

Electronic Supplementary Document for:

Cultural macroevolution of musical instruments in South America

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NOTE: The data and code for the analyses are available at

https://github.com/chiarabarbieri/SouthAmerica_MusicInstruments

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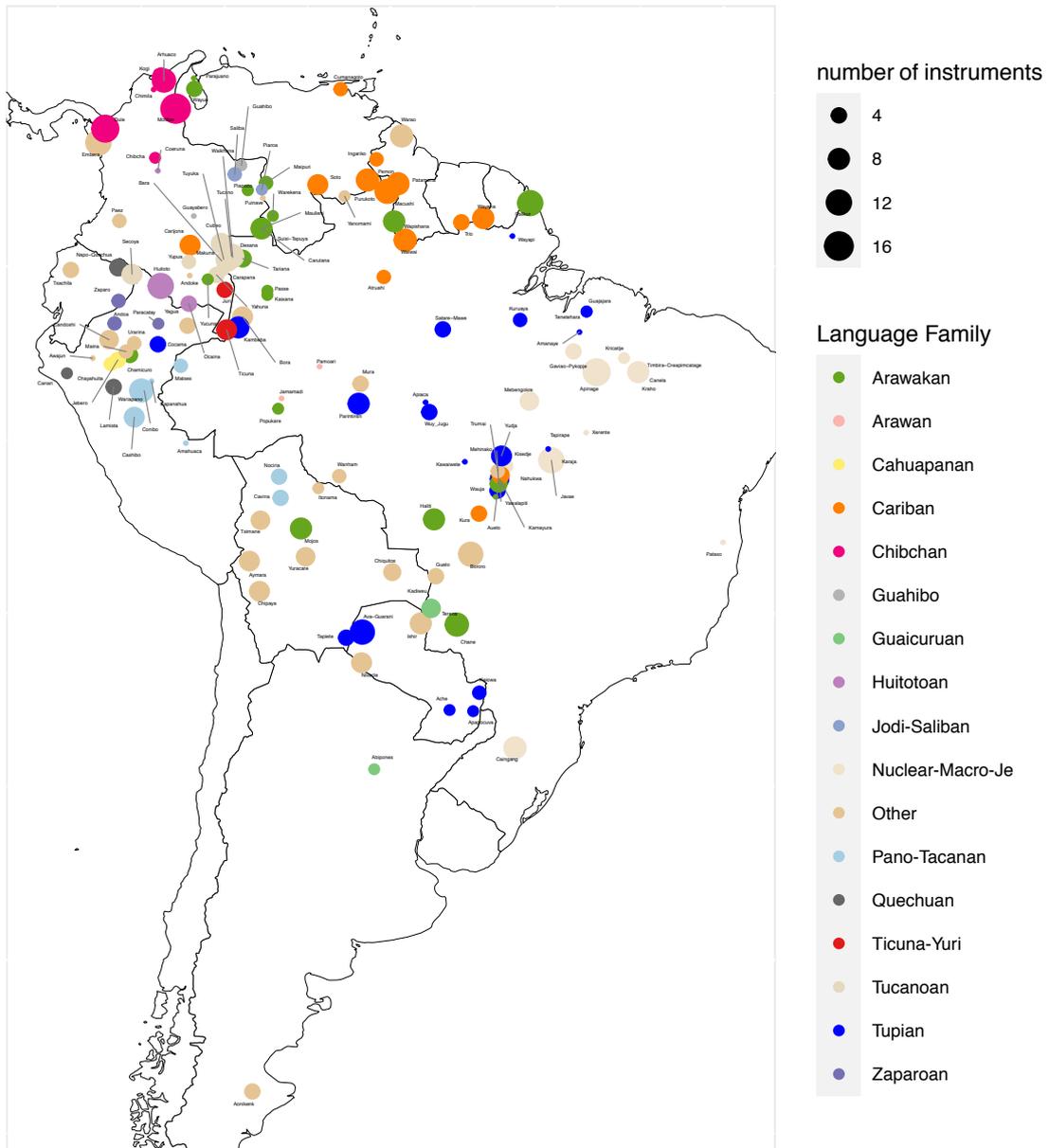
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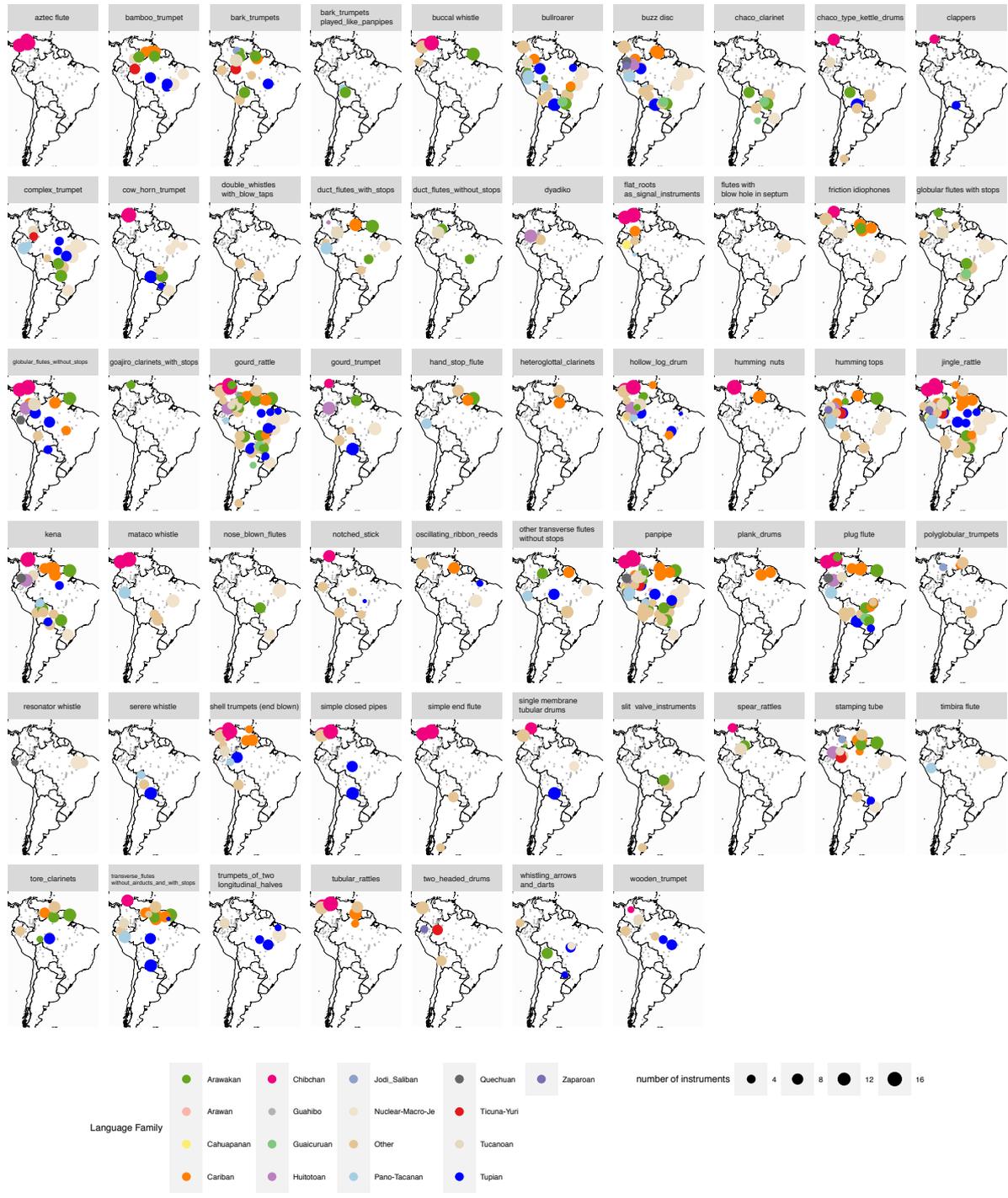
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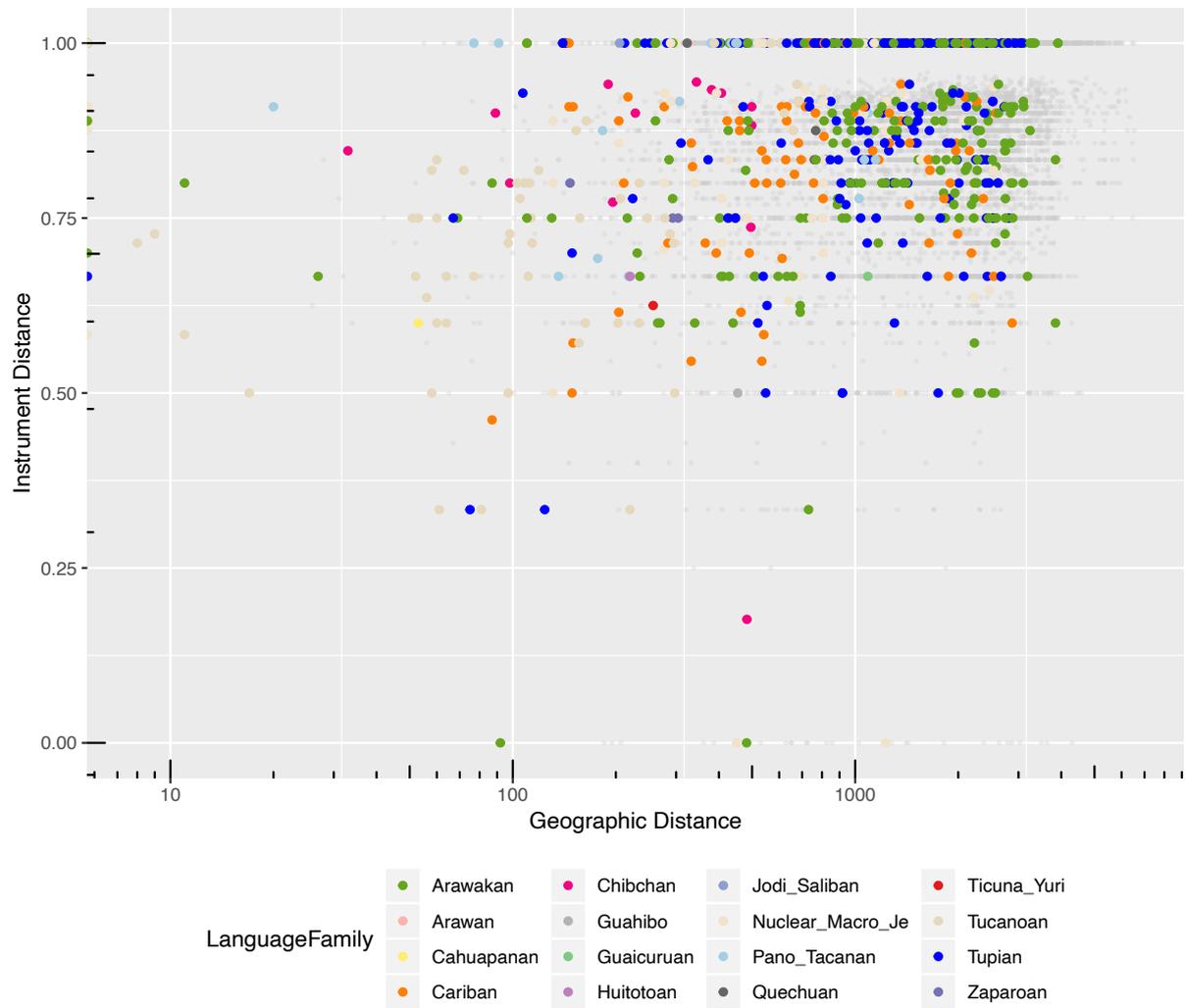
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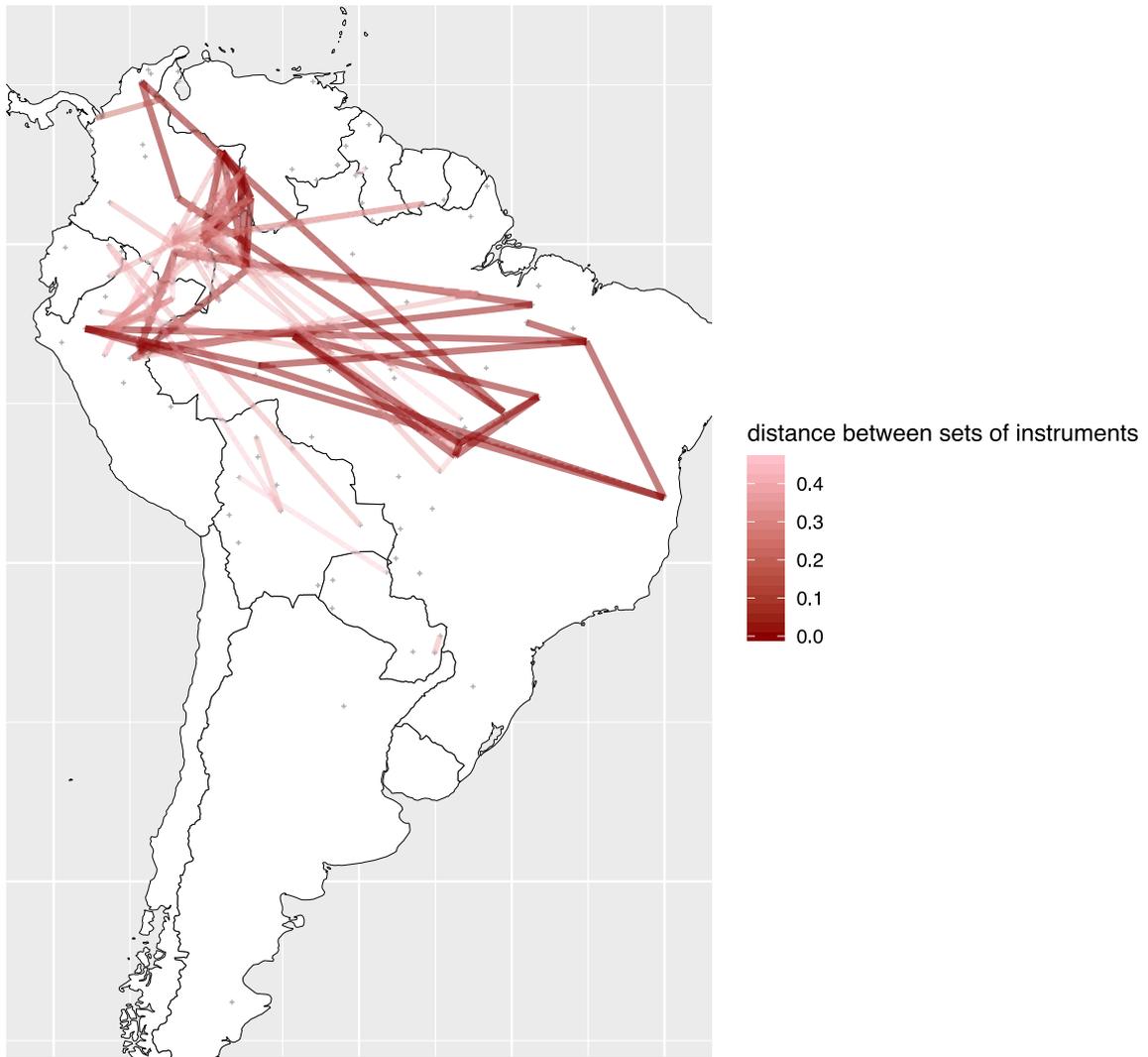
Supplementary Figure S1. Map showing the approximate locations of the ethnic groups included in the analysis based on Izikowitz's data. Colour legend corresponds to the language family, and size of the dot corresponds to the number of instruments described for each ethnic group.



Supplementary Figure S2. Geographic distribution of the 57 instruments of the Izikowitz database.



Supplementary Figure S3: correlation between geographic distance (in km, x axis, logarithmic scale) and instrument distance for 144 societies in South America. Population pairs who belong to the same language family are colour coded for language family affiliation. Population pairs from different language families are represented in smaller gray dots.



Supplementary Figure S4: distances between sets of instruments below 0.5. Dark, thick lines correspond to close distances.

List of features used in the section “Networks based on panpipe trait variation, compared against cultural areas”

1. Size:
Small, maximum height less than 10 cm (0); medium, maximum height between 10 cm and 50 cm (1); large, more than 50 cm (2).
2. Number of rows¹:
Single (0); double, distal row has open tubes (open at both ends) (1); double, distal row has closed tubes (2).
3. Parts:
One part (0); two parts, two complementary instruments, or parts of an instrument, are played collectively by two musicians² (1); two parts, two complementary parts of a panpipe are attached by a string³(2).
4. Number of single pipes forming the first row (modified from Izikowitz, 1935. Note: on double panpipes with resonator, the closed row is counted; when both rows are closed e.g., [siku], the greatest number is recorded here):
Less than four (0); four (1); five (2); six (3); seven (4); eight (5); nine to eleven (6); twelve (7); more than twelve (8).
5. Seriation of pipes⁴:
One series in decreasing order (0); multiple series in consecutive decreasing order (1—rondador); shortest tube in the middle (2); two decreasing series (3); longest in the middle (4); longest on the sides (5).
6. Ligature kind (inapplicable for clay and stone panpipes):
Guna (0); simple (1); complex ligature thread only(2—chain and possibly campa ligatures); covered in a cloth (3— no ligature); horizontal splint (4); two splints(5); Aymara ligature (6); extensively covered by thread (7); stick between ligature (8); reed (9); similar to Aymara (A).

¹ The tubes in the second row are generally termed “resonators”, but “timbre modifiers” is a more accurate description, given that the resonance is produced at a different pitch.

² The siku requires two interdependent parts, the ira (leader/male) and arca (follower/female); these parts are meant to be played by two men in a musically-interlocking fashion (Olsen, 2004). The ira and arca can also be conceptualized as two instruments, each of which is able to play only a part of the pitches needed to perform the music of the sikuris (Olsen, 2004, Romero, 1985). There is strong evidence to think that Nazca panpipes were played in pairs (Olsen, 2004), and coded accordingly in this analysis. The carrizos of Venezuela are also played in pairs, although an instrument set may involve 3 instruments. The instruments may be played in interlocking fashion (as with sikus) or in juxtaposition (Olsen, 2004). Note that this character departs from the others by using information not directly taken from the instruments themselves.

³ Two musicians play together in an interlocking fashion, each musician holds the two parts (or two halves) of the instrument.

⁴ Archaeological figurines from the Ebnöther collection indicate that other seriation patterns (e.g., shortest tubes in the middle) existed in Ecuador and Peru. Izikowitz (1935) also documented panpipes with the longest tubes in the middle common for the Arhuaco («Ijca») and Mutilon tribes of Colombia/Venezuela.

7. Resin was used either to put tubes together or to cover some tubes (inapplicable for clay and stone panpipes):
No (0); yes (1).
8. Space is left below the node on the distal part (inapplicable for clay and stone panpipes):
No (0); yes (1).
9. Indentations on proximal (blowing) ends of panpipes (inapplicable for clay and stone panpipes):
Absent (0); present (1); sharpened end (2); two cuts (3).
10. Distal profile:
Tubes show externally the same length (0); laddered profile (1); diagonal profile (2).
11. Some tubes made by more than one culm (inapplicable for clay and stone panpipes):
No (0); yes (1).
12. Textile art (inapplicable for clay and stone panpipes):
None (0); coloured threads used for binding (1); patterns covering large area of tubes (2).
13. Feathers attached (inapplicable for clay and stone panpipes):
No (0); yes (1).

Taxon	Delta Score	Q-residual
Archaeo_Chancay	0.26114	0.043845
Aymara_Chile	0.26346	0.058502
Bolivia_unknown	0.26394	0.05945
Oyanpik	0.26766	0.040028
Wayana	0.26766	0.040028
Kuikuru	0.26766	0.040028
Apinaye	0.26802	0.046704
Jebero	0.27519	0.036776
Aguano	0.27519	0.036776
Achuara	0.27842	0.037584
Kamsa	0.27842	0.037584
Yagua	0.27923	0.046291
Archaeo_Paracas	0.27949	0.048804
Bora	0.28353	0.053592
Aymara_Bolivia	0.28668	0.074812
Quechua_CentralAndes_Peru	0.28977	0.0509
Chacobo	0.29009	0.042826
Piraha	0.29097	0.043365
Aymara_LaPaz	0.29459	0.09615
Huambisa	0.2984	0.049515
Witoto	0.30012	0.075028
Kalapalo	0.30138	0.067324
Txicao	0.30138	0.067324
Maku	0.30146	0.047273
Archaeo_Arica	0.30273	0.04174
Wapishana	0.30368	0.064967
Ashaninka	0.30368	0.064967
Tukano_Uaupes	0.30405	0.049477
Gambiano	0.30614	0.066412
Secoya	0.30614	0.066412
Quechua_NorthAndes	0.30614	0.066412
Aripaktsa	0.30773	0.064083
Archaeo_Peru	0.31052	0.05543
Conibo	0.31326	0.041048
Titicaca_Basin	0.31343	0.062657
Curripaco	0.31413	0.065658
Machiguenga	0.31904	0.072999
Siriono	0.3196	0.0498
Akawaio	0.32034	0.081569
Cajamarca	0.32091	0.074425
Quechua_CentralAndes_Bolivia	0.32129	0.064167
Guahibo	0.33407	0.074007
Cashibo	0.34247	0.04201
Archaeo_Wari	0.35146	0.068971
Jivaro	0.35445	0.047629
Tupi_Rondonia	0.35445	0.047629

Coreguaje	0.35471	0.058499
Quijo	0.35566	0.051582
Bolivia_Oruro	0.36144	0.11665
Archaeo_NorteChico	0.36288	0.056538
Cuna	0.36373	0.093662
Archaeo_Ancon	0.37572	0.056688
Yekuana	0.37695	0.062977
Nambiquara	0.38646	0.054495
Mehinacu	0.39058	0.058825
Bororo	0.39346	0.059775
Archaeo_Nasca	0.39848	0.10036
Waura	0.40238	0.062252
Ache	0.41107	0.061285
Lamas	0.41413	0.067569
Boca_Preta	0.42095	0.086349

Supplementary Table. Delta scores for individual taxa (societies) from the network analysis, ordered from lowest to highest values. Higher delta scores indicate a higher amount of reticulate (non tree-like) signal in the data.

Supplementary References

Izikowitz, KG (1935) Musical and Other Sound Instruments of the South American Indians. Series A. Humanities. Elanders Boktryckeri Aktiebolag , Gothenburg

Olsen, DA (2004) Aerophones of traditional use in South America, with references to Central America and Mexico. In: Kuss M (ed) Music in Latin America and the Caribbean, an Encyclopedic History, vol 1. University of Texas Press, Austin, pp 261–325

Romero, R. (1985). La música Tradicional y Popular – La música en el Perú. In: (ed) Patronato Popular y Porvenir Pro-Música Clásica. Industrial Gráfica, Lima, pp. 215–282