Ethnolinguistic niche modelling: The case of New Guinea

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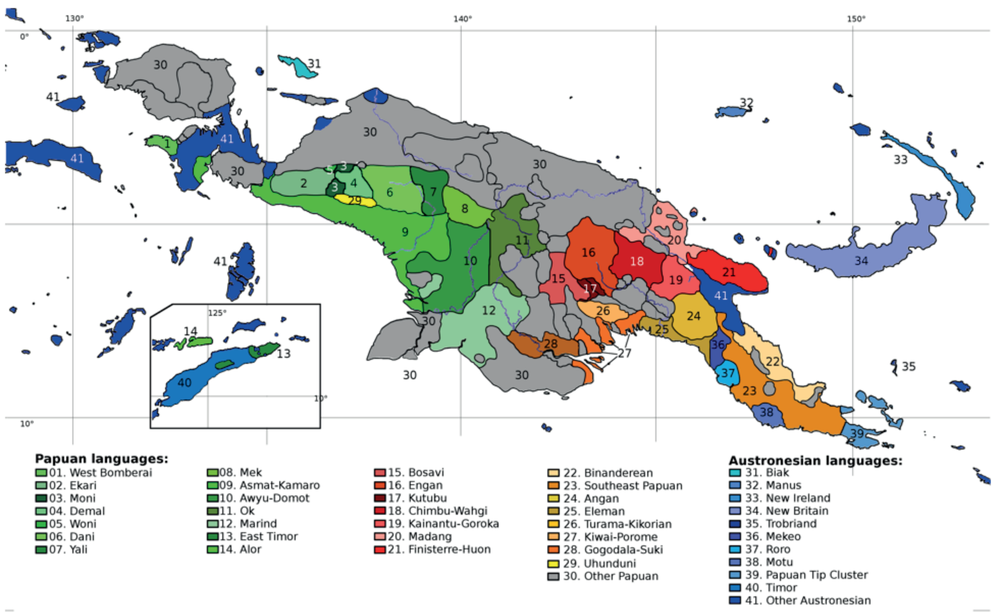
This pilot study is part of a larger project that investigates possible links between material culture, language, and environment with respect to present-day populations in New Guinea.
We use a methodology that predicts the best fit ecological niches of languages (ELN) and bead-type occurrences using raster Geographical-Information-System layers.
Results reveal that the territory occupied by a given ethno-linguistic group only rarely overlaps with the predicted ELN and that in most cases individual ELNs are occupied by multiple languages, i.e. while environmental variables likely constrain the potential territory of ethno-linguistic groups, processes such as cultural drift, isolation by distance and human behaviour, especially warfare, play a greater role in the ethno-linguistic diversity observed in New Guinea.

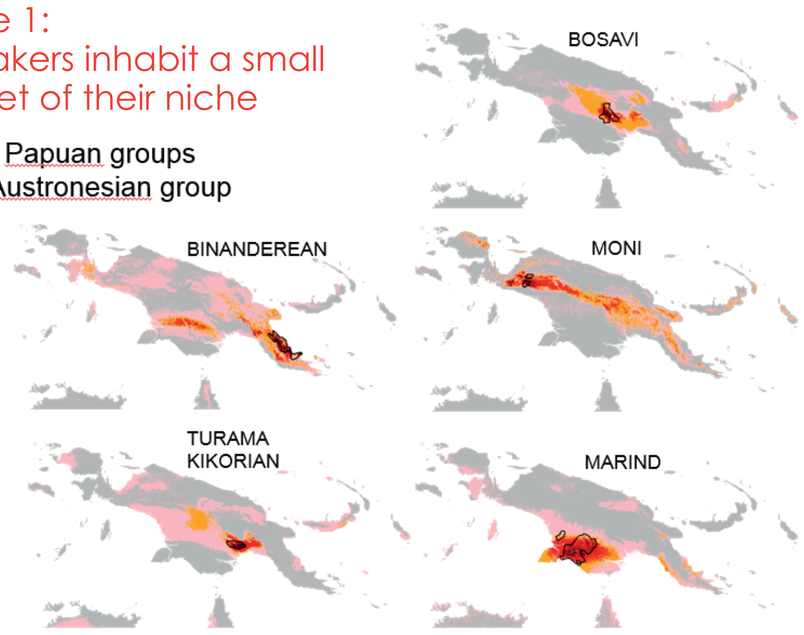
Papuan and Austronesian language groups of New Guinea



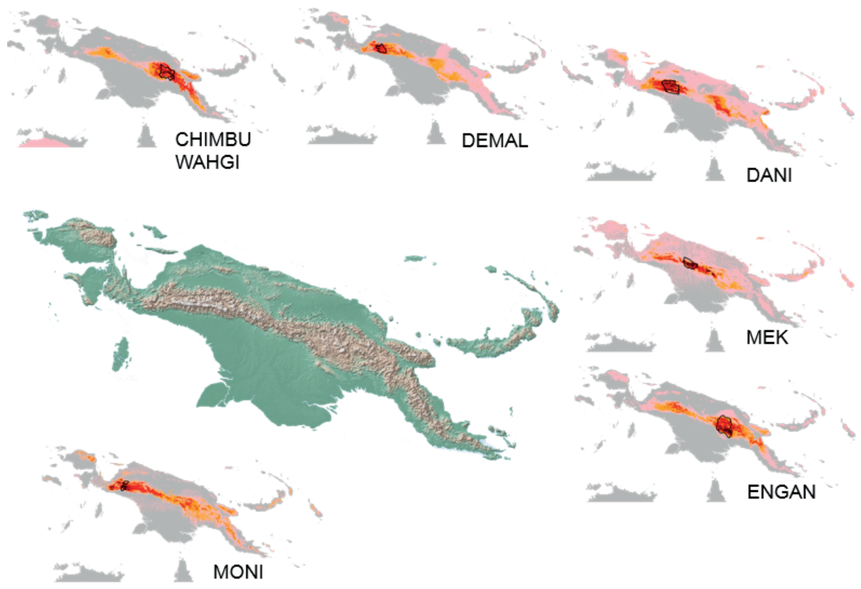
New Guinea represents an area with one of the highest rates of ethno-linguistic diversity in the world (many hundreds of different languages). Understanding the links and mechanisms at work behind the interactions between language, material culture and ecology is key when attempting to interpret the variability observed in the ethnographic record and will likely prove useful when investigating the archaeological record there and in other parts of the world.

Case 1: Speakers inhabit a small subset of their niche

23 Papuan groups
1 Austronesian group

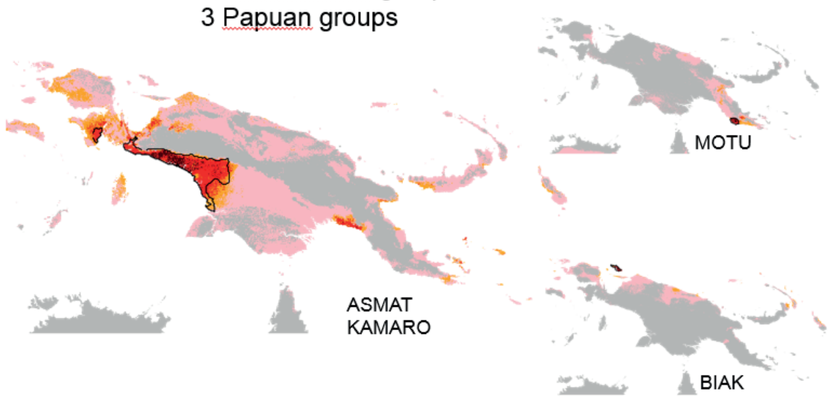


Case 1: Examples of the Highlands

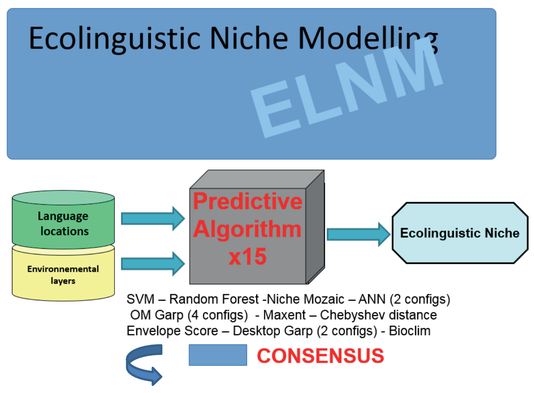


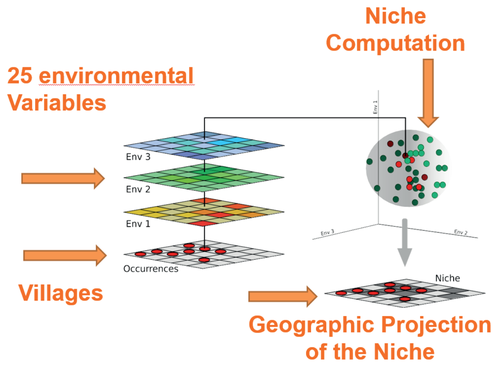
Case 2: Speakers occupy almost all their niche or the niche is splited in several unreachable parts

8 Austronesian groups
3 Papuan groups



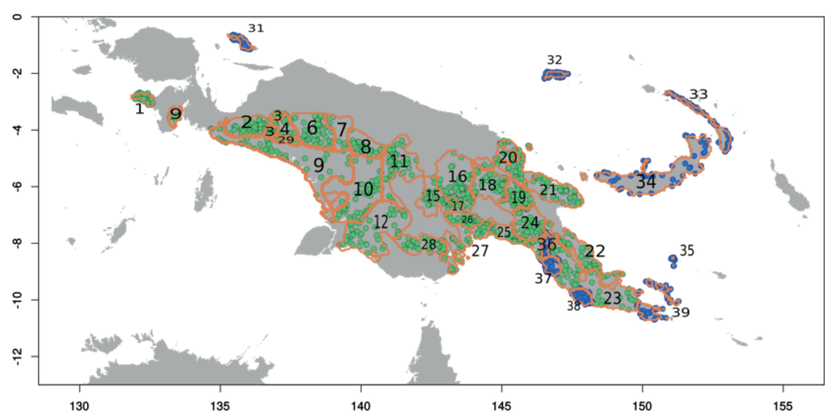
Ecolinguistic Niche Modelling

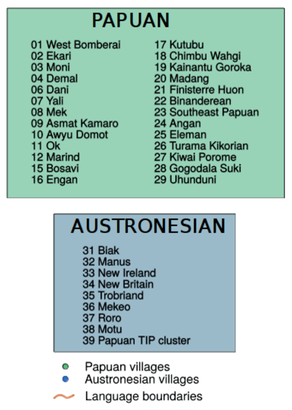




In order to explore if and to what extent the ethno-linguistic geography of New Guinea is linked to environmental factors, we applied 15 predictive algorithms, (such as GARP [Stockwell and Peters, 1999] and Maxent [Phillips, 2006], which are commonly used for predicting species' ecological niches and geographic distributions),....

1532 occurences — 35 Ethno-linguistic groups

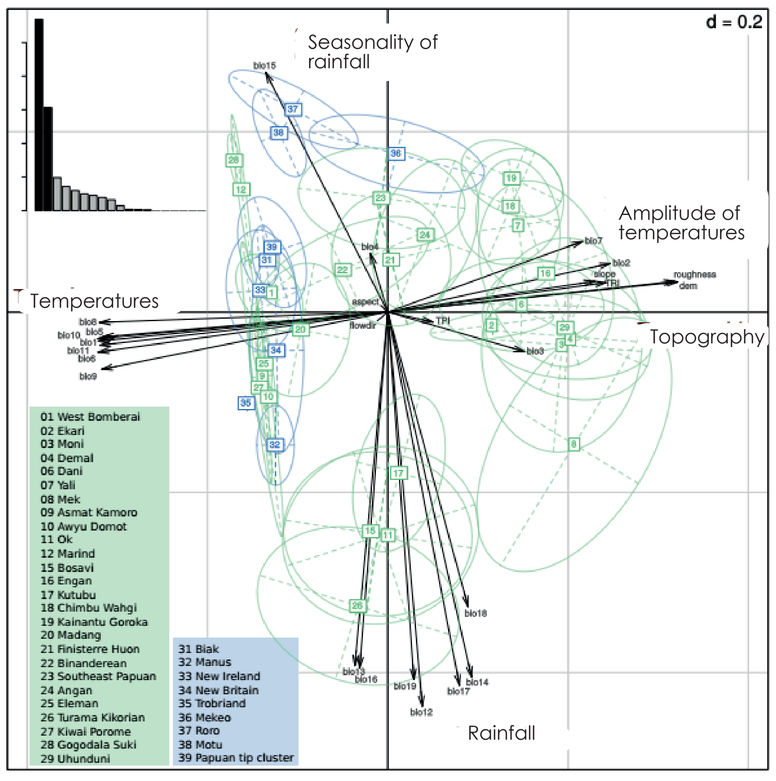




...to the two main language families present on the island (Papuan and Austronesian) as well as 41 ethno-linguistic groups subsumed within these families, as defined by Ross (2005) and adapted by one of us (Schiefenhövel, 2014). Ethnolinguistic groups are represented by a random sample of village occurrences within each group's present-day geographic distribution.

We used high resolution (30 arc-second grid resolution) environmental variables to produce the niche estimations and included 19 bioclimatic parameters derived from monthly precipitation and temperature values (WorldClim, Hijmans et al., 2005), along with 6 topographic parameters that summarize altitude and topography.

Results show that the predicted eco-linguistic niches (ELN) can be grouped into two categories.
In the first and most common case, language groups only occupy a small subset of their potential niche, whereas in the other case language groups and their potential niche closely overlap.
We hypothesize that a close degree of overlap between a predicted ELN and a language group's geographic distribution represents a situation in which the ELN, language, specific material culture and subsistence strategies match.
A lack of coincidence between ELN and language group distribution likely represents situations in which language groups are largely independent from subsistence strategies (i.e people speaking different languages but having similar subsistence strategies). The mechanisms influencing linguistic diversity and its geography in the latter cases are likely not correlated with ecology but rather more closely likely linked to phenomena such as cultural drift, isolation by distance, warfare and and other human behavior.



In order to understand which environmental variables determine the niche predictions, we performed a Principal Component Analysis.
The results were highly significant on the first two axes which explain 70 % of the variability.
The Austronesian groups are in blue and the Papuan groups in green. The arrows identify the 25 environmental variables. Those along the horizontal axis have to do with temperature and topography, and those along the vertical axis with precipitation and seasonality.
It is interesting to note here, that the ecolinguistic niches seem to cluster in groups and that the Austronesian and Papuan ecolinguistic niches only partially overlap.

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Observed mismatches suggest that environmental conditions such as: temperature, precipitation or topography, influence linguistic geography. However, other factors, independent from the environment, certainly have an important impact on cultural and linguistic geography too. By closely documenting language-environment relationships, and exploring situations in which they co-vary, we attempt to shed new light on the mechanisms that govern the complex relationships between natural and cultural parameters and how they influenced settlement patterns. The complex psychosocial mechanism, by which ethnic groups are established, and which is called pseudospetiation (Erikson 1985) is a powerfull way to explain the formation of ethnic groups whith their very high cohesion.