THE TRACE ASSEMBLAGE OF THE PILCOMAYO MEGAFAN AND INSIGHTS INTO THE TERRESTRIAL TRACE FOSSIL RECORD

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Introduction and Background

Megafan systems could provide a significantly better model for understanding terrestrial fossil preservation than traditional tributary river system models (Weissmann et al. 2010). The Pilcomayo megafan (Fig. 1) retains an abundant and diverse (albeit somewhat human influenced) vertebrate fauna and captures sedimentary environments analogous with unmodified examples from the rock record (Trendell et al. 2013). Our research group has been studying the preservation of modern trace assemblages at two localities on the Pilcomayo to provide comparative data for ichnological studies within fossil record. ***We hypothesize that the vertebrate tracks on the Pilcomayo megafan will show a closer correspondence to the fossil record in terms of ecological and preservational patterns than current modern analogs.***

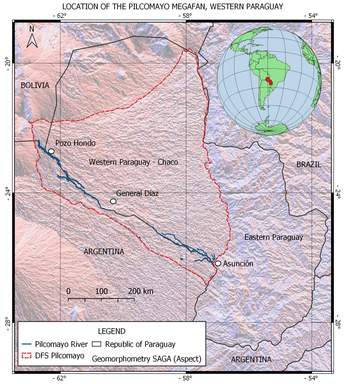

Figure 1: *The patterns of trackway presence on the Pilcomayo River Megafan were surveyed at Pozo Hondo (toward fan apex) and General Diaz (medial on the fan). The Pilcomayo Megafan is of the same scale (100s kms) as many fossiliferous fans described from the geological record. Flow on the Pilcomayo near Pozo Hondo is minimally managed, but flow near General Diaz has been modified by anthropogenic reorientation of the river's path. General Diaz is the site of active lobe deposition in 2023 and 2024.*

Methods

We divided our study areas into five sedimentary subenvironments, comparable to those that can be interpreted in the geologic past (channel, levee, floodplain, depositional lobe, flood basin). By observing the presence of track makers and the characteristics of their tracks, a dataset of species occurrence and track taphonomy was compiled consisting of 142 localities and 18 higher taxa, split between our two study sites.

Transects were surveyed in each subenvironment present in each study site and the track assemblage was characterized focusing on sampling track richness rather than evenness. For each studied track/trackway the following characteristics were measured:

- Grain size of substrate (coarse/fine)
- Depth of tracks ([1] slight depression; [2] 4-6 cm depression; [3] 7+ cm depression)
- Preservation ([1] weathered/little to no clarity or on sandy surface; [2] slight clarity of the trackway; [3] trackway is clear and identifiable in solid surface)
- Track length and stride length

G-tests (Sokal & Rohlf 1981) were conducted to test for differences in preservational and ecological diversity patterns between subenvironments.

Results

Taxa	Channel		Depositional Lobe	Levee		Flood Apron	Flood Plain
	GD	PH	GD	GD	PH	GD	PH
Snake	X		X			X	
Small Felid	X	X	X				
Large Felid			X				
Fox			X				X
Cow	X	X	X	X	X	X	X
Horse		X			X		X
Capybara			X				
Caiman	X	X	X				
Tapir	X						
Canid		X					X
Deer	X	X	X	X			X
Armadillo		X					
Peccary		X	X				
Feral Pig		X	X				
Small Bird	X	X	X			X	X
Raccoon	X	X	X				X
Large Bird		X					
Goat		X					

Table 1: *Track diversity across different depositional subenvironments and our two study sites: Pozo Hondo (PH, proximal to fan apex) and General Diaz (GD, medial to apex). Some subenvironments were not present at both study sites.*

Category	Channel		Depositional Lobe	Levee		Flood Apron	Floodplain	G-Statistic	P-Value
	GD	PH	GD	GD	PH	GD	PH		
Size: 1-10 kg	2	14	3	0	3	1	3	24.037	0.007504
Size: 10-100 kg	5	12	13	1	0	0	5		
Size: 100+ kg	1	15	5	0	3	0	14		
Grainsize: Coarse	2	11	16	0	3	1	7	15.295	0.009172
Grainsize: Fine	6	25	5	1	2	0	13		
Depth 1	2	11	6	0	1	0	3	14.232	0.1627
Depth 2	1	17	8	0	3	0	5		
Depth 3	5	8	7	1	1	0	12		
Preservation 1	0	9	11	0	4	0	5	30.399	0.0007369
Preservation 2	4	24	7	0	1	0	7		
Preservation 3	4	3	3	1	0	0	8		

Table 2: *Track occurrence by subenvironment partitioned by: taxon body size, substrate grain size, track preservation quality, and track depth. G-statistics and p-values assess the statistical significance of the distribution across these environments.*

Body Size (kg)	Fine	Coarse	Preservation 1	Preservation 2	Preservation 3	Depth 1	Depth 2	Depth 3	G-Statistic	P-Value
1 - 10	13	9	8	13	1	12	8	2	29.316	0.009467
10 - 100	22	8	7	13	10	7	12	11		
100 +	21	15	10	18	8	4	11	21		

Table 3: *Track maker body size compared to substrate grain size, track preservation quality, and track depth. G-statistics and p-values are included to show significant correlations between body size and environmental factors.*

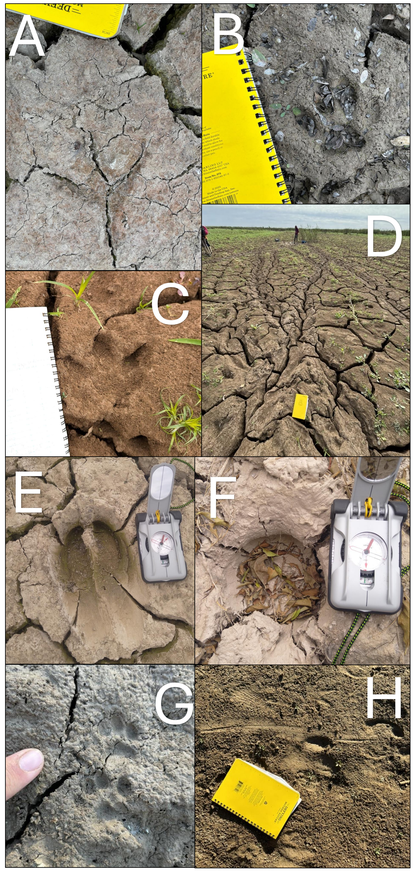

Figure 2: *Example of photographic record for trackways. (A) and (F) depict 'Preservation 1'; (C) and (B) depict 'Preservation 2'; (E) depicts 'Preservation 3'; (D) depicts Caiman trackways through mud cracks on a depositional lobe; (G) and (H) are additional with (H) showing scale imprints from Caiman.*

Conclusions

- Smaller taxa exhibit reduced track depth and left fewer very well-preserved tracks, indicating a preservation bias against smaller taxa.
- Track preservation quality decreases as sediment coarseness increases, particularly in depositional lobe deposits.
- Both channels and the depositional lobe show relatively high taxonomic diversity, whereas other depositional environments appear more depauperate.
- Channel subenvironments provide the best point census of local track makers, but depositional lobe environments may provide the best targets to survey for tracks, due to reduced likelihood of reworking of surface sediments.

Future Directions

Continued fieldwork will expand our dataset of examine track preservation and abundance and will be complemented by live surveys of the trackmakers and consideration of other traces.

Figure 3: *UNM, UNA, and GRPM field crew*

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