivian Altiplano (highland-plateau) region and the location of the two municipalities Umala and Ancoraimes. Google map (Map data©2012 Google, Inav/Geosistemas SRL, MapLink, Mapcity).

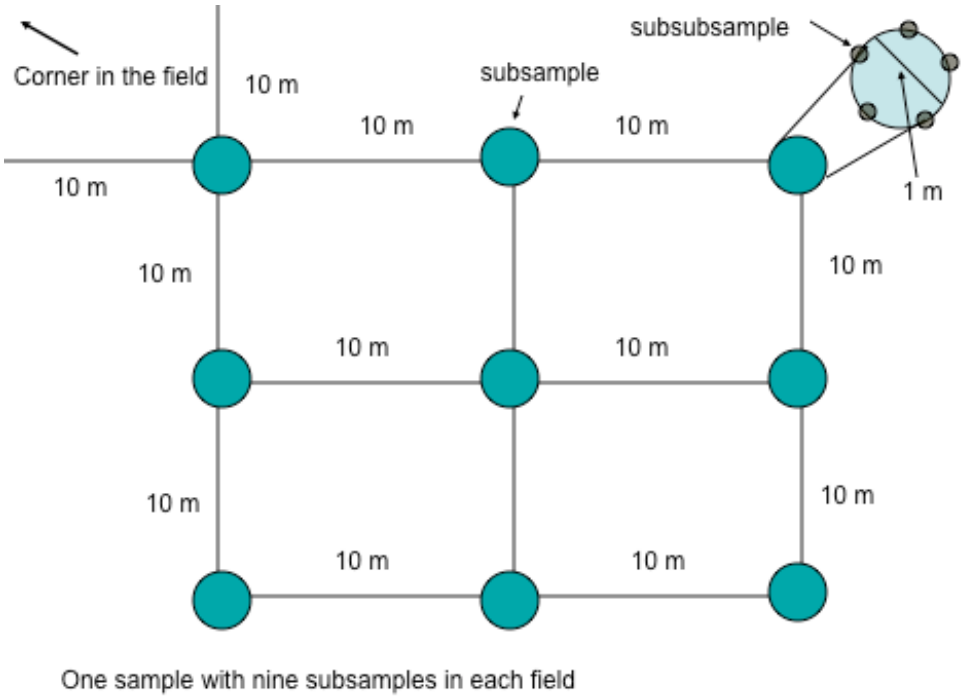


Fig. S2. Sampling scheme used within each field sampled at two municipalities of the Bolivian Altiplano (Umala and Ancoraimes). In each field, nine subsamples were collected where each subsample was composed of five sub-subsamples.

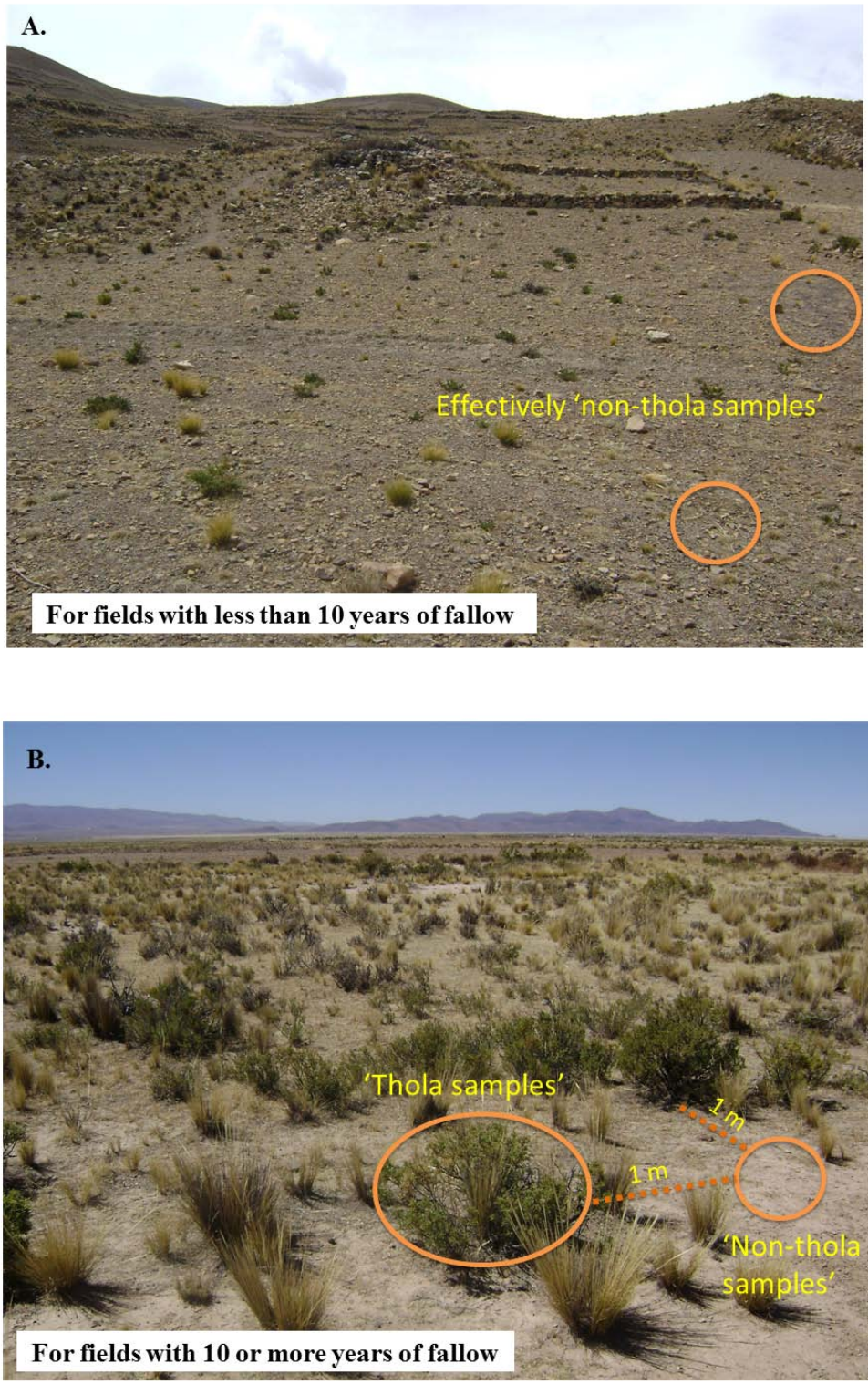
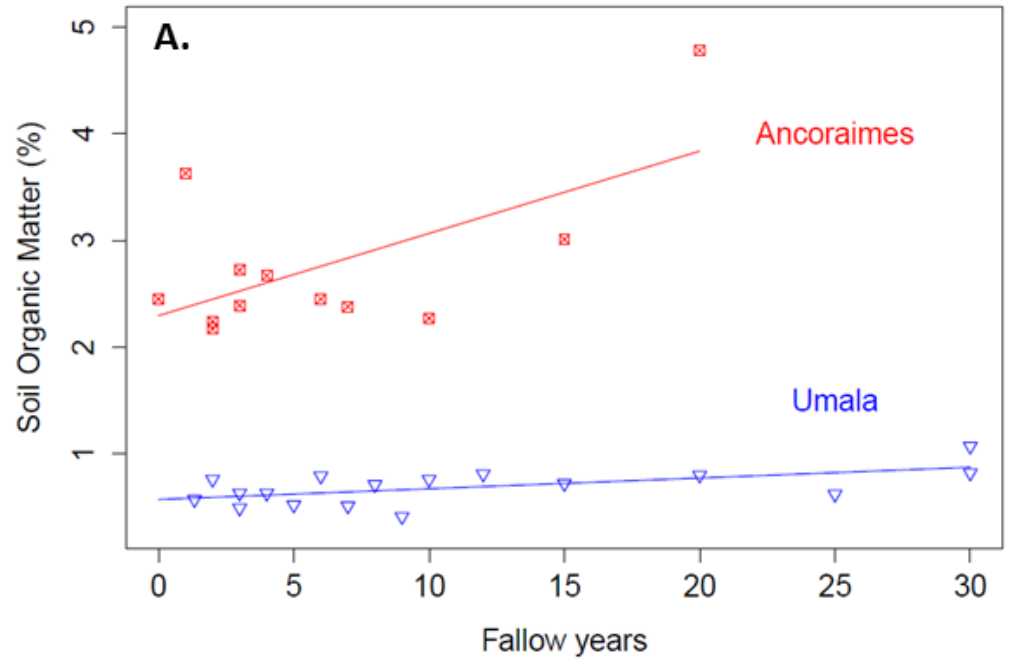
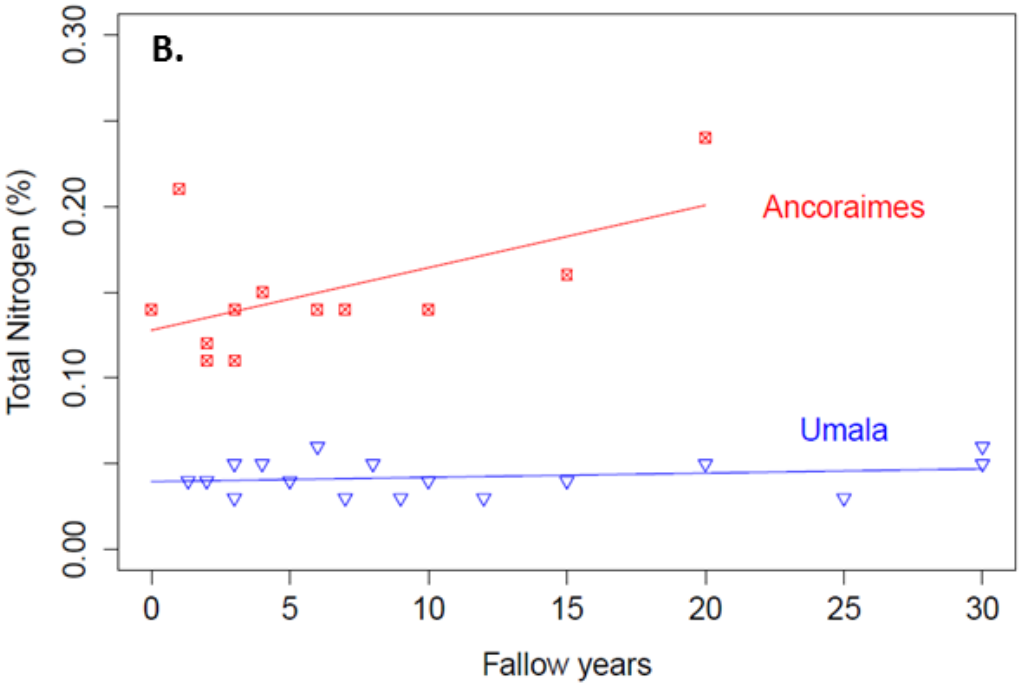
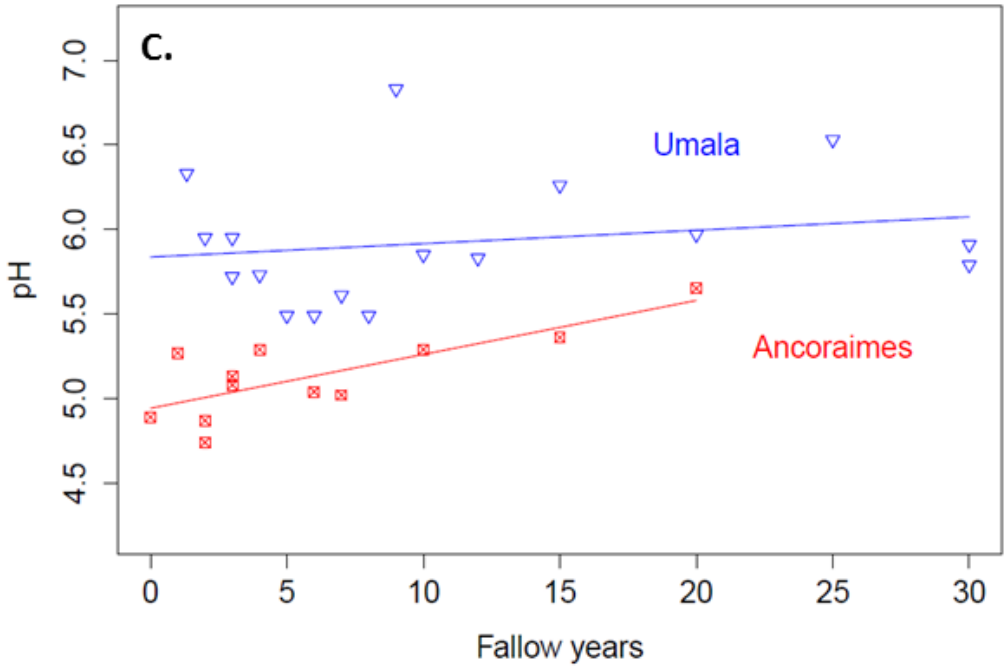


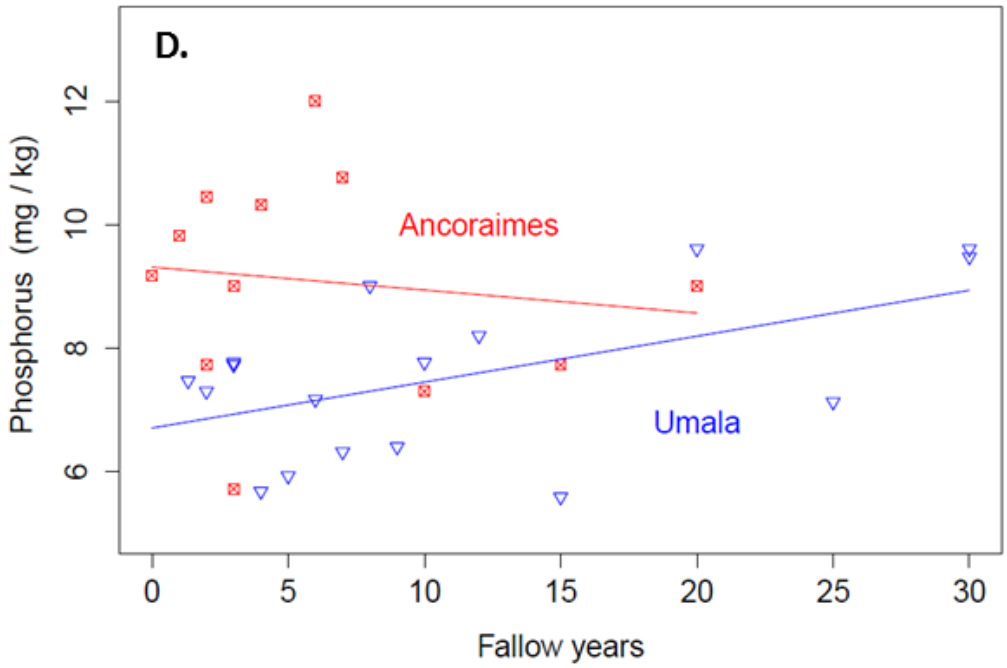
Fig. S3. Examples of fields in the two municipalities of the Bolivian Altiplano (Umala and Ancoraimes) illustrating the presence of the fallow period shrub species (thola: Asteraceae).

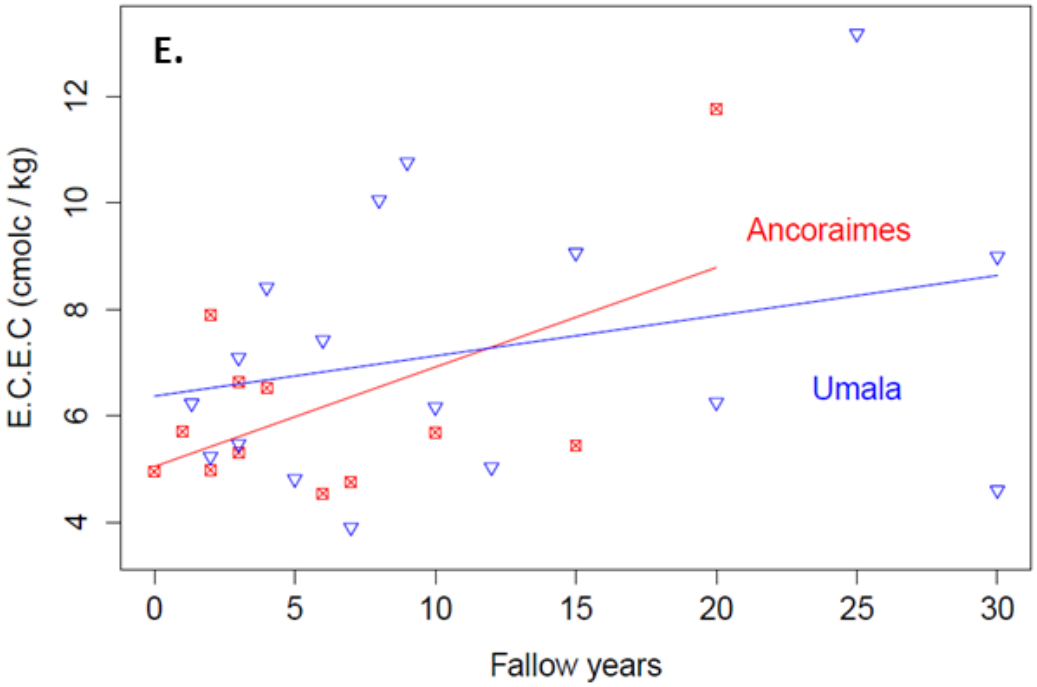
A. For fields with less than 10 years of fallow and scarce presence of thola, 9 soil subsamples were collected away from thola (non-thola samples).
B. For fields with 10 or more years of fallow and sufficient number of thola, 18 soil subsamples were collected as follows. First, at each of the nine subsample points, a subsample was collected under the canopy of the thola individual closest to the subsample point (the ‘thola subsample’). Second, the other subsample was sampled near the subsample point but at least 1 m away from the nearest thola (the ‘non-thola subsample’).


A.
Ancoraimes
Umala
Soil Organic Matter (%)
1
2
3
4
5
0
5
10
15
20
25
30
Fallow years


B.
Ancoraimes
Umala
Total Nitrogen (%)
0.00
0.10
0.20
0.30
0
5
10
15
20
25
30
Fallow years


C.
pH
7.0
6.5
6.0
5.5
5.0
4.5
Umala
Ancoraimes
0
5
10
15
20
25
30
Fallow years


D.
Phosphorus (mg / kg)
12
10
8
6
Ancoraimes
Umala
0
5
10
15
20
25
30
Fallow years


E.
E.C.E.C (cmolc / kg)
4
6
8
10
12
Ancoraimes
Umala
0
5
10
15
20
25
30
Fallow years

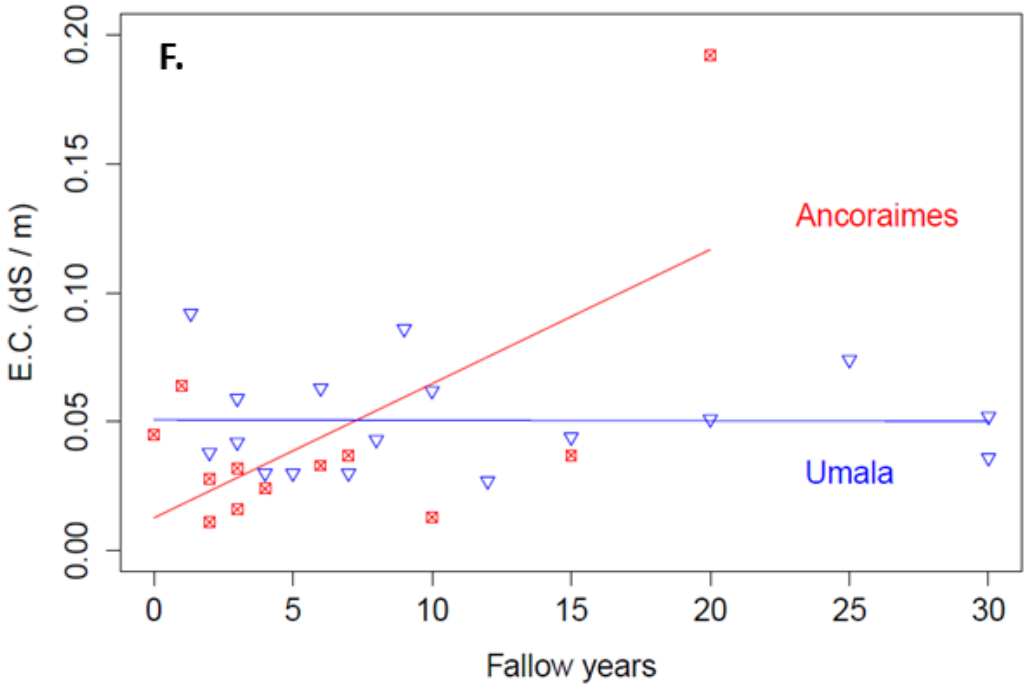

F.
E.C. (dS / m)
0.00
0.05
0.10
0.15
0.20
Ancoraimes
Umala
0
5
10
15
20
25
30
Fallow years

Fig. S4. Fallow period effect on edaphic properties in two municipalities of the Bolivian Altiplano (Umala and Ancoraimes) evaluated in linear regression analysis. Note that one field in Ancoraimes had particularly high leverage, in the sense of importance in determining the model fit, where animals had been grazed extensively and there was abundant manure.

(A) SOM: Ancoraimes ($p=0.03$, $R^2=0.33$), Umala ($p=0.01$, $R^2=0.31$), t-test comparing Umala and Ancoraimes ($p < 0.001$).

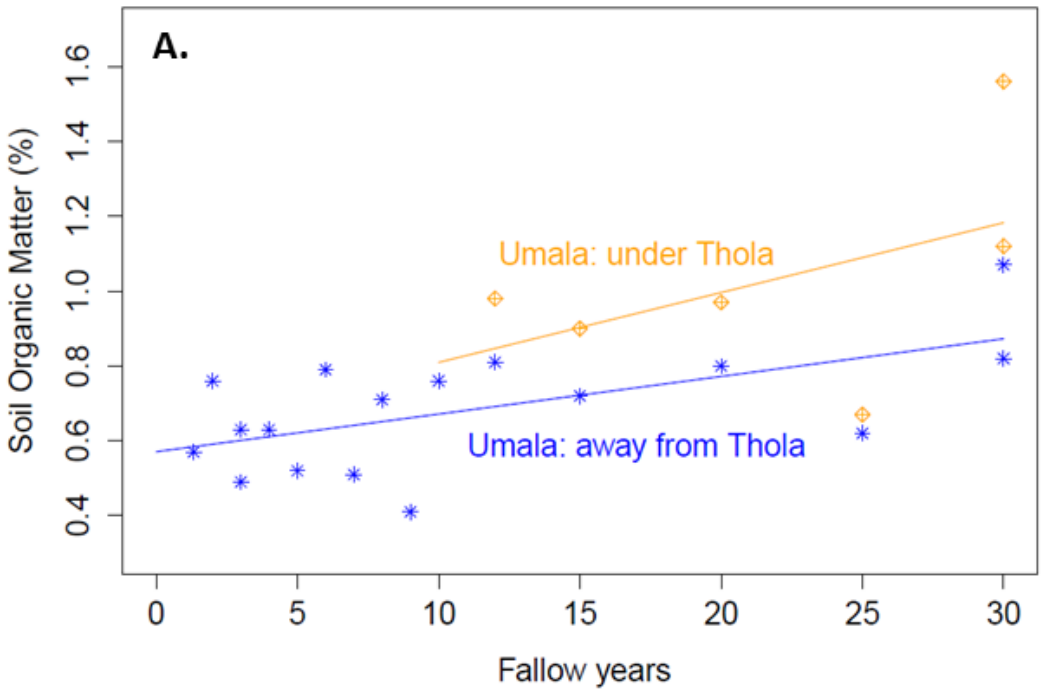
(B) Total N: Ancoraimes ($p=0.05$, $R^2=0.26$, Umala ($p=0.37$, $R^2=0$), t-test comparing Umala and Ancoraimes ($p < 0.001$).

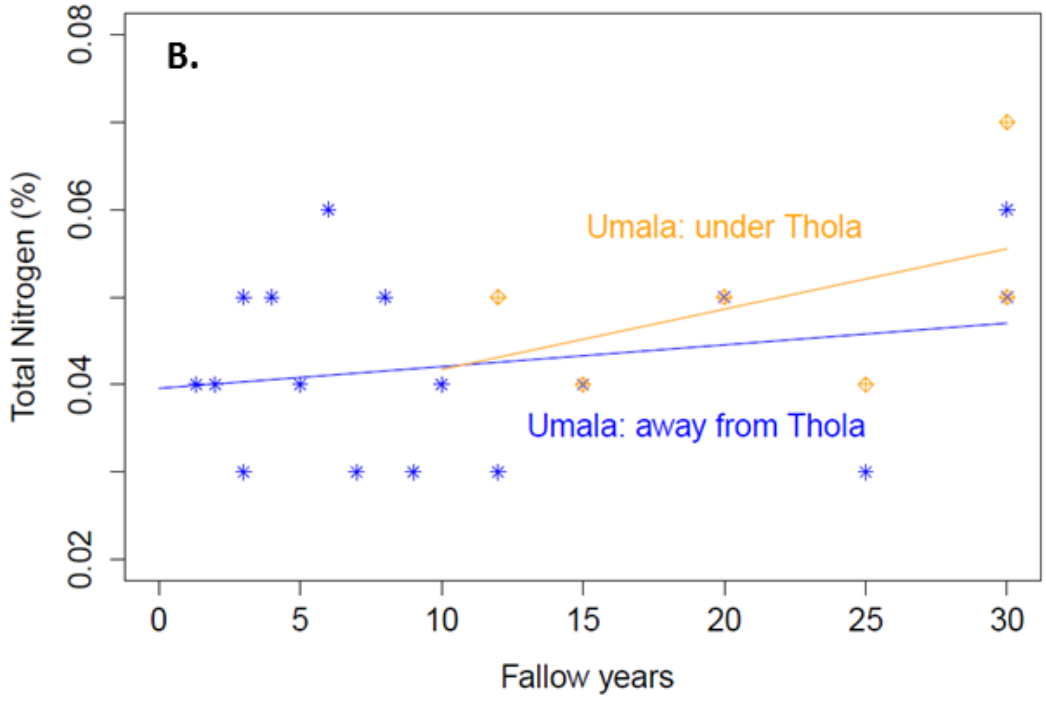
(C) pH: Ancoraimes ($p=0.003$, $R^2=0.55$), Umala ($p=0.4$, $R^2=0$), t-test comparing Umala and Ancoraimes ($p < 0.001$).

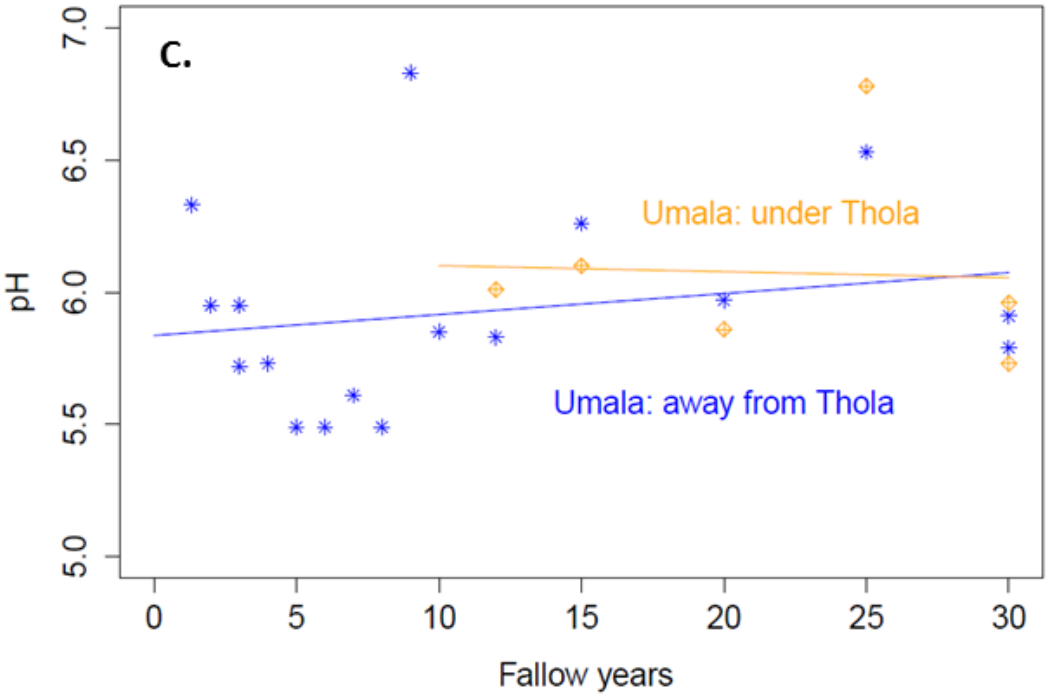
(D) P: Ancoraimes ($p=0.68$, $R^2=0$), Umala ($p=0.03$, $R^2=0.24$), t-test comparing Umala and Ancoraimes ($p < 0.05$).

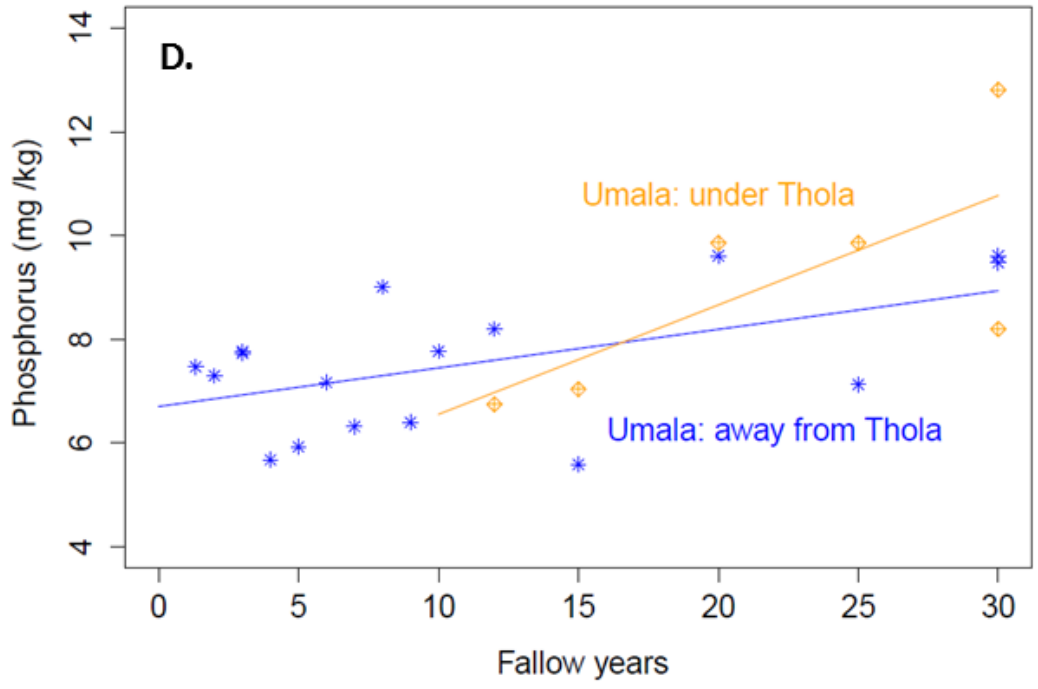
(E) ECEC: Ancoraimes ($p=0.05$, $R^2=0.26$), Umala ($p=0.26$, $R^2=0.02$), t-test comparing Umala and Ancoraimes ($p = 0.23$).

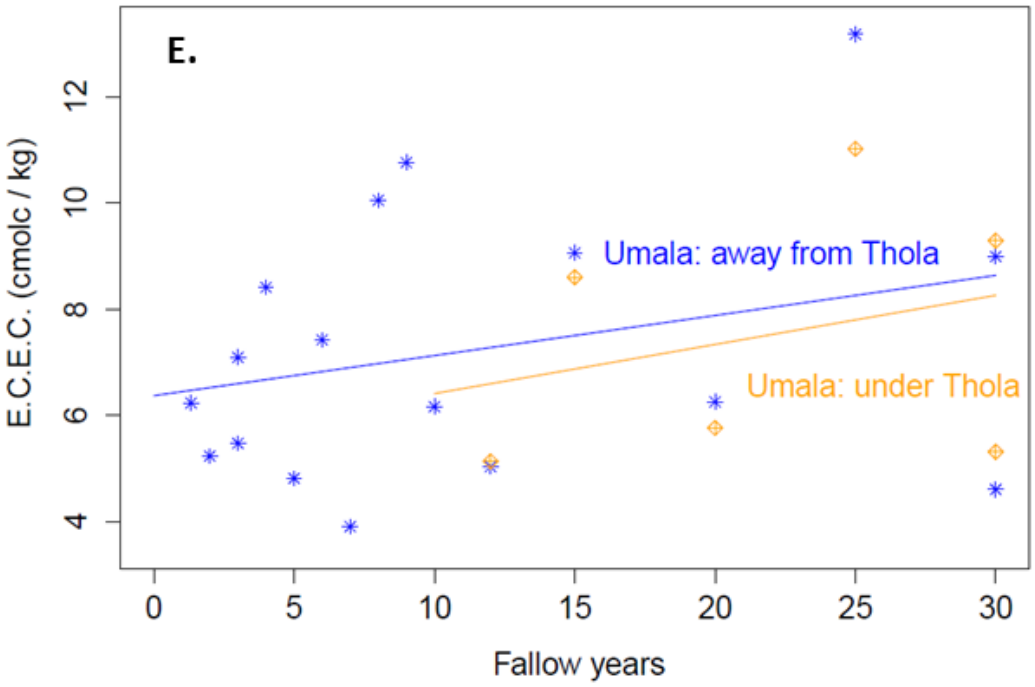
(F) EC: Ancoraimes ($p=0.02$, $R^2=0.36$), Umala ($p=0.97$, $R^2=0$), t-test comparing Umala and Ancoraimes ($p = 0.68$).


A.
Soil Organic Matter (%)
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Umala: under Thola
Umala: away from Thola
0
5
10
15
20
25
30
Fallow years


B.
Total Nitrogen (%)
0.02
0.04
0.06
0.08
Umala: under Thola
Umala: away from Thola
0
5
10
15
20
25
30
Fallow years


C.
pH
7.0
6.5
6.0
5.5
5.0
0
5
10
15
20
25
30
Fallow years
Umala: under Thola
Umala: away from Thola


D.
Phosphorus (mg /kg)
14
12
10
8
6
4
0
5
10
15
20
25
30
Fallow years
Umala: under Thola
Umala: away from Thola


E.
E.C.E.C. (cmolc / kg)
4
6
8
10
12
0
5
10
15
20
25
30
Fallow years
Umala: away from Thola
Umala: under Thola

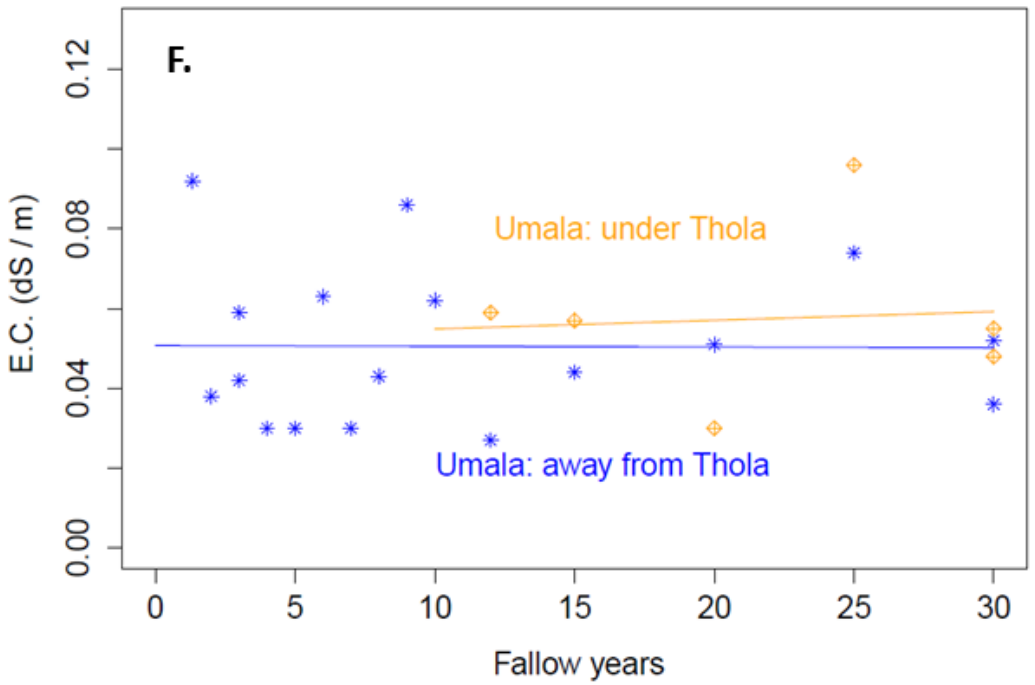

F.
E.C. (dS / m)
0.00
0.04
0.08
0.12
0
5
10
15
20
25
30
Fallow years
Umala: under Thola
Umala: away from Thola

Fig. S5. A comparison of the effects of fallow period duration and sampling under the common fallow-period shrub species (thola; Asteraceae), 'thola samples', versus sampling at least one m away from thola, 'non-thola samples'. Samples in Umala were evaluated using linear regression (slope p-value is given with R^2) and paired t-tests.

(A) SOM: non-thola (p=0.01, R^2=0.31), thola (p=0.34, R^2=0.03), Paired T-test (p = 0.01).

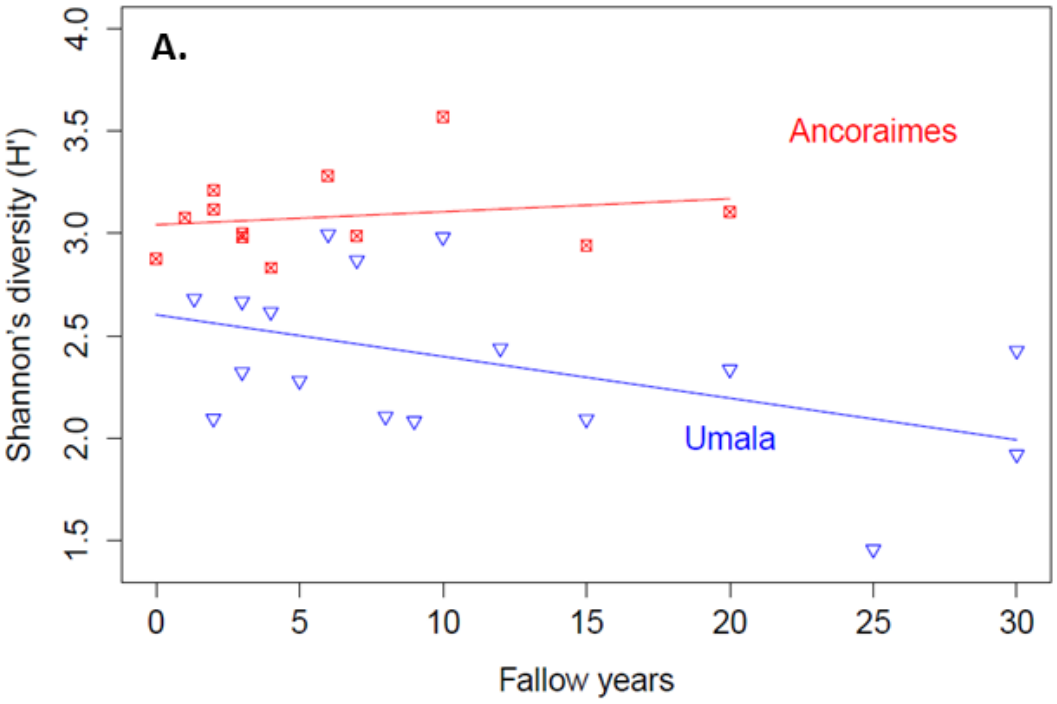
(B) Total N: non-thola (p=0.37, R^2=0), thola (p=0.34, R^2=0.04), Paired T-test (p = 0.10).

(C) pH: non-thola (p=0.4, R^2=0), thola (p=0.93, R^2=0), Paired T-test (p = 0.72).

(D) P: non-thola (p=0.03, R^2=0.24), thola (p=0.11, R^2=0.38), Paired T-test (p = 0.36).

(E) ECEC: non-thola (p= 0.26, R^2=0.02), thola (p=0.58, R^2=0), Paired T-test (p = 0.45).

(F) EC: non-thola (p=0.97, R^2=0), thola (p=0.88, R^2=0), Paired T-test (p = 0.23).


A.
Ancoraimes
Umala
Shannon's diversity (H')
1.5
2.0
2.5
3.0
3.5
4.0
0
5
10
15
20
25
30
Fallow years

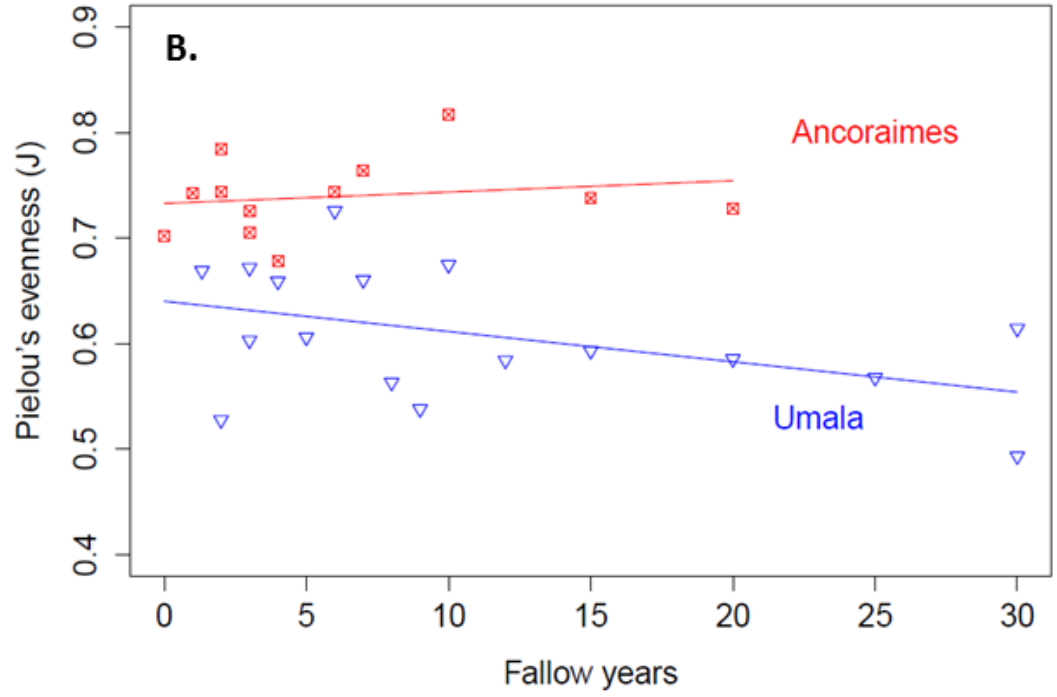
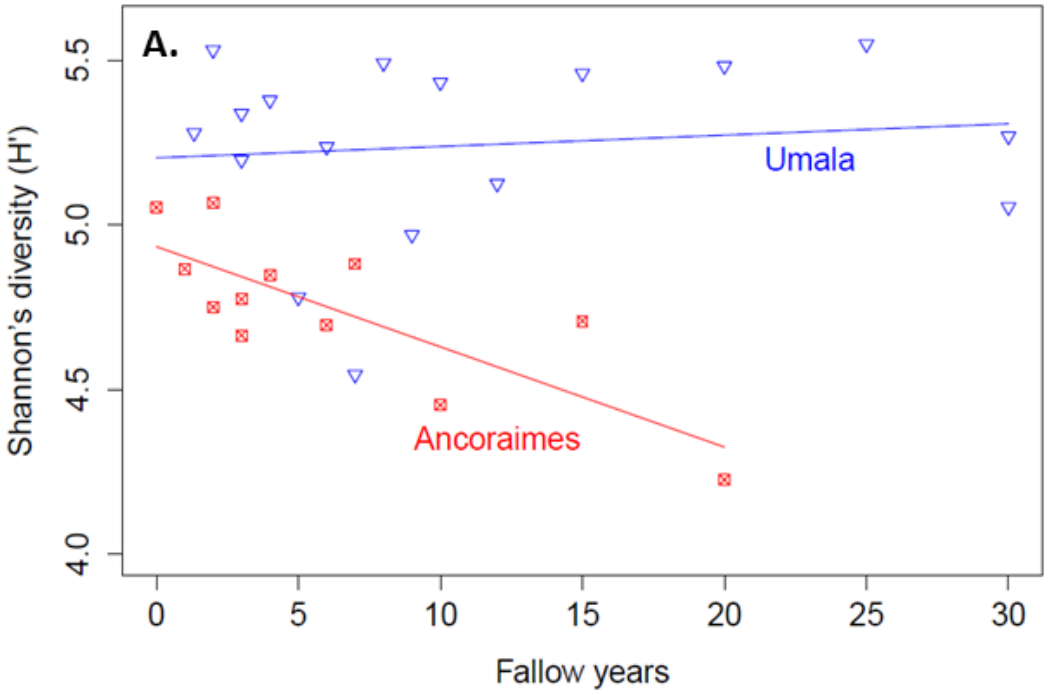

B.
Ancoraimes
Umala
Pielou's evenness (J)
0.4
0.5
0.6
0.7
0.8
0.9
0
5
10
15
20
25
30
Fallow years

Fig. S6. Diversity indices for **fungi** in two municipalities (Umala and Ancoraimes) of the Bolivian Altiplano across fallow periods (years) for non-thola samples. The following three estimators were evaluated in regression analyses. Taxon diversity based on 97% similarity.

(A) Shannon' s diversity (H'): Ancoraimes (slope $p=0.55$, $R^2=0$), Umala ($p=0.05$, $R^2=0.18$), t-test comparing Umala and Ancoraimes ($p < 0.001$).

(B) Pielou's evenness (J): Ancoraimes ($p=0.58$, $R^2=0$), Umala ($p=0.07$, $R^2=0.14$), t-test comparing Umala and Ancoraimes ($p < 0.001$).


A.
Shannon's diversity (H')
5.5
5.0
4.5
4.0
Umala
Ancoraimes
0
5
10
15
20
25
30
Fallow years

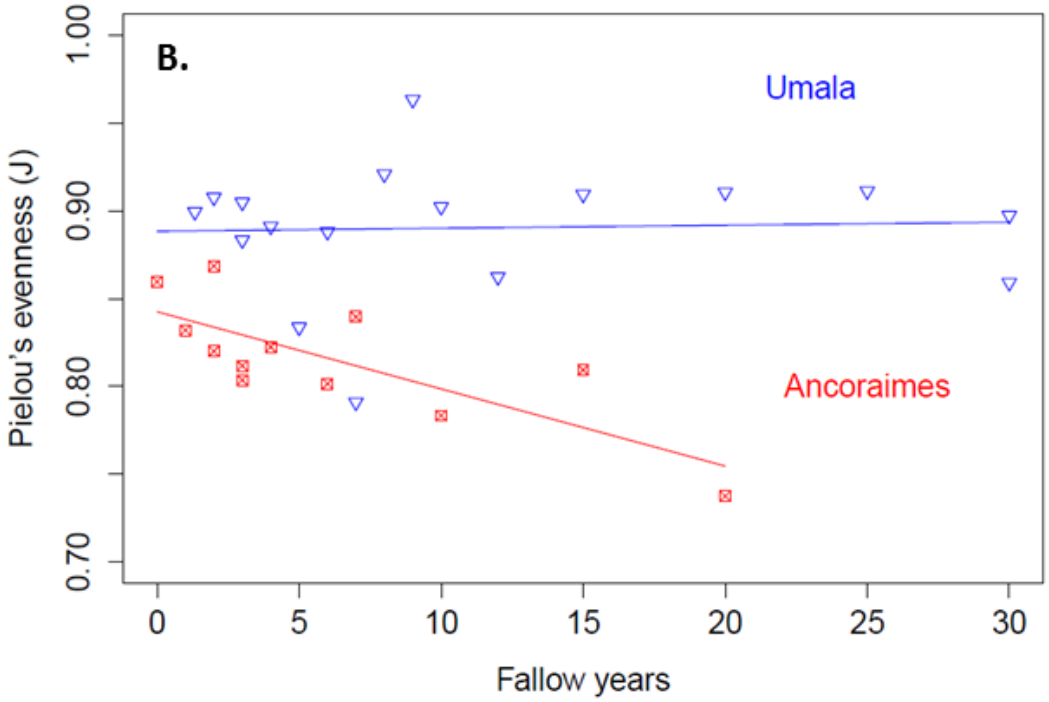

B.
Pielou's evenness (J)
1.00
0.90
0.80
0.70
Umala
Ancoraimes
0
5
10
15
20
25
30
Fallow years

Fig. S7. Diversity indices for **bacteria** in two municipalities (Umala and Ancoraimes) of the Bolivian Altiplano across fallow periods (years) for non-thola samples. The following three estimators were evaluated in regression analyses. Taxon diversity based on 89% similarity.

(A) Shannon's diversity (H'): Ancoraimes ($p=0.002$, $R^2=0.58$), Umala ($p=0.65$, $R^2=0$), t-test comparing Umala and Ancoraimes ($p < 0.001$).

(B) Pielou's evenness (J): Ancoraimes ($p=0.003$, $R^2=0.55$), Umala ($p=0.87$, $R^2=0$), t-test comparing Umala and Ancoraimes ($p < 0.001$).