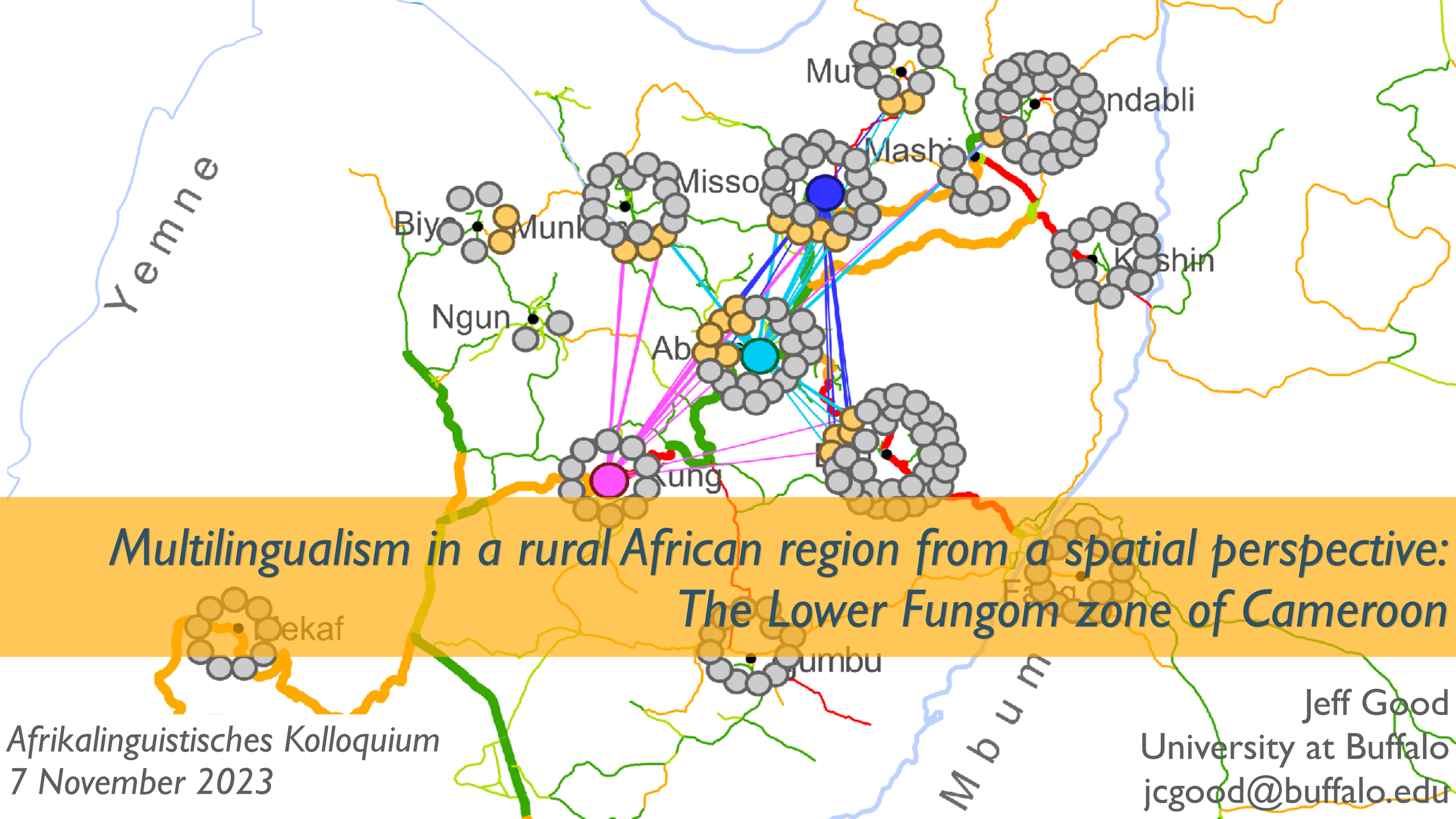

Multilingualism in a rural African region from a spatial perspective: The Lower Fungom zone of Cameroon

Afrikalinguistisches Kolloquium
7 November 2023

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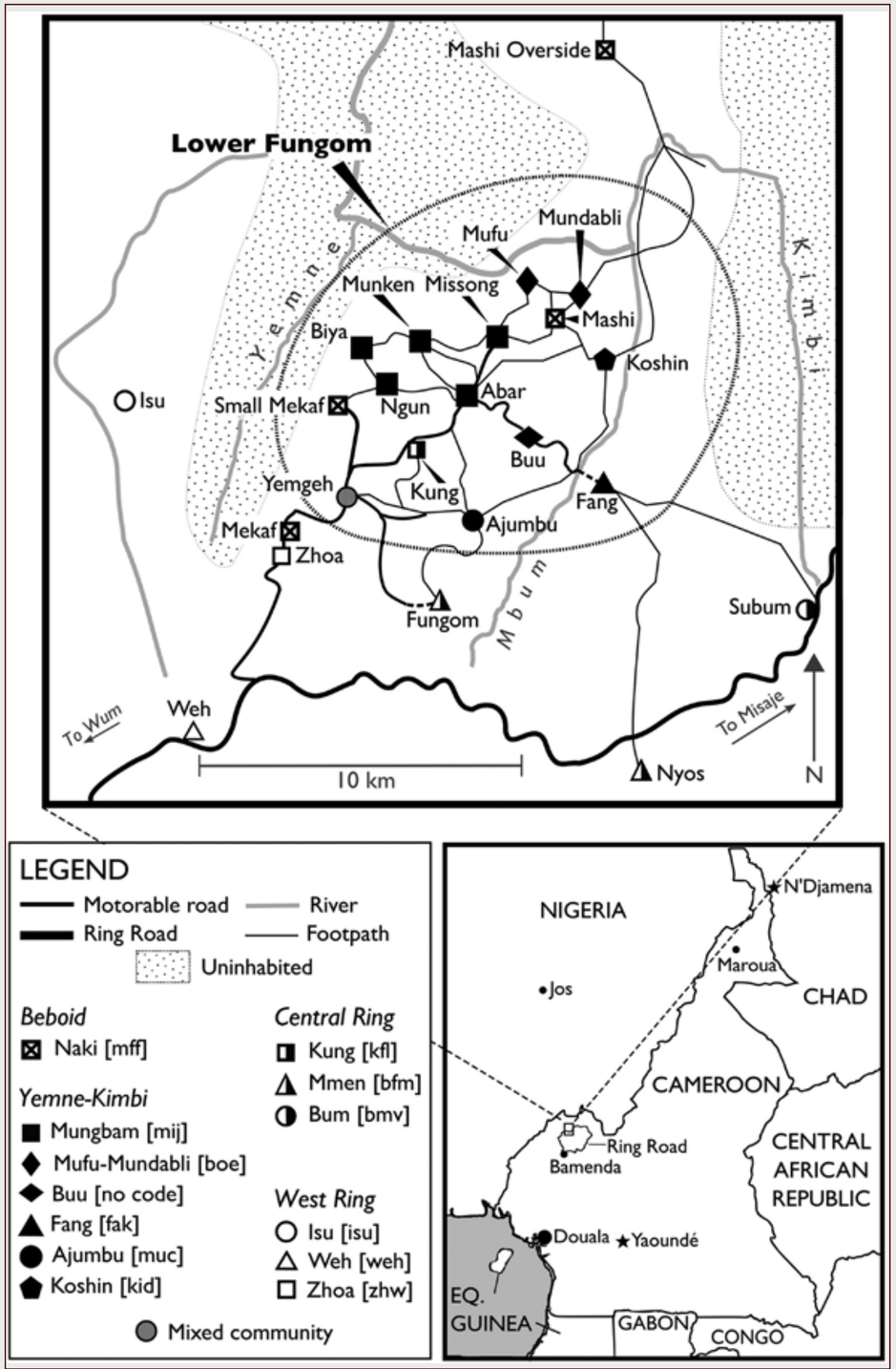
  - The Max Planck Institute for Evolutionary Anthropology
  - The Endangered Languages Documentation Programme
  - The University at Buffalo, State University of New York
- Key co-researchers for this work: Pierpaolo Di Carlo, Ling Bian, Yujia Pan, Penghang Liu, Jiazhen Sun, Clayton Hamre, and Nelson Tschonghongei

KPAAM-CAM

- Key Pluridisciplinary Advances in African Multilingualism
- A collaboration between U. Buffalo, U. Yaoundé I, U. Buea, U. Bamenda, U. Dschang, and the Catholic University of Cameroon, Bamenda
- Long-term research goal: Longitudinal investigation of language change in a diverse region of the Cameroonian Grassfields
- Applied research on language choice and public health messaging and building training capacity has also been undertaken
- See http://kpaam-cam.org for more information

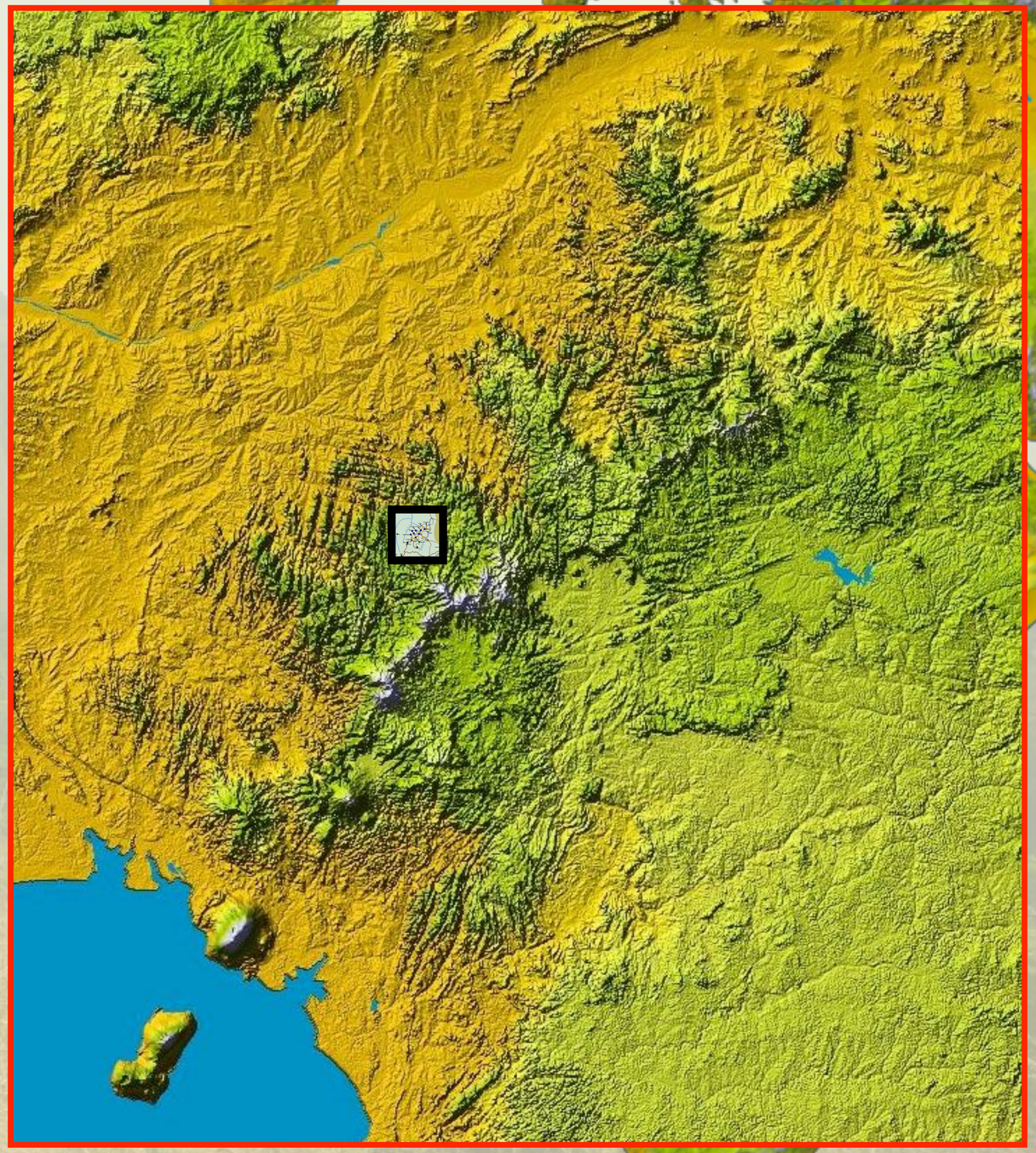
Dynamics of language and space

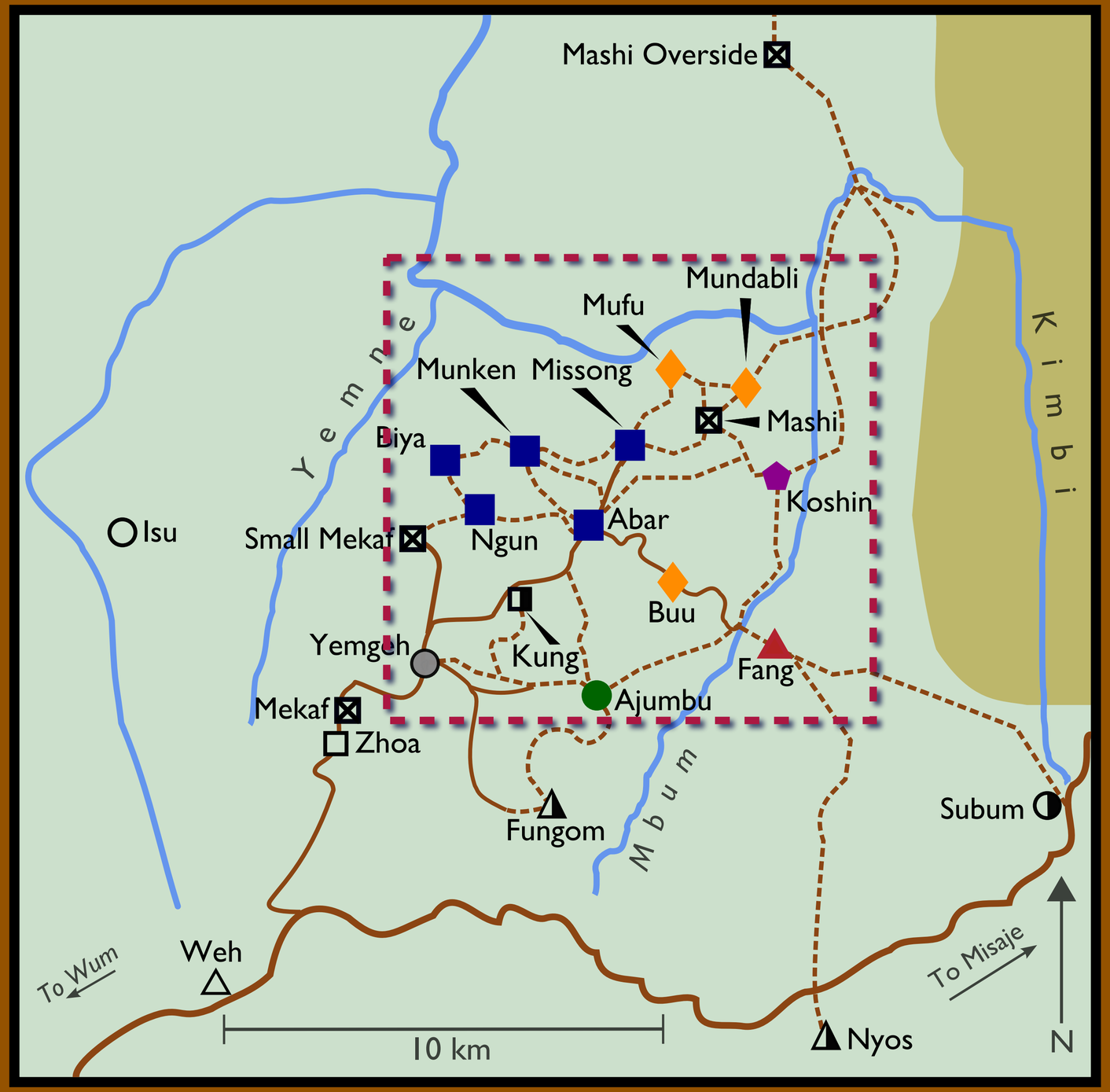
- The linguistic study of language and space generally
  - Starts from a simplifying assumption that communities are monolingual
  - Treats each speaker as being associated with a single location
  - Views space primarily as a "stage" on which language users operate (but see Di Carlo & Pizziolo 2012 and Hammarström & Güldemann 2015)



Lower Fungom

At the northern edge of the Grassfields





Lower Fungom

- 13 villages
- 7–9 "languages"
- 5 local isolates
- 2 dialect clusters
- 12,000(?) people (before 2017)
- Rural economy
- Localist attitudes
- Multilingualism/multilectalism pervasive

Image source: https://blogs.shu.edu/journalofdiplomacy/2018/02/refoulement-the-case-of-nigeria-and-cameroon/

Interview guide excerpt

Paternal name

Maternal name

Other names

Paternal affiliation

Maternal affiliation

Spouse's provenance

Spouse's languages

Father's provenance

Father's languages

Mother's provenance

Mother's languages

Children's languages

Language name

Degree of competence
1=hears a bit; 2=hears but no talk; 3=talks a bit, 4=fluent; 5=native

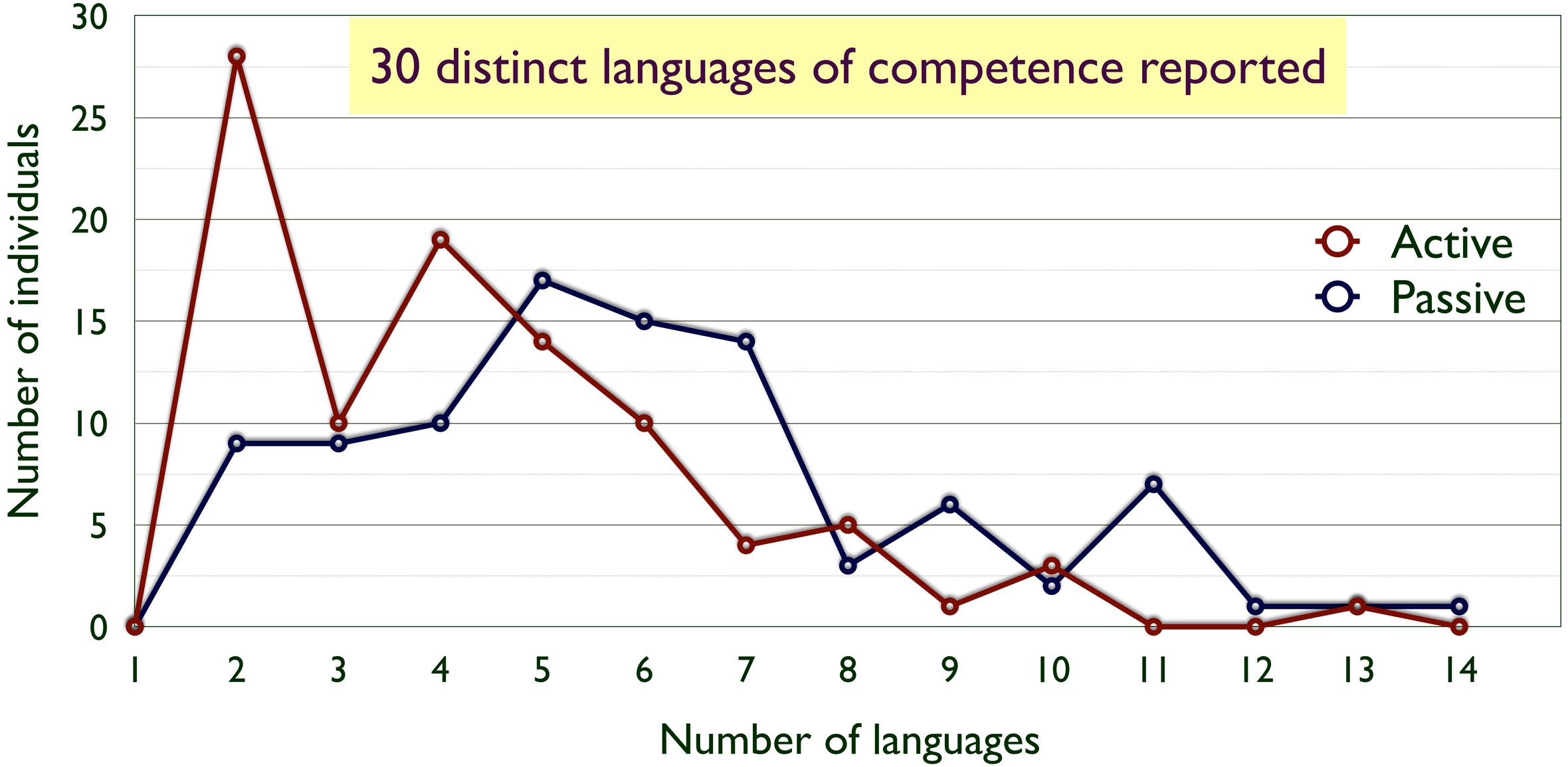
Where did you learn it?

Where do you use it?

What are the advantages of knowing this language?

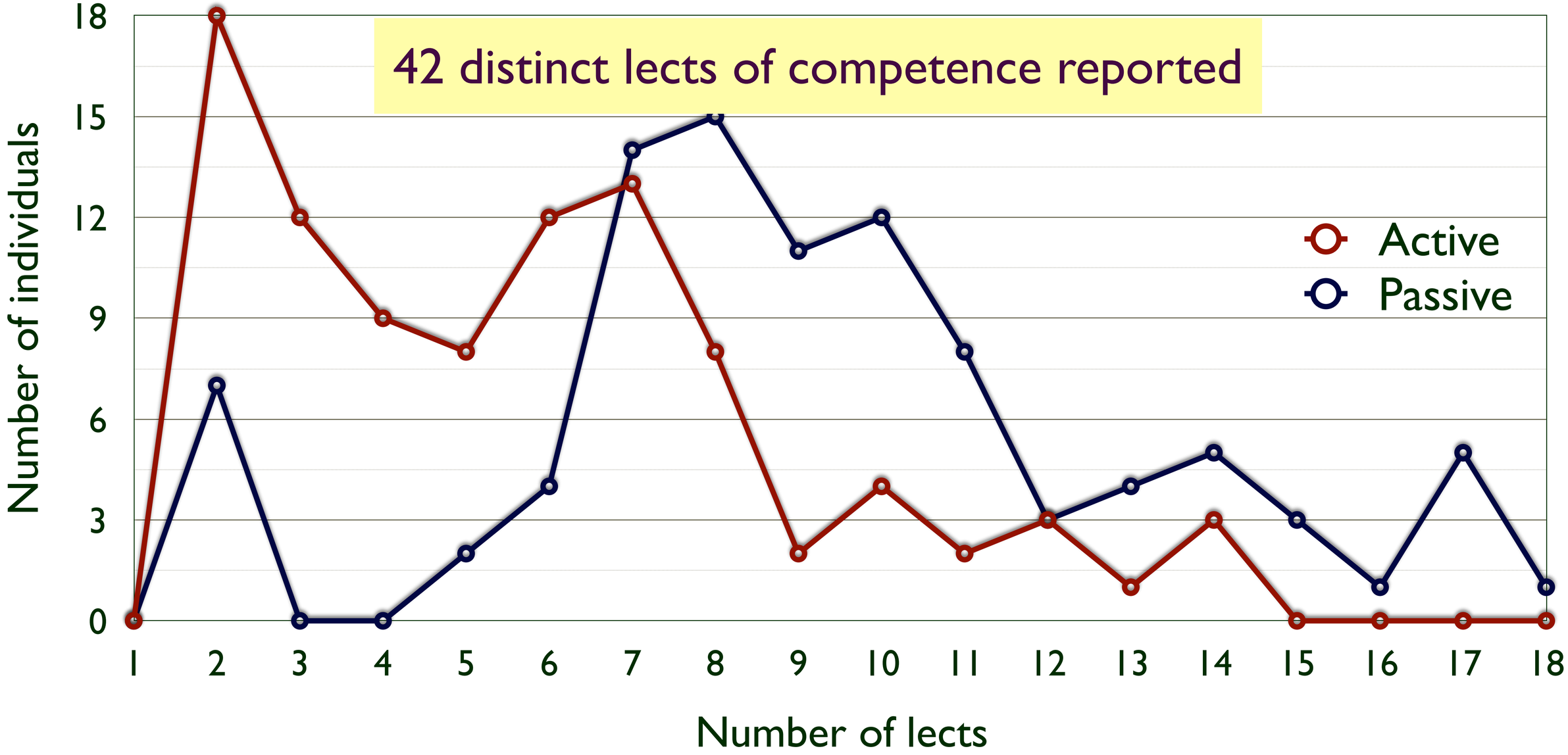
Are there special occasions in which you use it (e.g. prayers, songs, etc.)?

Reported number of languages spoken



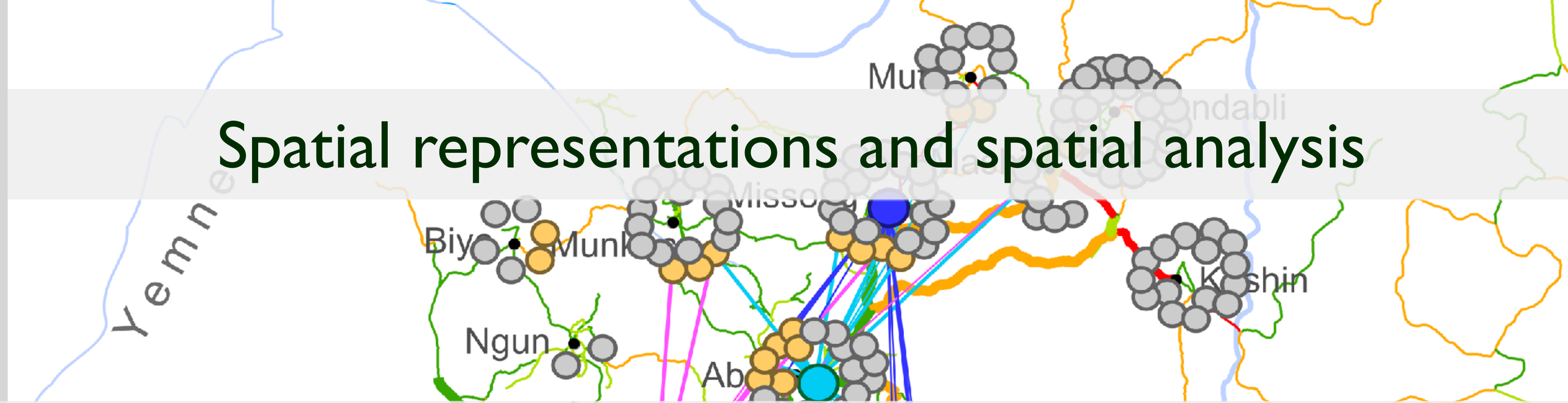
Esene Agwara (2013)

Reported number of lects spoken



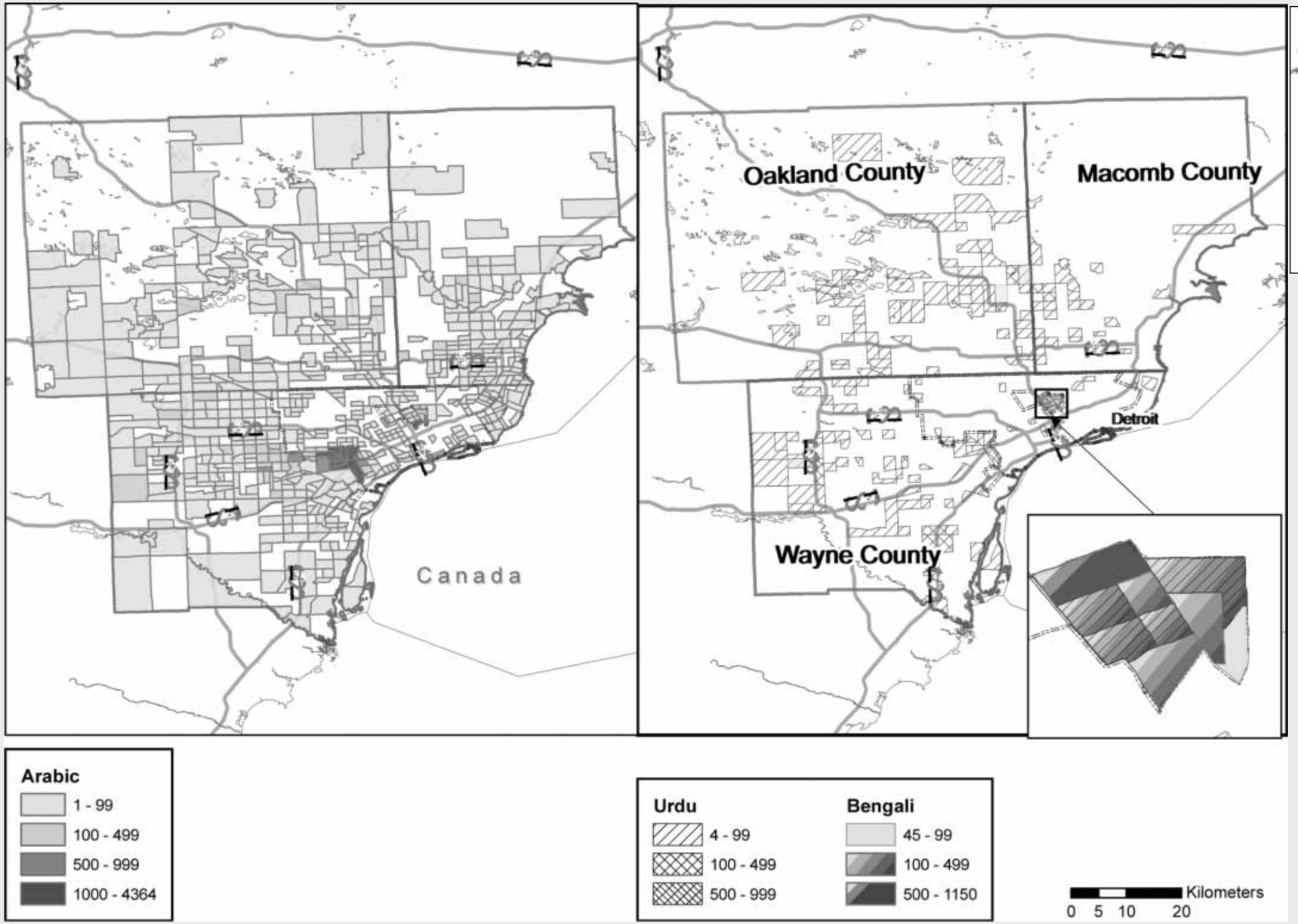
Esene Agwara (2013)

Spatial representations and spatial analysis



- Geographers are not (necessarily) cartographers
- However, data with spatial properties can be used to create useful visualizations for conveying linguistic patterns
- The same data can be used to conduct quantitative analyses of the relationship between language and space

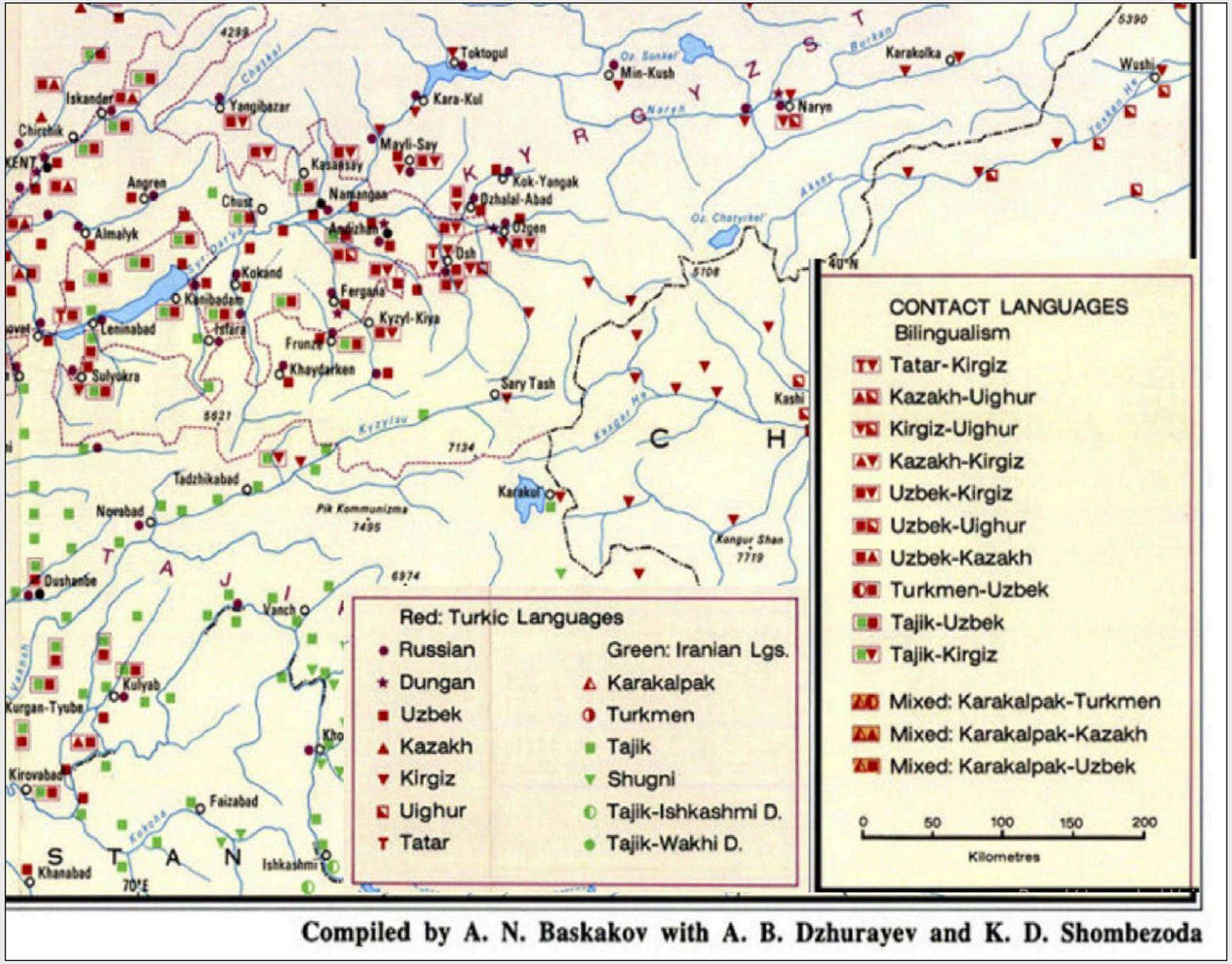
Veselinova & Booza (2008)



Uses census tracts for fine-grained visualization and analysis, as well as overlays for presence of multiple languages.

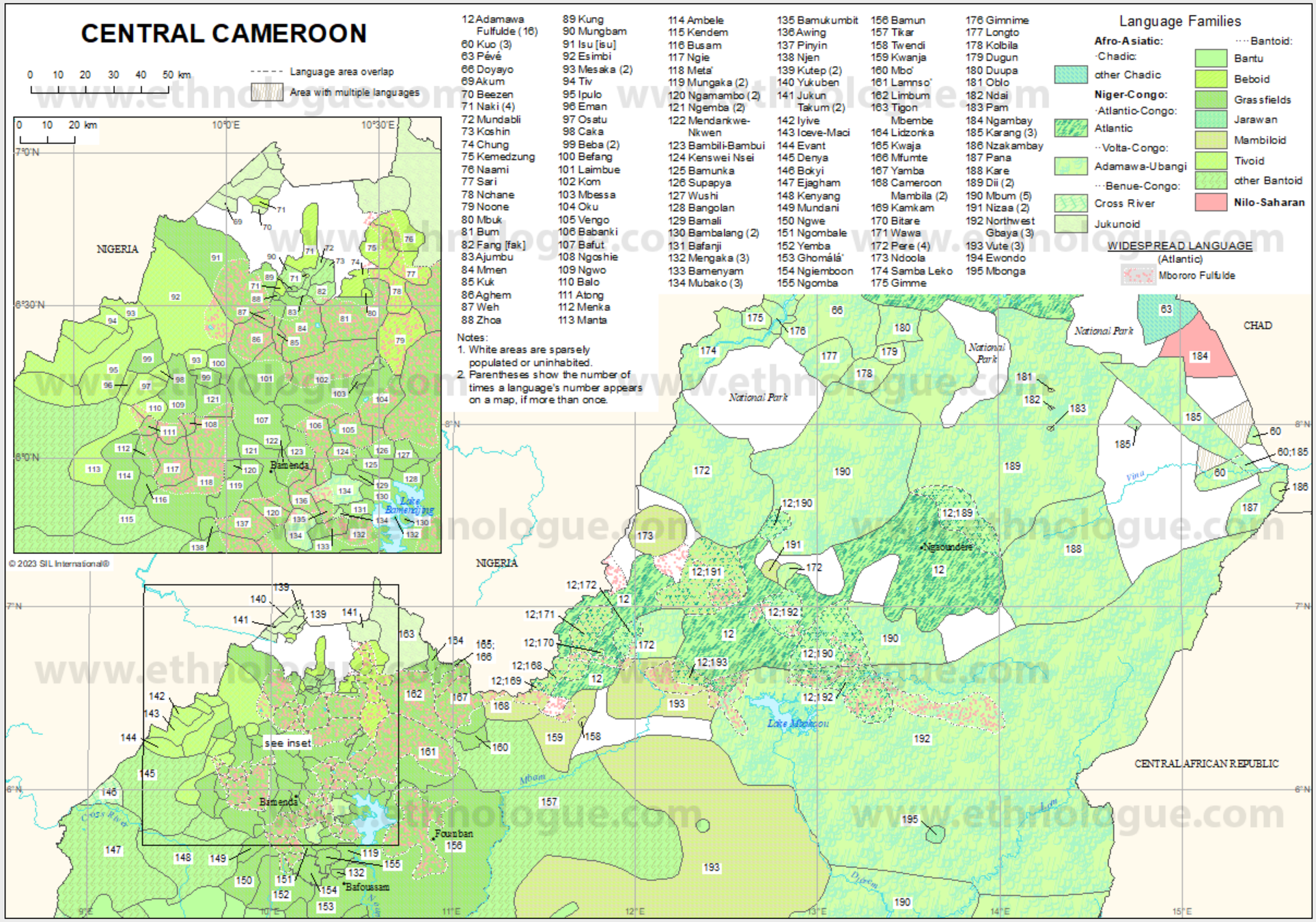
See also: Di Carlo (2022)

Baskakov et al. (1996)



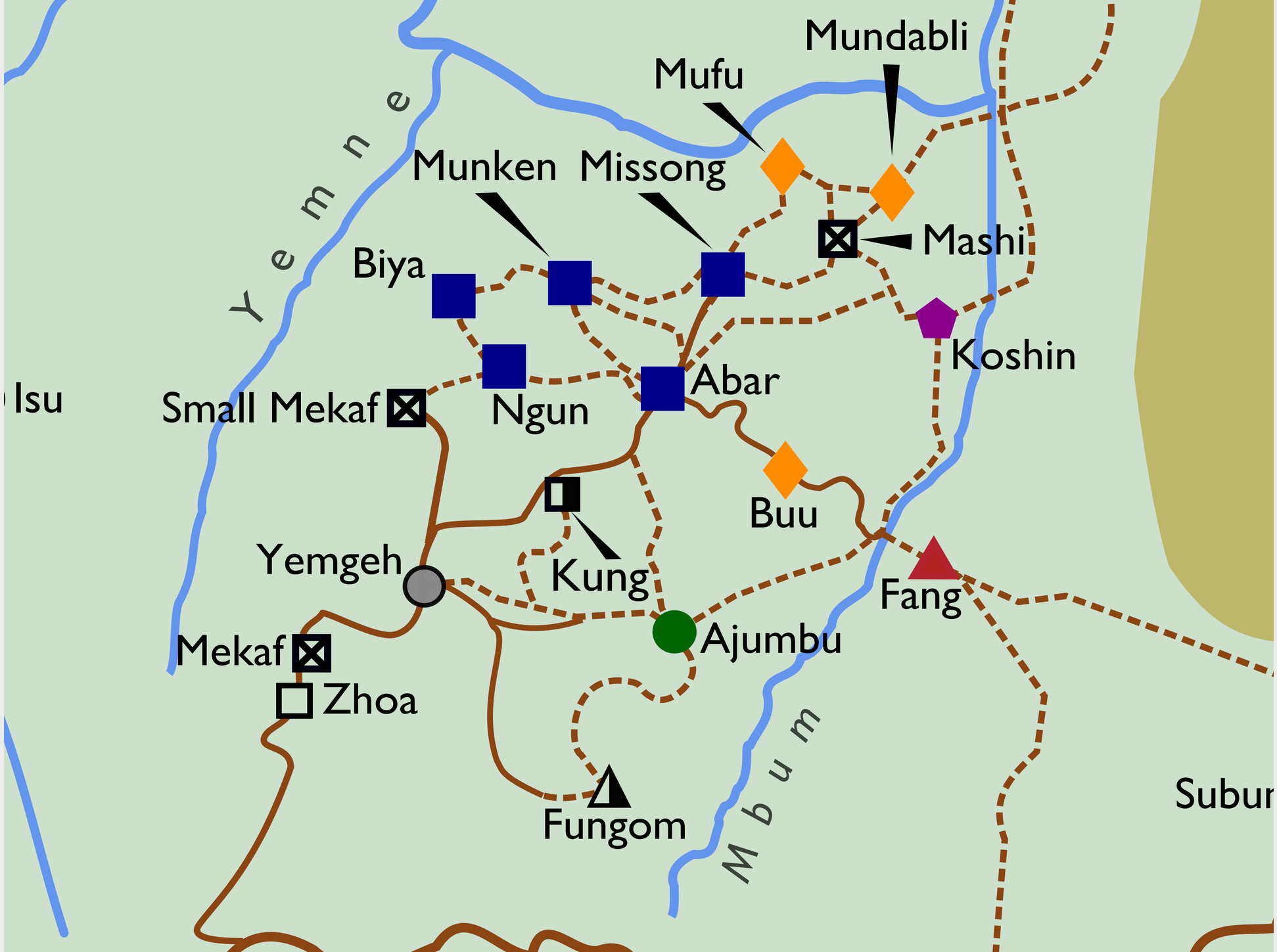
Provides information on bilingualism among individuals surveyed, placing them in the place where they resided at the time of the survey.

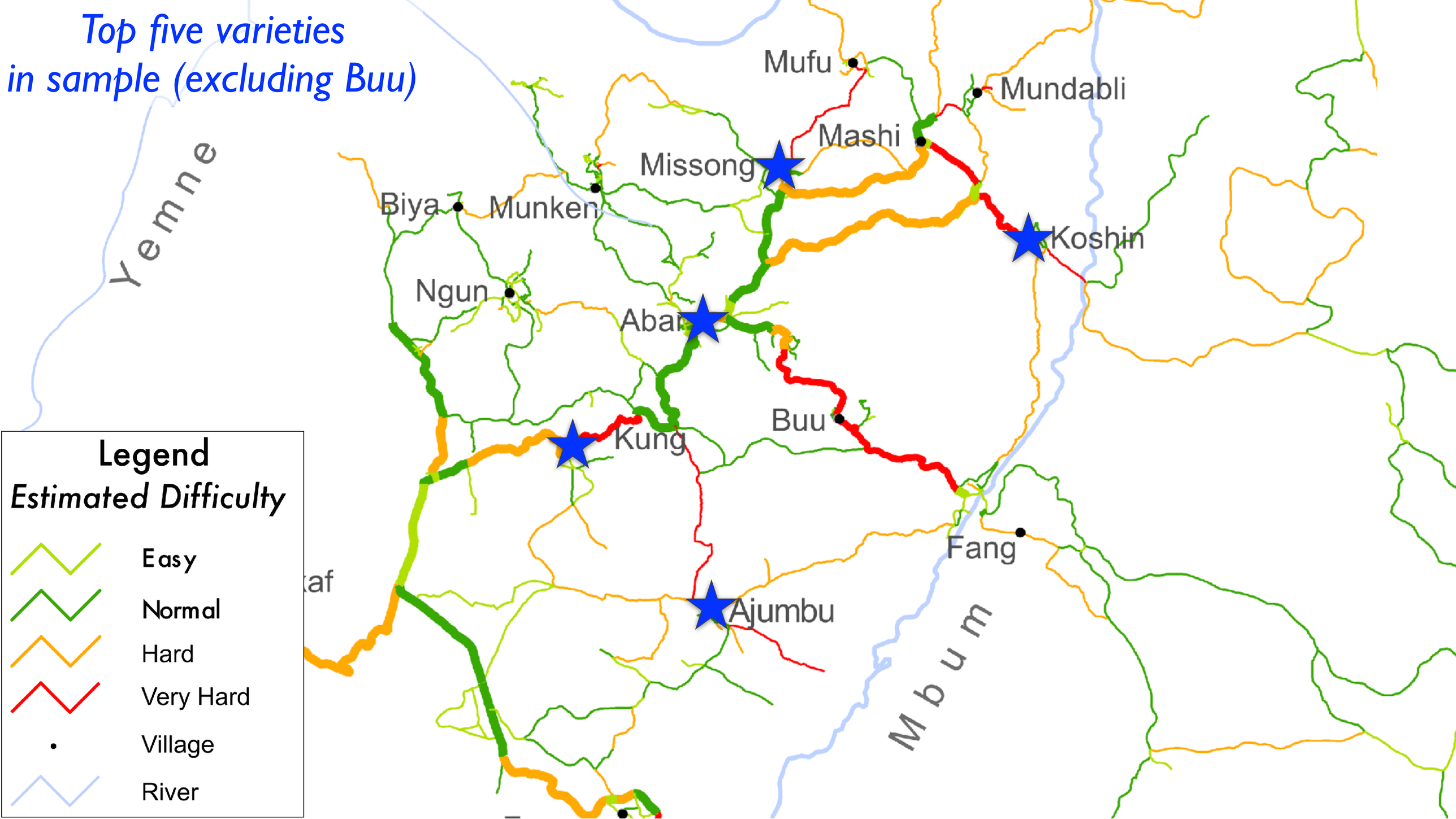
See also: Di Carlo (2022)

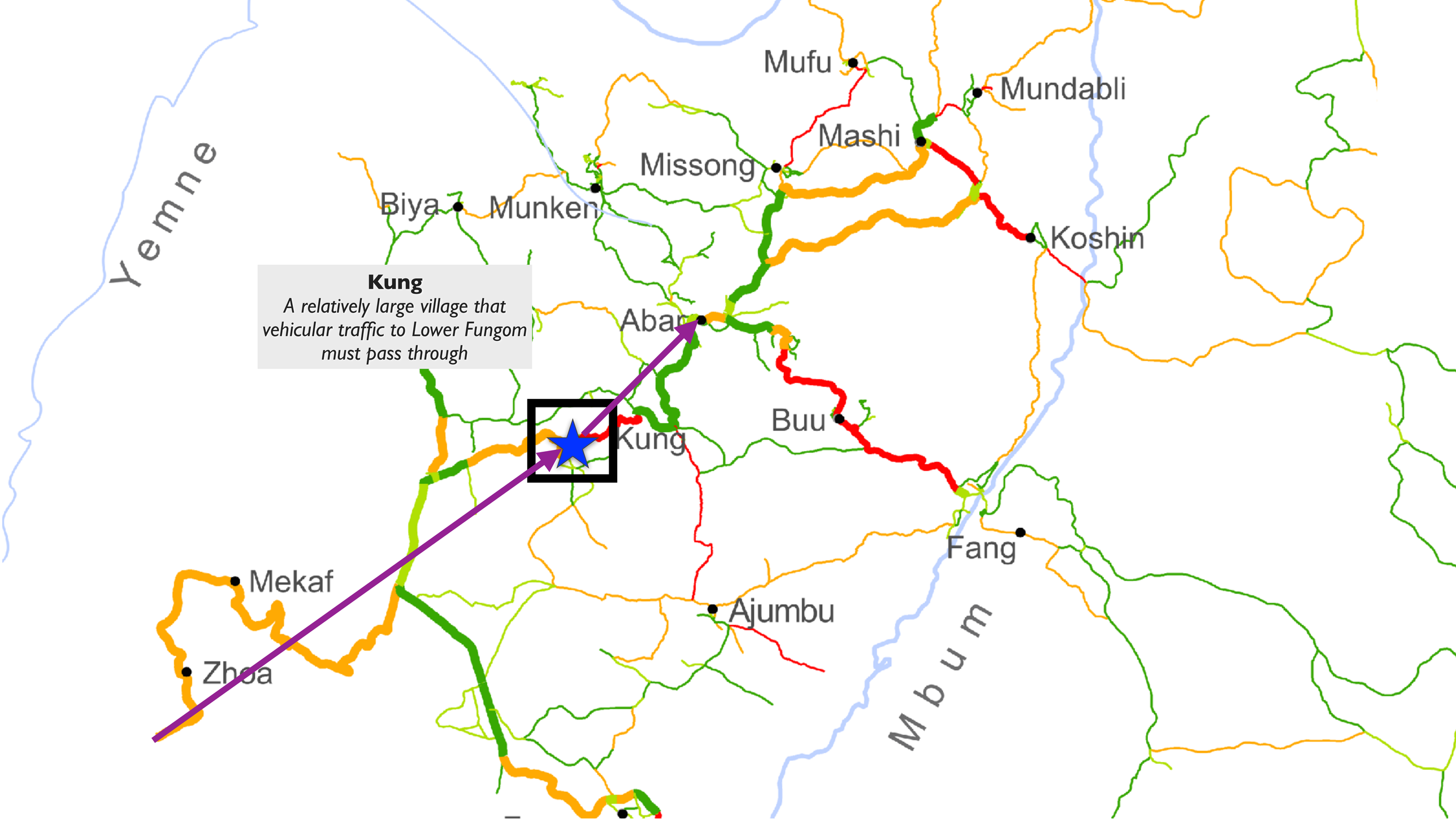


Ethnologue map that includes the Lower Fungom region

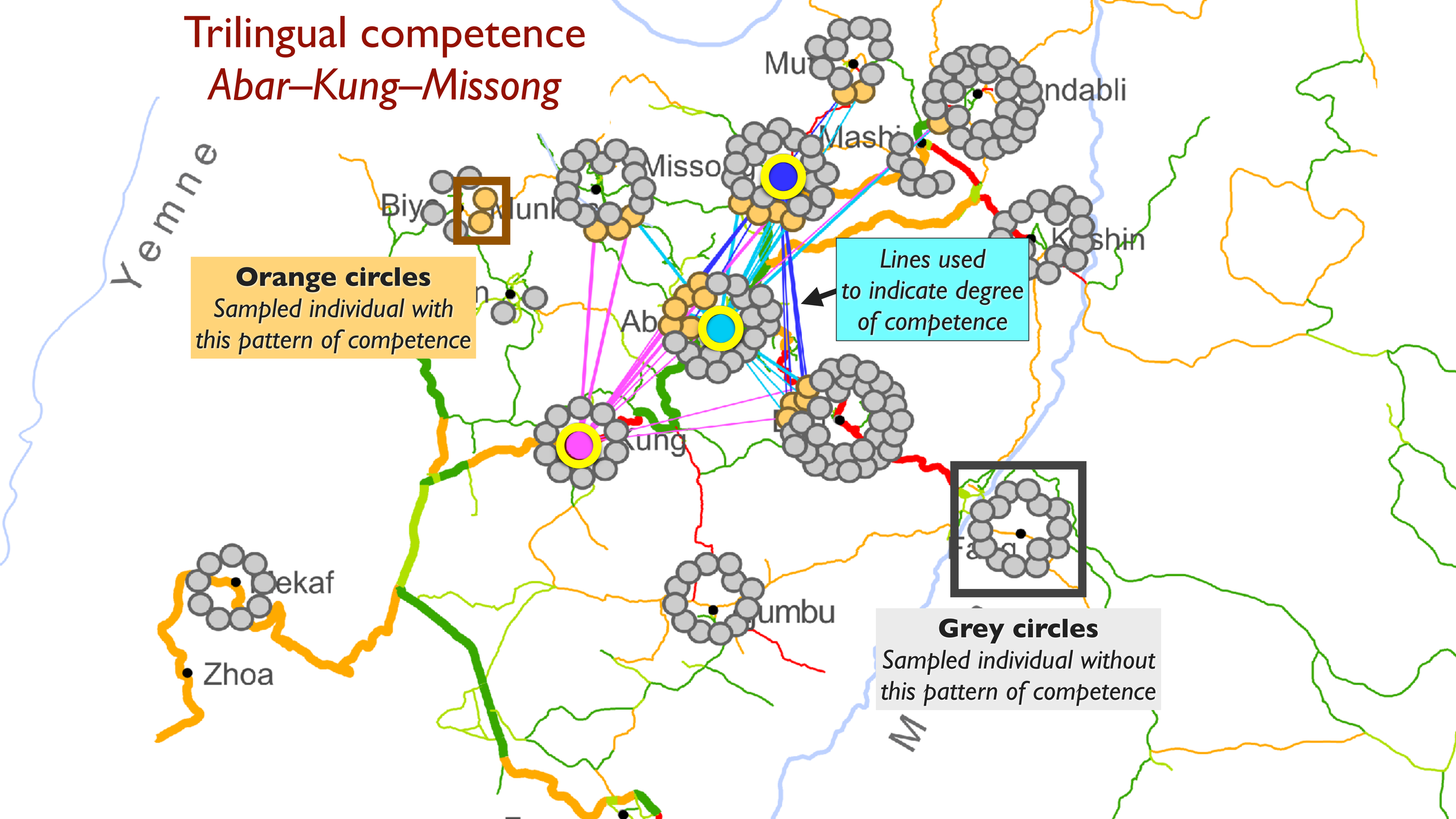
Overlays dots to show where Fulfulde herders live in areas also occupied by farmers; otherwise divides the country into polygons that are not always well supported by data.


Mundabli
Mufu
Munken
Missong
Mashi
Biya
Yemmene
Koshin
Abar
Isu
Small Mekaf
Ngun
Buu
Kung
Yemgeh
Fang
Ajumbu
Mekaf
Zhoa
Fungom
Mbum
Subur


Top five varieties
in sample (excluding Buu)
Mufu
Mundabli
Mashi
Missong
Biya
Munken
Koshin
Ngun
Abar
Buu
Kung
Fang
Ajumbu
Yemne
Mbum
Legend
Estimated Difficulty
Easy
Normal
Hard
Very Hard
Village
River


Mufu
Mundabli
Mashi
Missong
Biya
Munken
Koshin
Yemne
Kung
A relatively large village that vehicular traffic to Lower Fungom must pass through
Abar
Buu
Kung
Fang
Mekaf
Ajumbu
Zhoa
Mbum

Trilingual competence
Abar–Kung–Missong

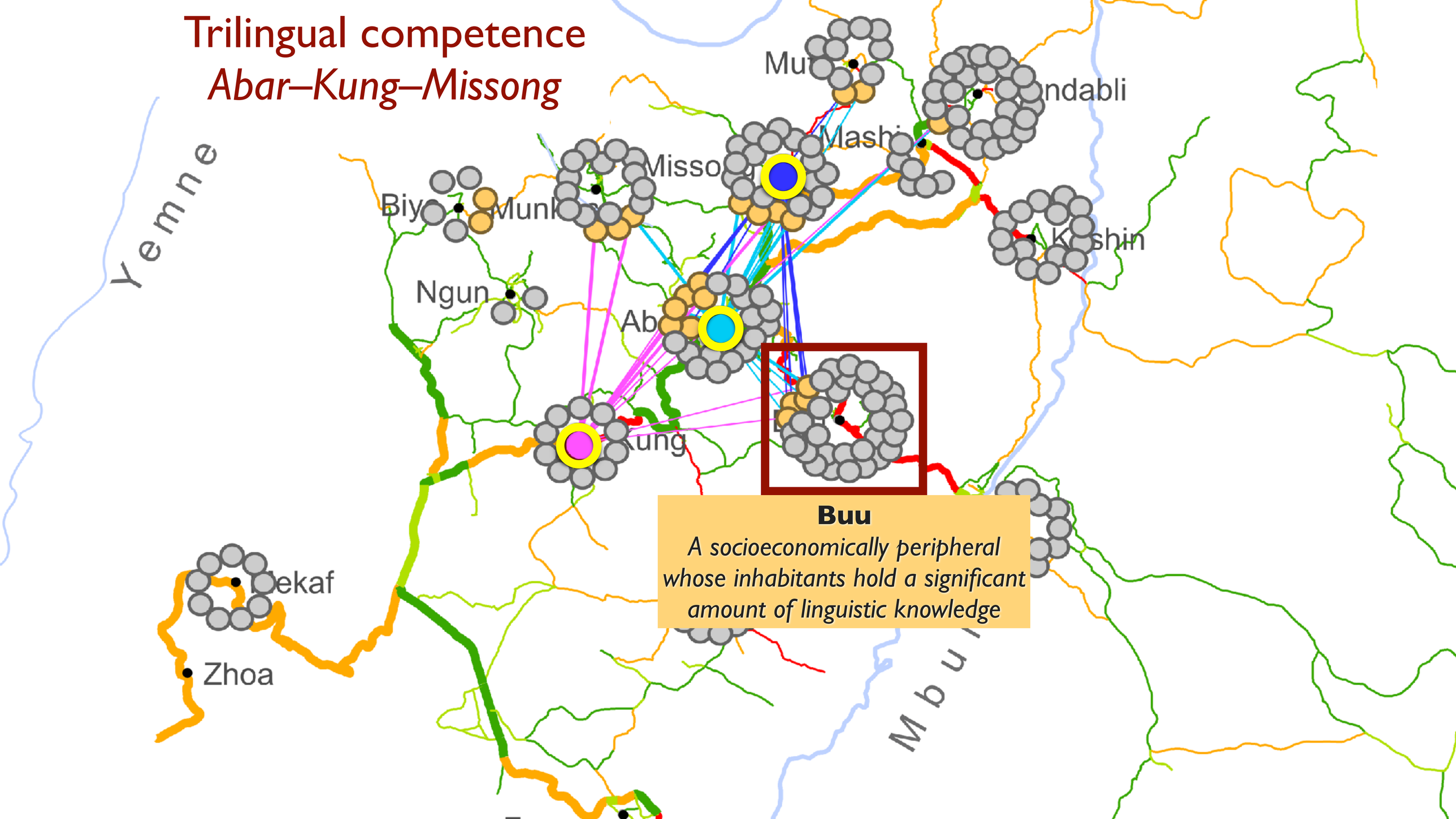


Orange circles
Sampled individual with this pattern of competence

Lines used to indicate degree of competence

Grey circles
Sampled individual without this pattern of competence

Trilingual competence
Abar–Kung–Missong



Buu

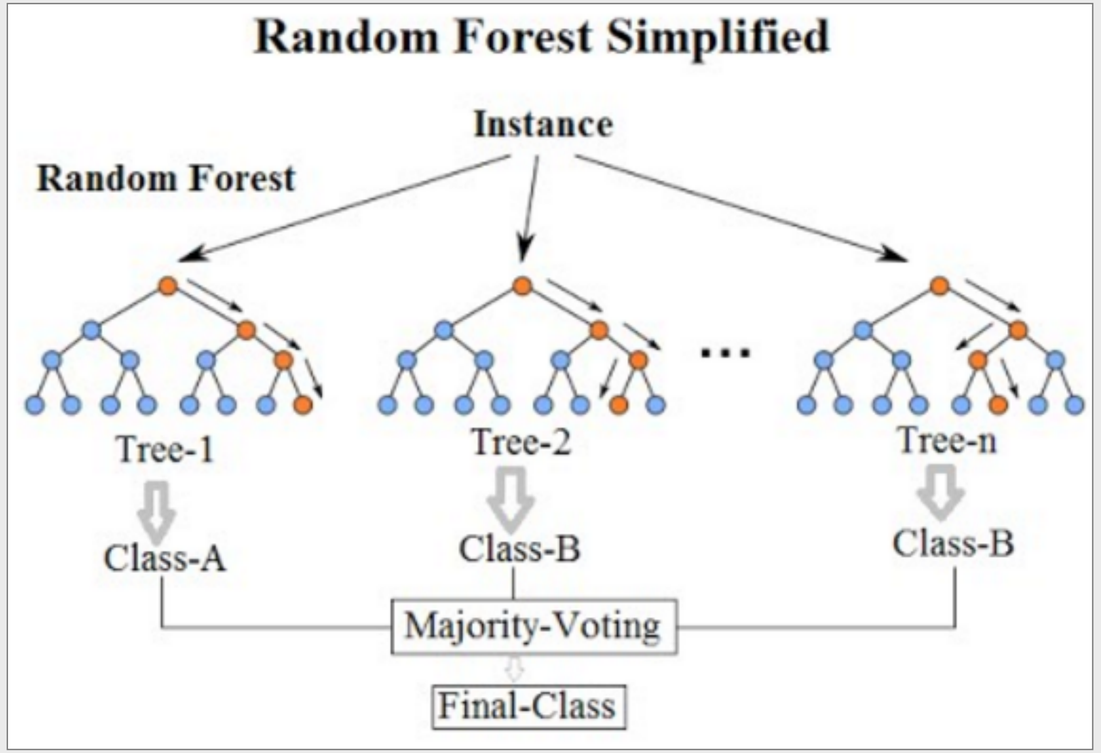
A socioeconomically peripheral whose inhabitants hold a significant amount of linguistic knowledge

Three spatial studies

- Predictive models of an individual's primary language
- Distribution of linguistic knowledge via village profiles
- Comparison between "key" languages and villages
- Work directed by Ling Bian and undertaken by Penghang Liu, Jiazhen Sun, and Yujia Pan

Predicting primary languages

- An initial, relatively simple case, involves looking at factors predicting an individual's reported primary language
- The main question: What is the relative importance of social relations versus residence?
- Secondary question: Are there effects related to an individual's linguistic repertoire?
- Sample size of 206 individuals, with random forest algorithm used for classification



Source: Venkata Jagannath via Wikipedia

Study by Jiazhen Sun

Features for classification

- Around 120 features were considered in the classification
  - An individual's residence and gender
  - Village affiliations of mother, father, and spouse(s)
  - Languages spoken by mother, father, and spouse(s)
  - Gender of spouse(s)

Top four predictive features

Features	*Relative importance*
Paternal affiliation	0.100
Ego's residence	0.090
Maternal affiliation	0.089
Ego's village of birth	0.057

- Across all features, the relative importance adds up to 1, the random forest approach should handle correlated variables well
- The next set of features is mostly repertoire-based (e.g., whether the father or mother speak a specific language)
- Most features contribute little to predicting an individual's main language
- It is not surprising that social networks and places of residence play a role in determining individual's primary languages
- This method helps us get a more precise understanding of the role of each in determining an individual's primary language identification

Village–language profiles

- How is linguistic knowledge distributed across villages?
- How is it distributed across generations across villages?
- This lets us look at overall shifts in multilingualism within Lower Fungom; we focused on the "top five" languages
- The methods are adapted from algorithms used for comparing images for points of similarity
- Work conducted primarily by Penghang Liu

Representing knowledge in space

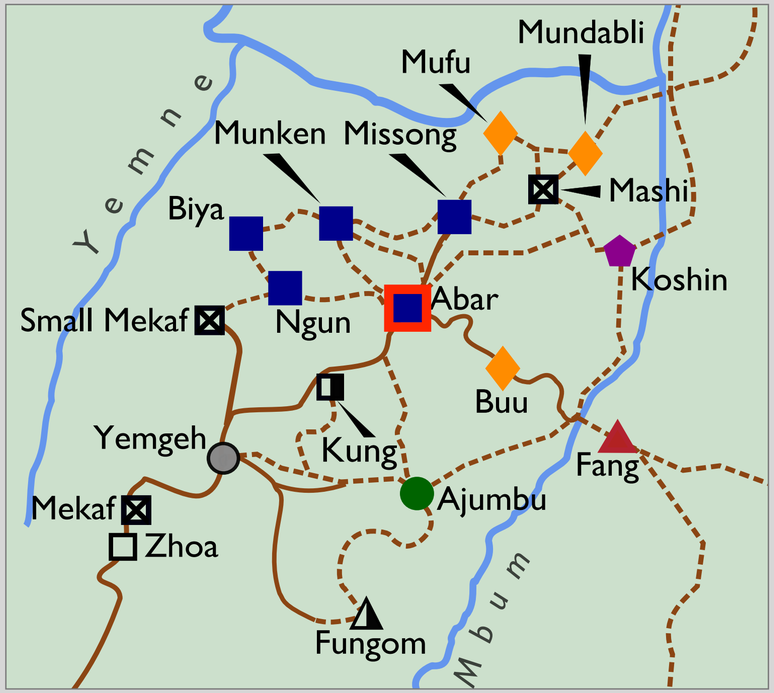
- Same sample size of 206 individuals from Lower Fungom
- For each language, create a vector representing how many people in a village report knowledge of a that language
- *Example: Knowledge of Abar across villages*
  (21, 0, 1, 34, 0, 1, 0, 3, 1, 0, 0, 0, 0, 1, 25, 0, 2, 2, 16, 2, 0, 0, 0, 5, 0, 0)
- Vectors produced for top-five languages in survey
- For Ego and Ego's Mother and Father

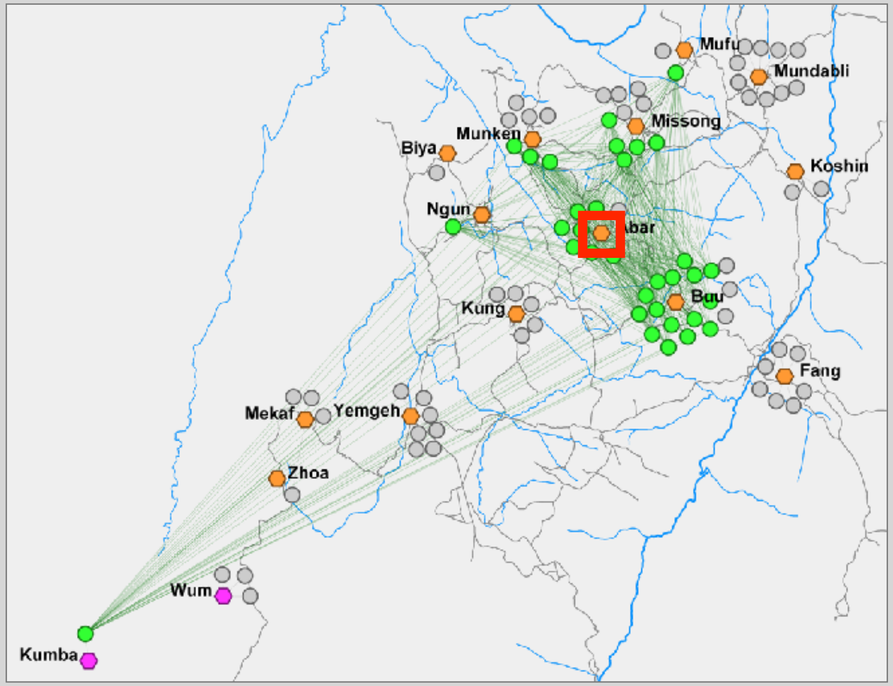
Knowledge of Abar across villages

(21, 0, 1, **34**, 0, 1, 0, 3, 1, 0, 0, 0, 0, 1, 25, 0, 2, 2, 16, **2**, 0, 0, 0, 5, 0, 0)

34 people in village 4
report knowledge of Abar

2 people in village 20
report knowledge of Abar

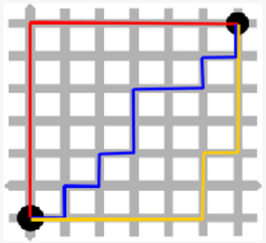




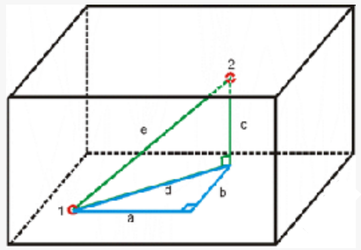
Generational comparison (e.g., for Abar variety)

Ego's generation	(7, 0, 0, 11, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 9, 0, 0, 0, 2, 1, 0, 0, 0, 1, 0, 0)
Mother's generation	(15, 0, 0, 12, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 8, 0, 1, 1, 8, 1, 0, 0, 0, 2, 0, 0)
Father's generation	(13, 0, 1, 11, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 8, 0, 1, 1, 6, 0, 0, 0, 0, 2, 0, 0)

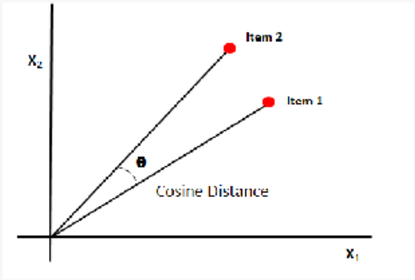
Comparison methods



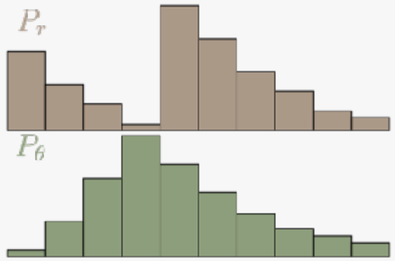
Manhattan distance



Euclidean distance



Cosine distance



Earth-mover distance

(also Quadratic distance)

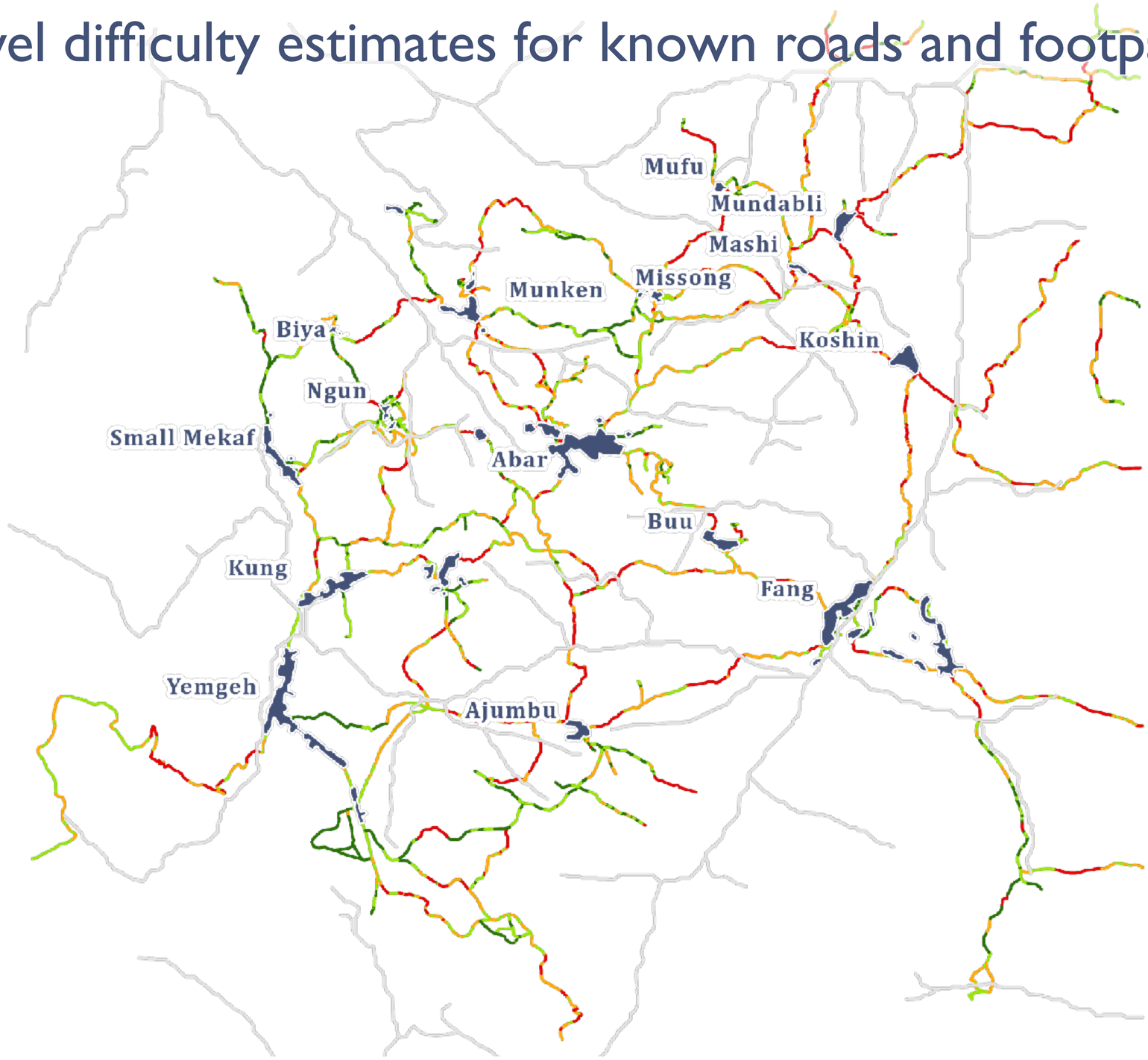
Image sources
https://qph.fs.quoracdn.net/main-qimg-8d64c8344fc8364e46b9712e2c51dca4
https://hlab.stanford.edu/brian/euclid3.gif
https://www.oreilly.com/library/view/statistics-for-machine/9781788295758/assets/2b4a7a82-ad4c-4b2a-b808-e423a334de6f.png
https://vincentherrmann.github.io/blog/wasserstein/

Differences within generations overall lower than across them

No significant difference found among varieties examined

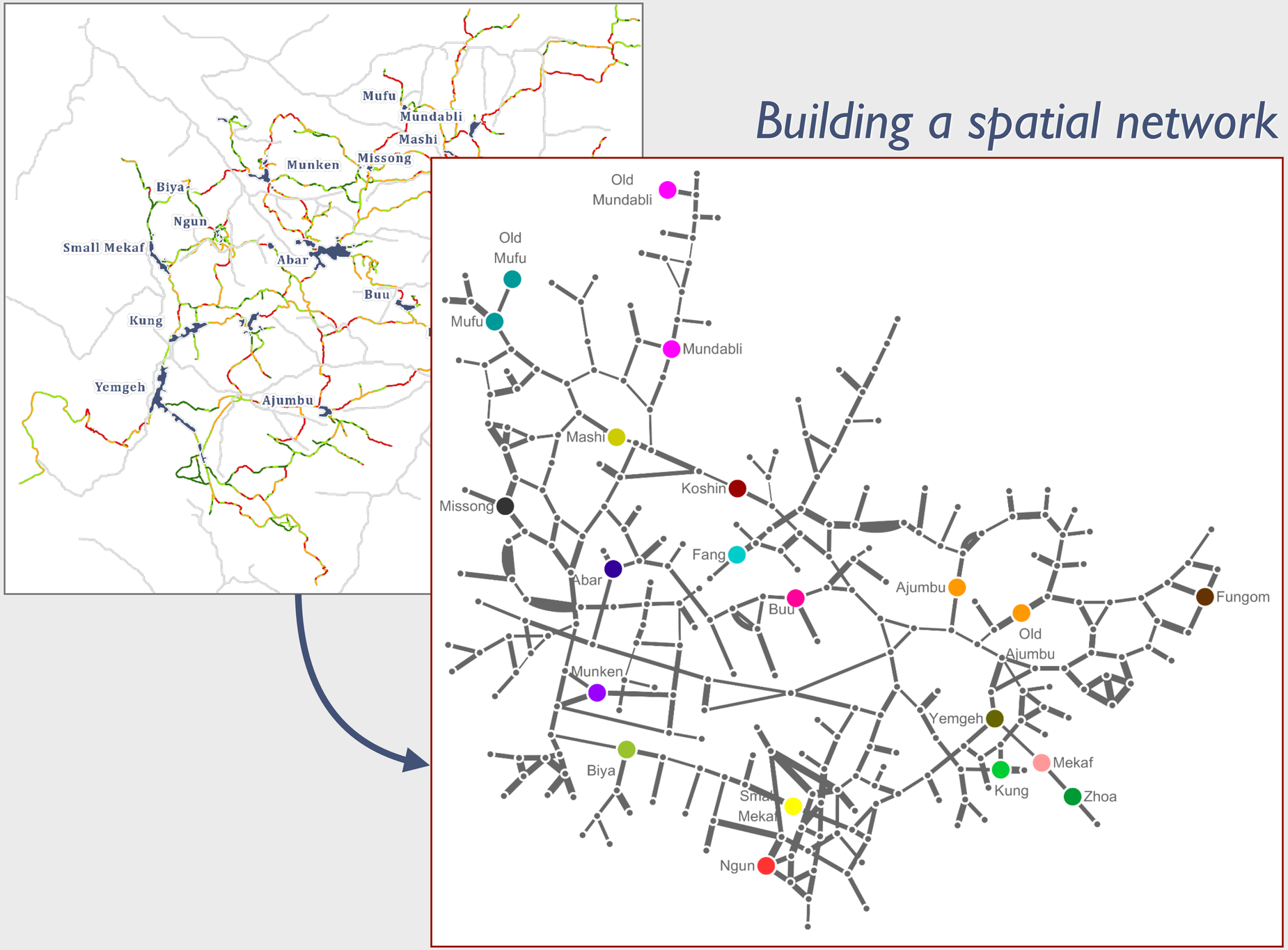
Variety	*Generation*	*Manhattan*	*Euclidean*	*Cosine*	*Quadratic*	*Earth Mover*
Abar	Ego-Father	22	8.833	0.015	49.650	3.141
	Ego-Mother	47	16.549	0.047	41.919	1.400
	Mother-Father	33	12.773	0.030	2.588	1.025
Ajumbu	Ego-Father	20	10.861	0.434	24.775	3.324
	Ego-Mother	22	10.000	0.455	23.738	3.582
	Mother-Father	8	3.743	0.038	16.334	2.694
Koshin	Ego-Father	26	8.488	0.076	31.630	2.366
	Ego-Mother	27	8.892	0.085	21.702	1.569
	Mother-Father	15	5.194	0.019	13.264	0.785
Kung	Ego-Father	35	13.383	0.265	47.172	3.473
	Ego-Mother	41	13.750	0.299	37.524	2.806
	Mother-Father	16	5.092	0.039	17.349	1.094
Missong	Ego-Father	22	8.124	0.017	32.933	1.304
	Ego-Mother	37	13.000	0.040	28.613	1.185
	Mother-Father	23	9.000	0.022	24.593	1.216

Travel difficulty estimates for known roads and footpaths

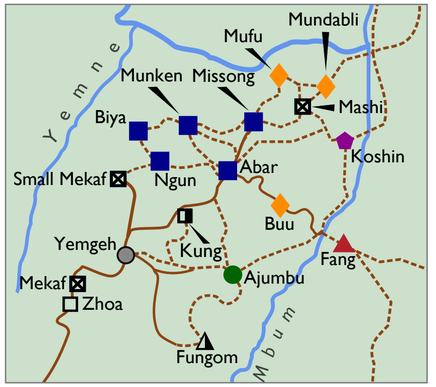


Study by Yujia Pan

Building a spatial network

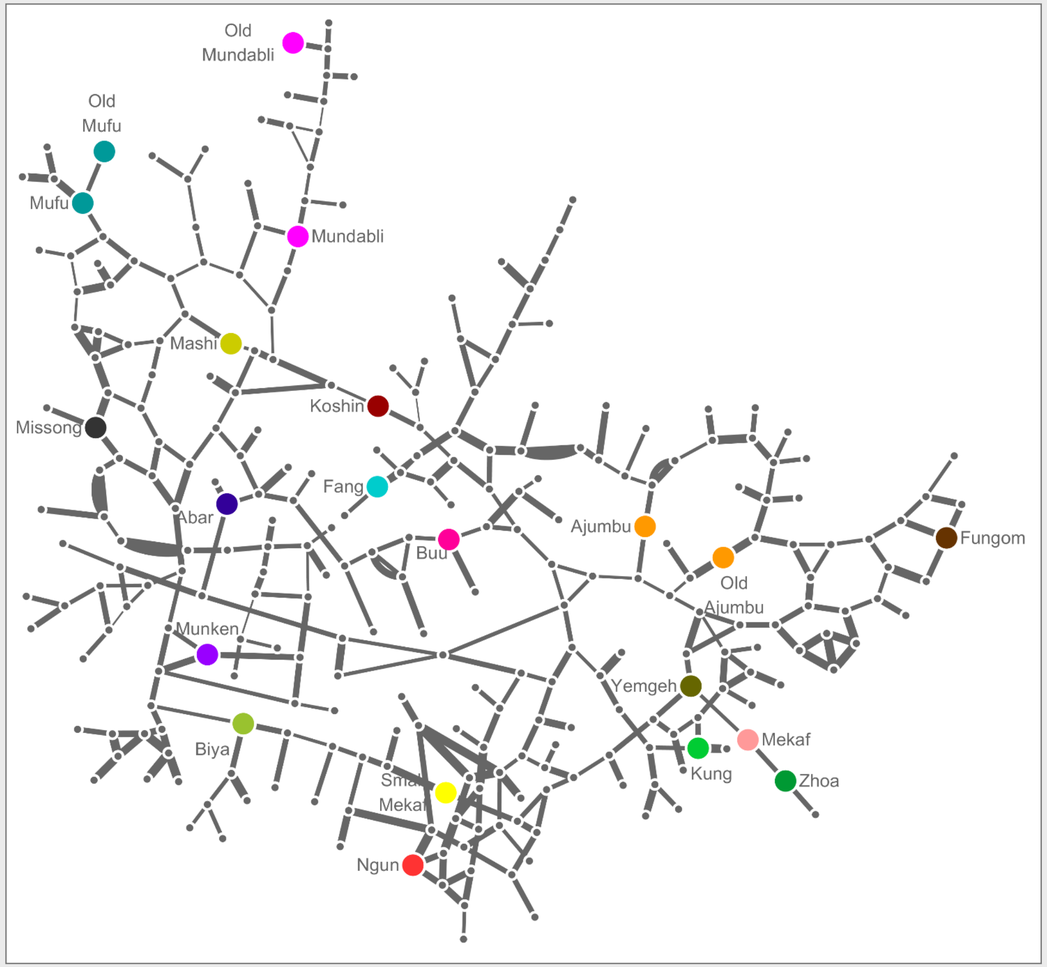


The current spatial network



Network analysis

- What can we learn by comparing a spatial and language networks?
- Are central villages associated with central varieties?
- Degree centrality: Measure of connections to other nodes
- Betweenness centrality: Measure of shortest paths that pass through the node
- Closeness centrality: Measure of how close a node is to other nodes along the existing paths

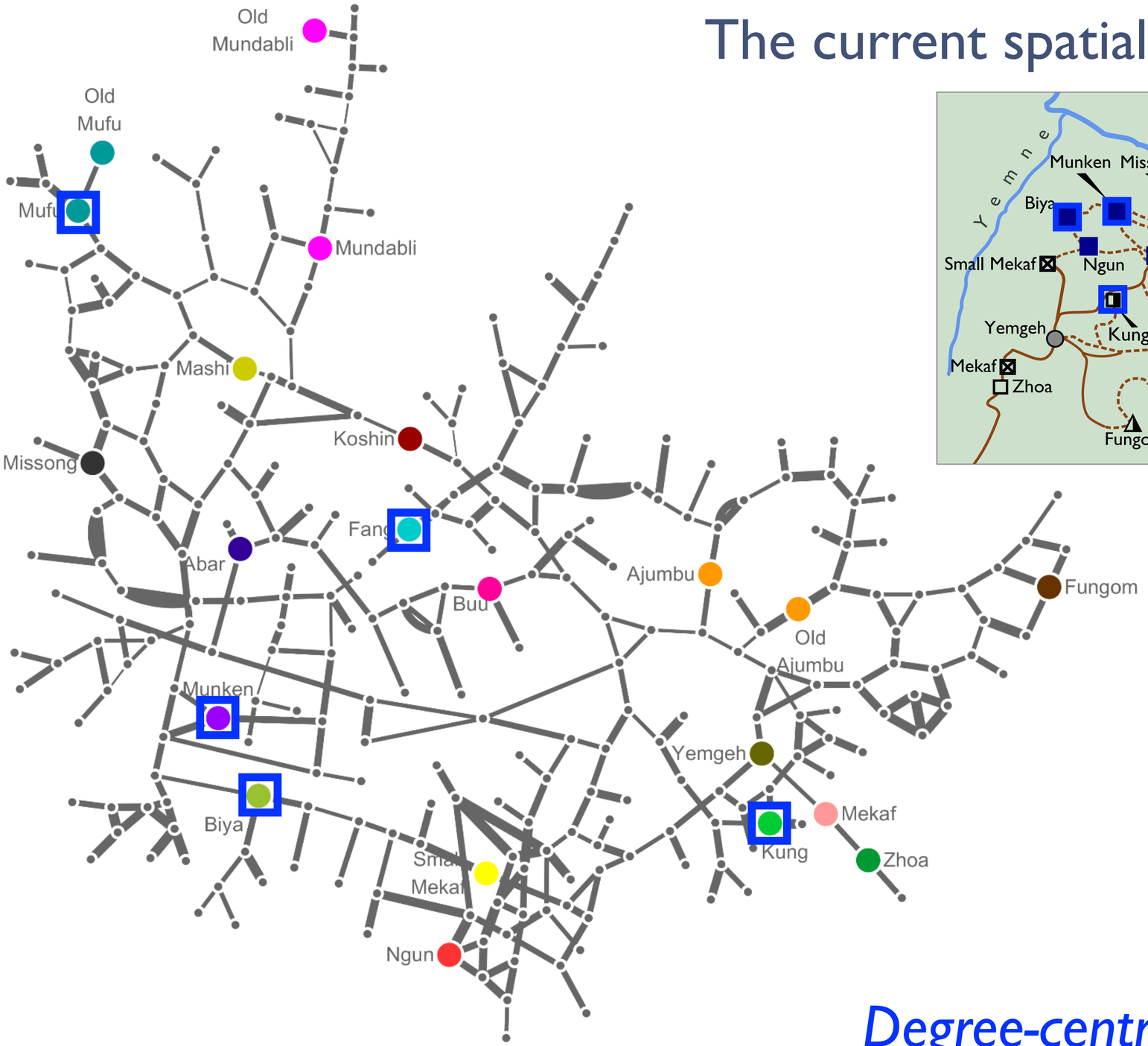


The current spatial network

Degree
Biya
Mufu
Fang
Kung
Munken

Betweenness
Abar
Biya
Ngun
Ajumbu
Munken

Closeness
Abar
Munken
Kung
Missong
Ngun



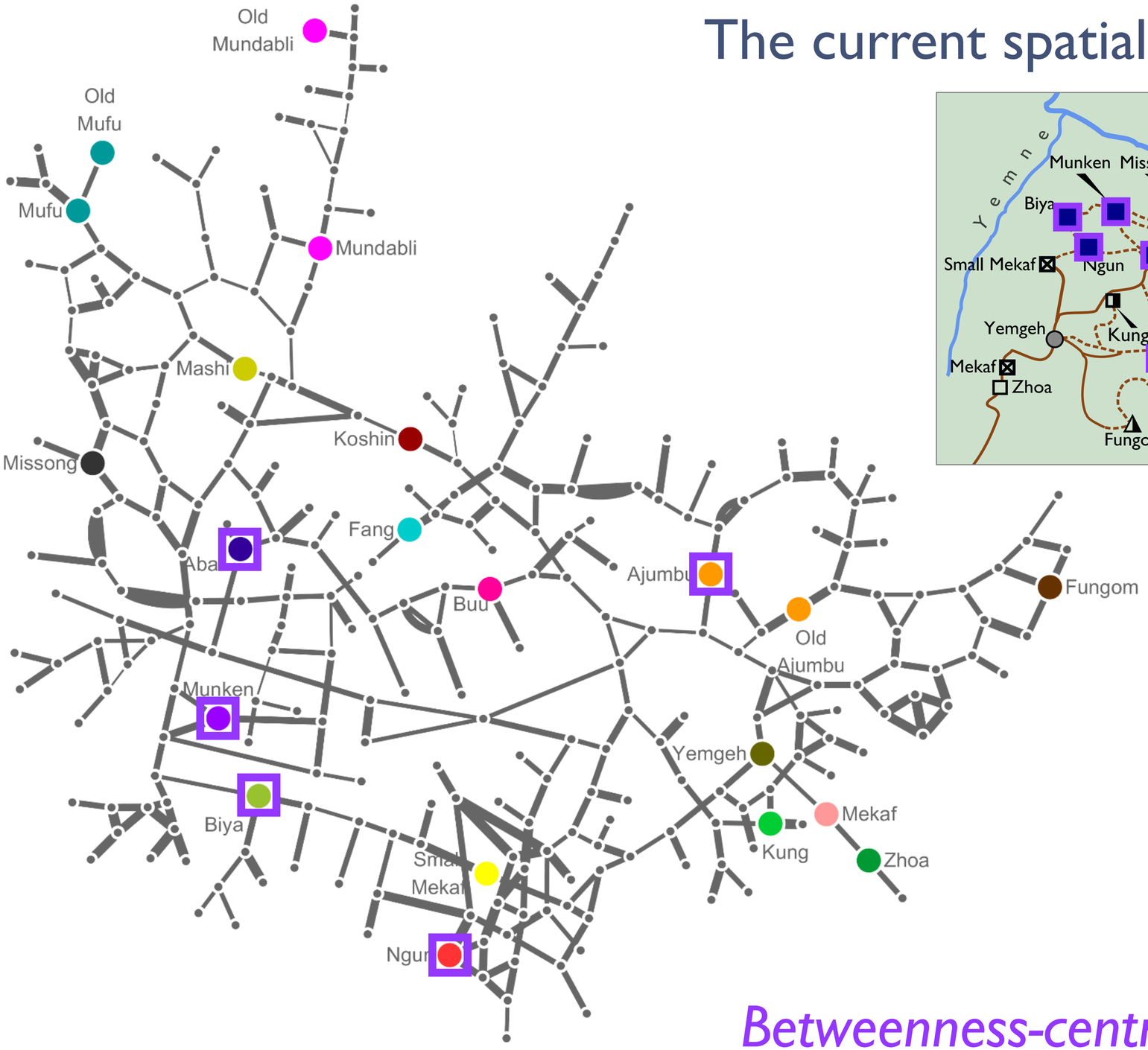
Degree-central villages

The current spatial network

Degree
Biya
Mufu
Fang
Kung
Munken

Betweenness
Abar
Biya
Ngun
Ajumbu
Munken

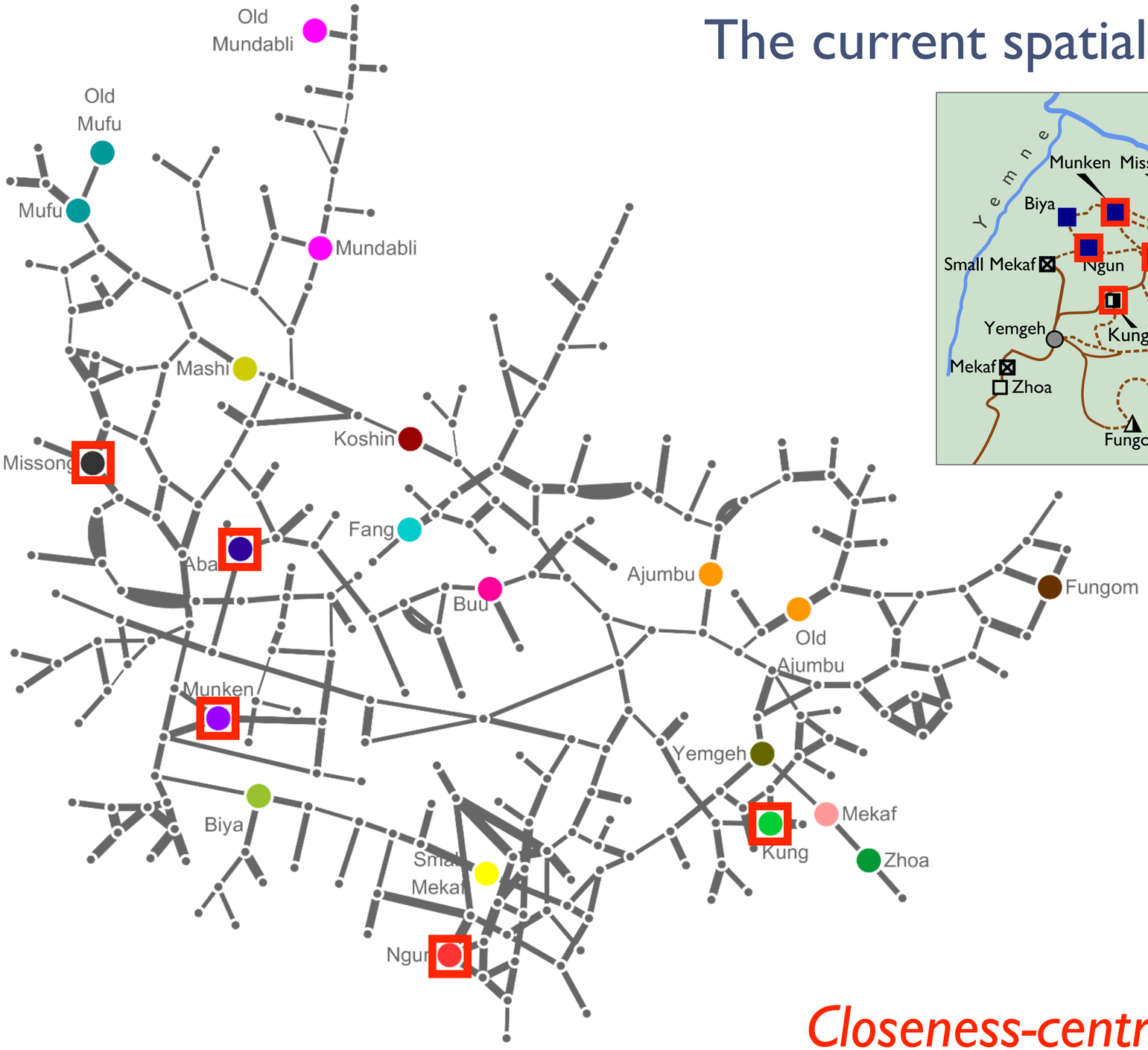
Closeness
Abar
Munken
Kung
Missong
Ngun



Betweenness-central villages

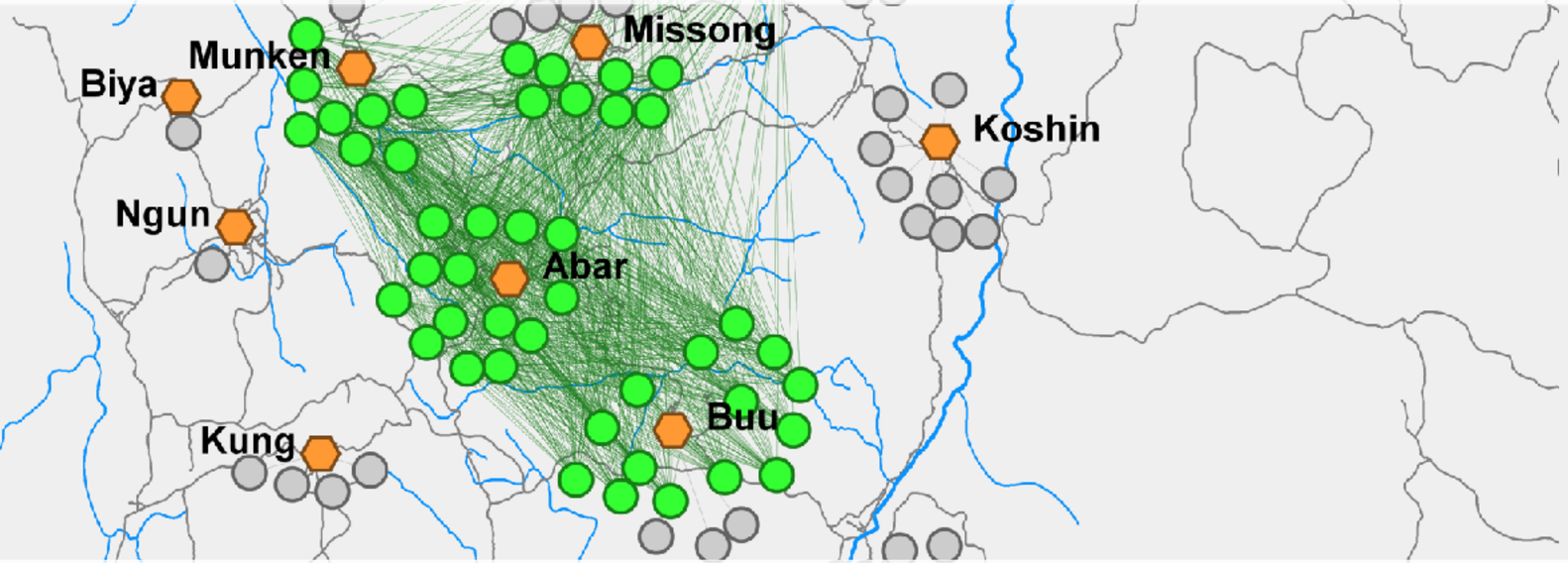
The current spatial network

Degree	Biya
	Mufu
	Fang
	Kung
	Munken
Betweenness	Abar
	Biya
	Ngun
	Ajumbu
	Munken
Closeness	Abar
	Munken
	Kung
	Missong
	Ngun



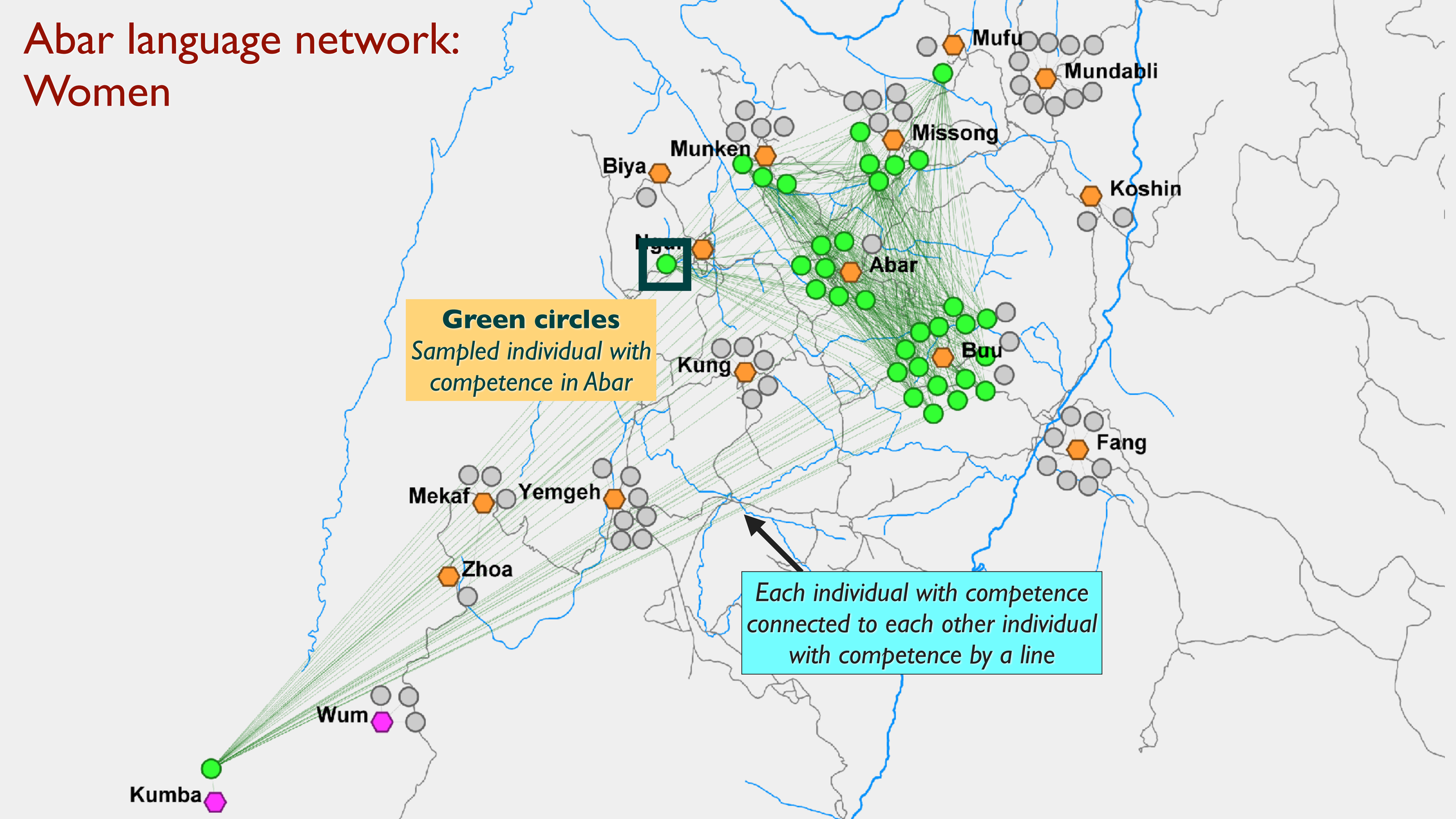
Closeness-central villages

Language networks

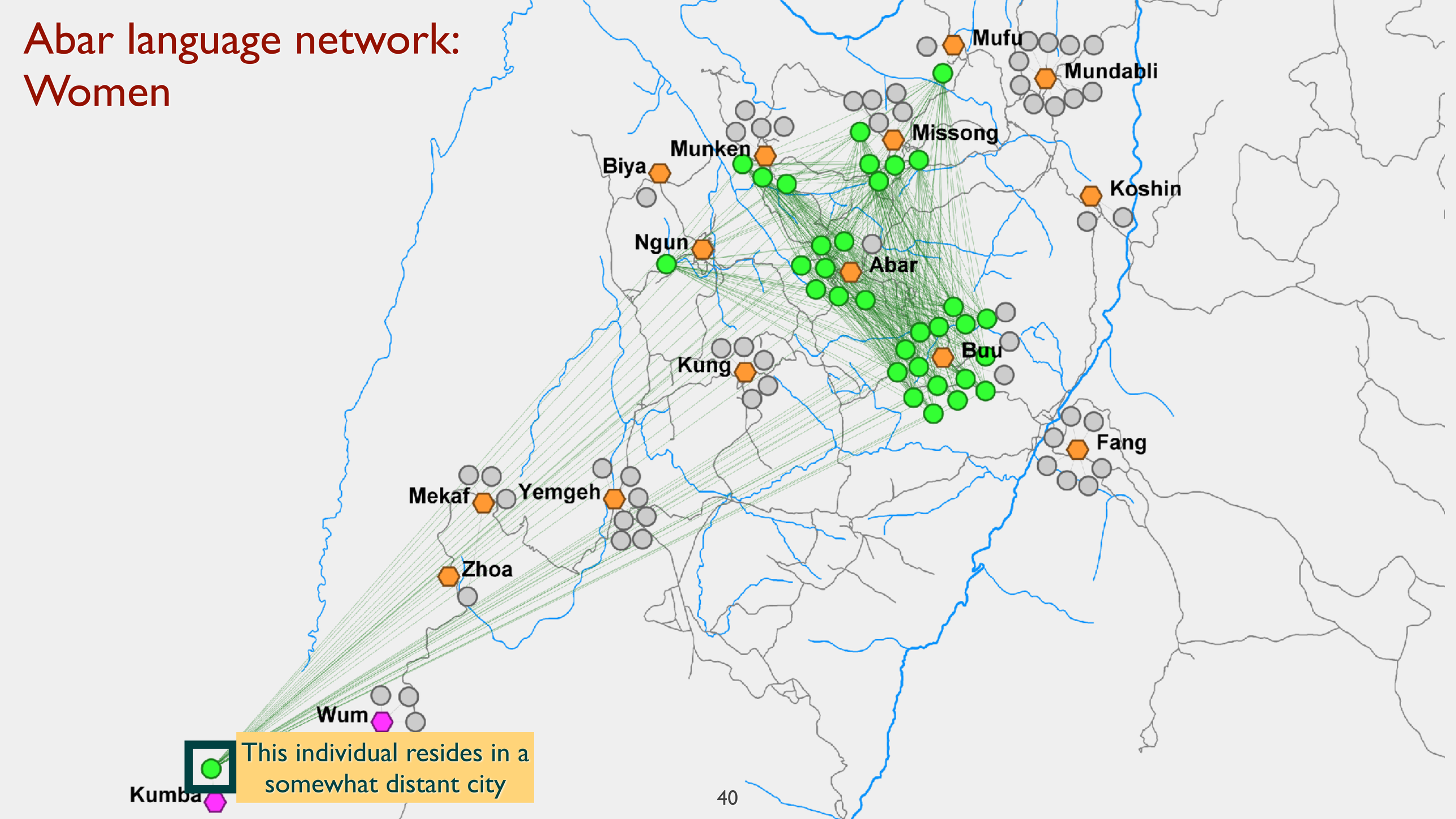


- Language network
  - Fix individuals in space (e.g., on the basis of residence)
  - Link individuals who share competence in a language
- This approach can represent distributed knowledge visually and also be used to look at correlations between linguistic and spatial features

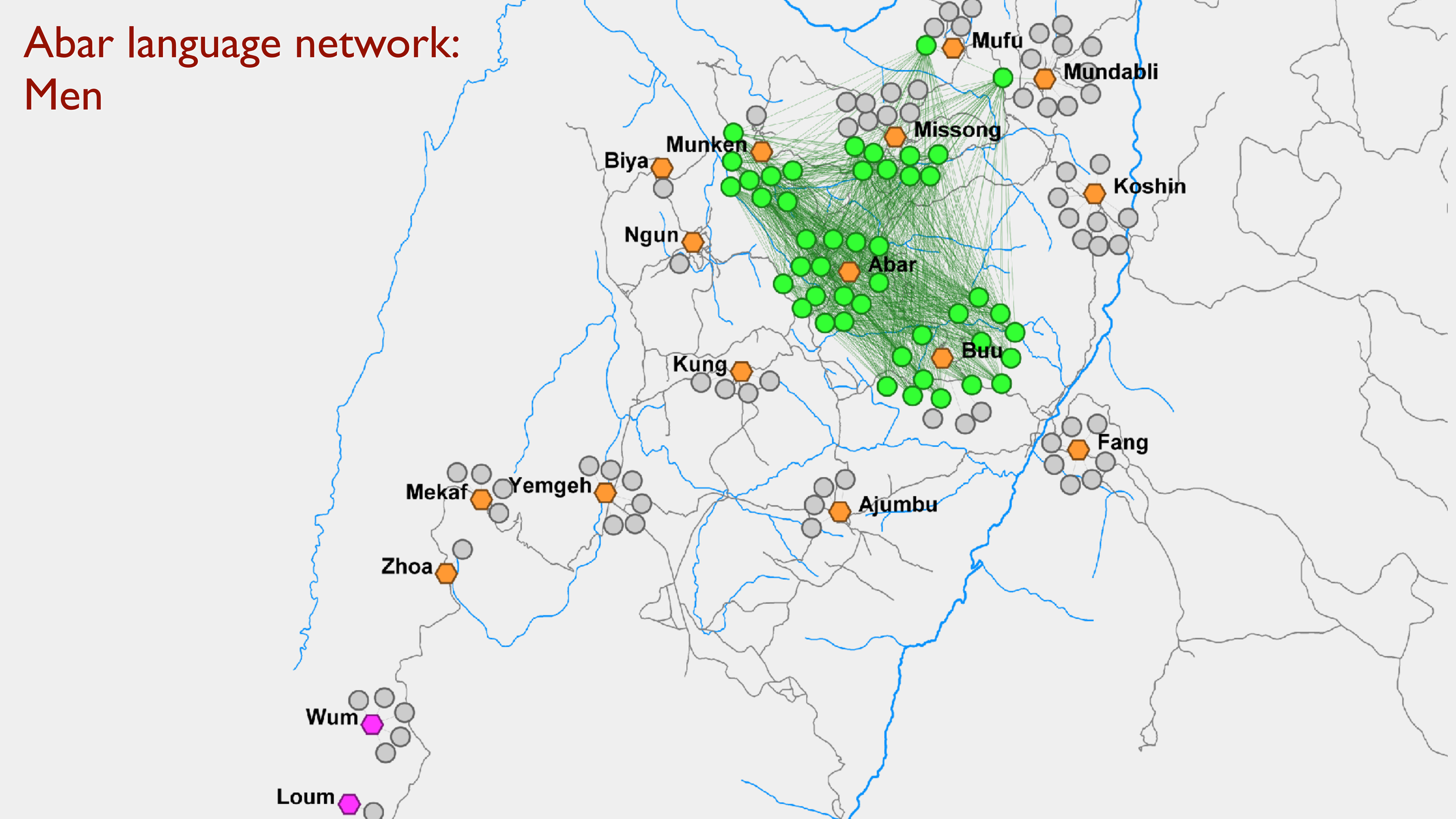
Abar language network: Women



Abar language network: Women

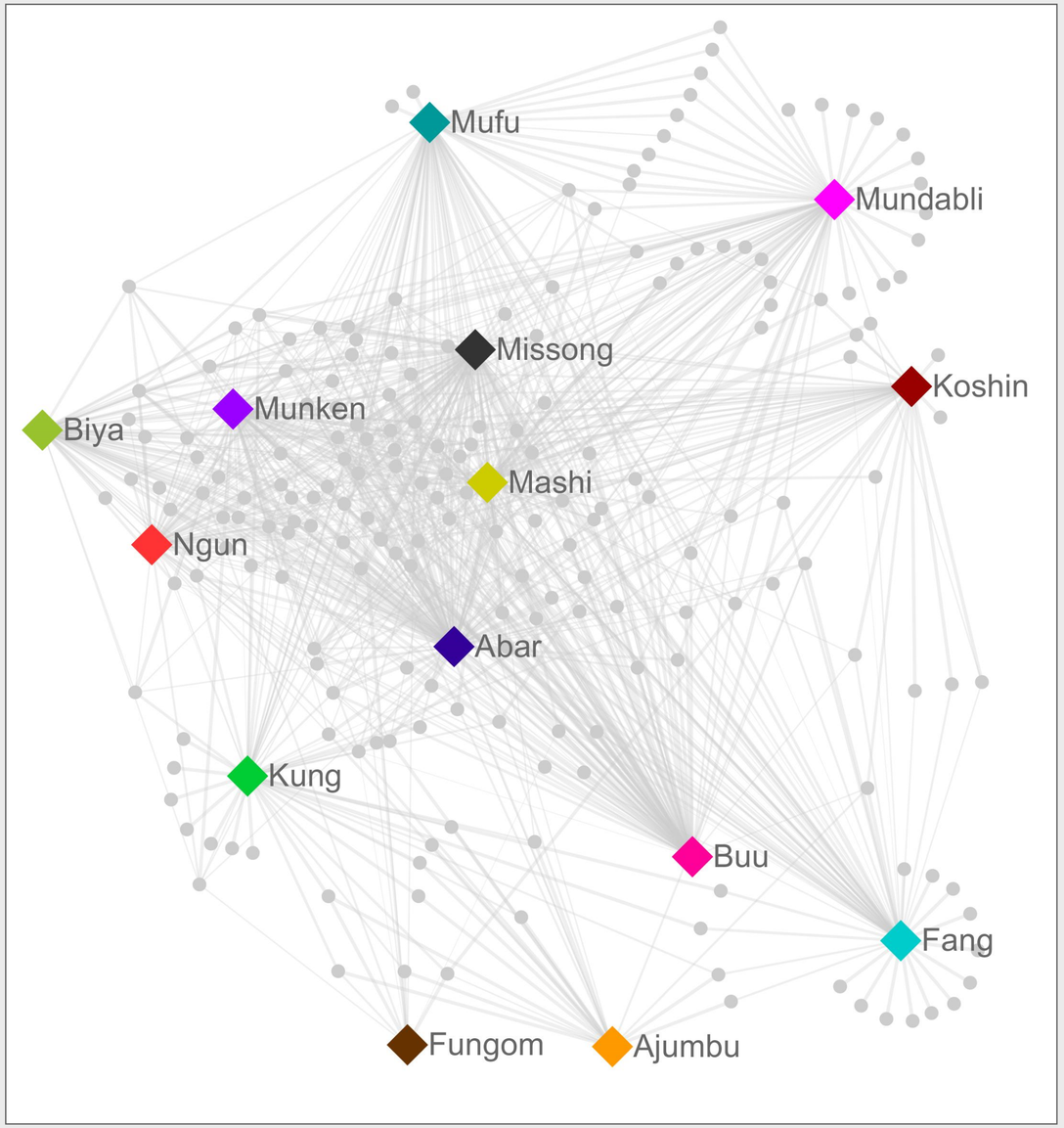


Abar language network: Men



Two-mode language network

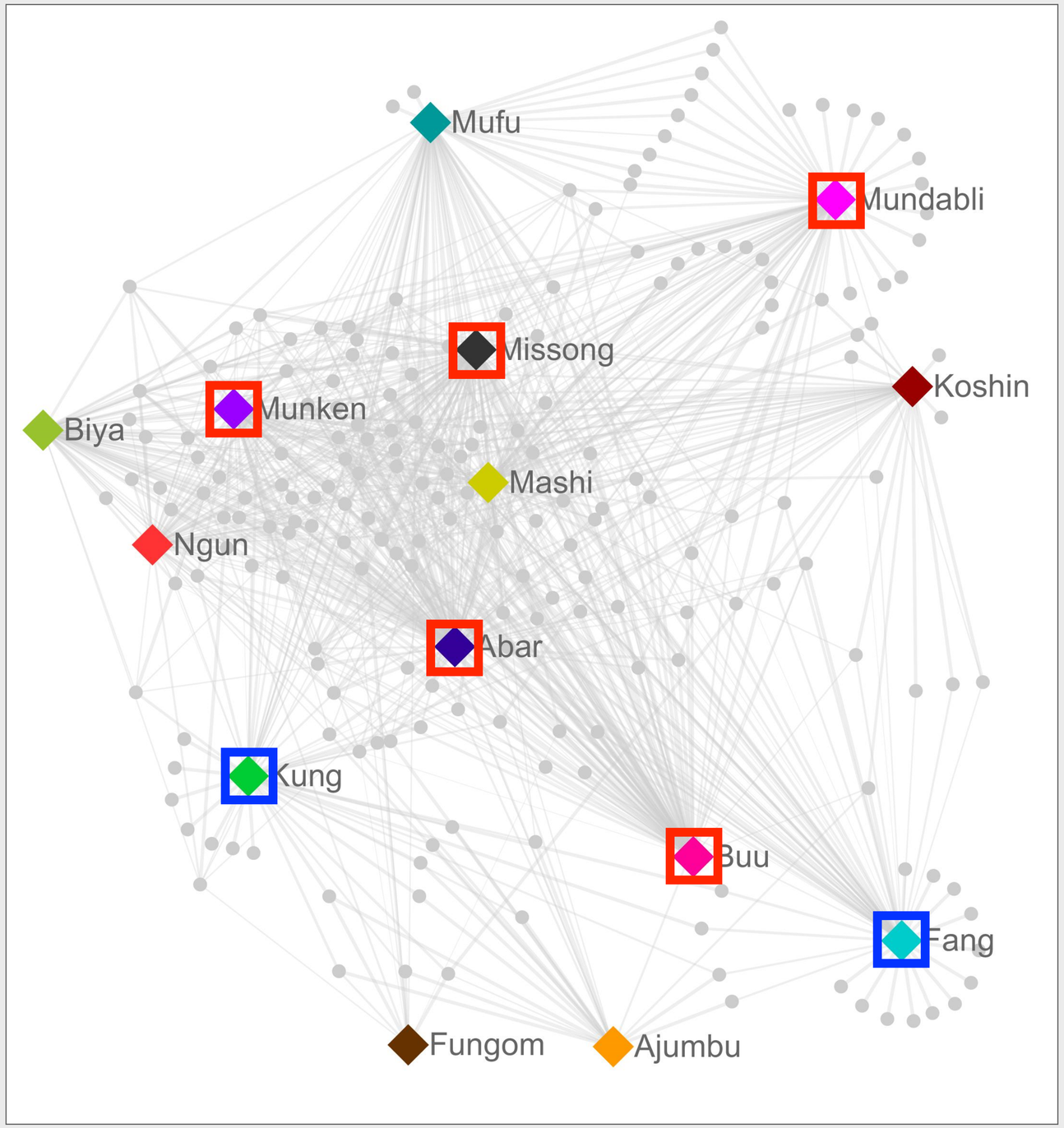
- A two-mode network allows us to visualize multiple language networks, which is useful for multilingual settings
- Language varieties then play a similar role to villages in the spatial network
- We can calculate centrality scores for different languages and how they connect individuals



Degree	Abar
	Missong
	Buu
	Mundabli
	Munken

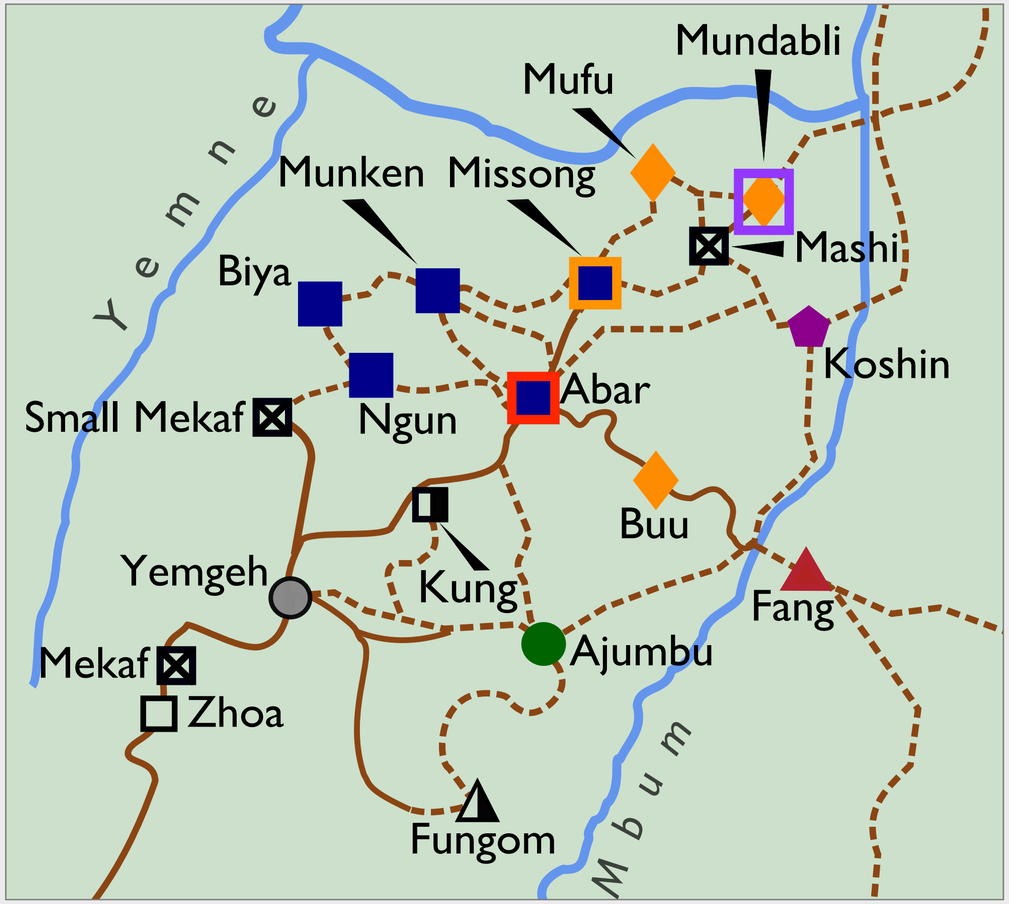
Betweenness	Abar
	Mundabli
	Fang
	Missong
	Kung

Closeness	Abar
	Missong
	Buu
	Mundabli
	Munken

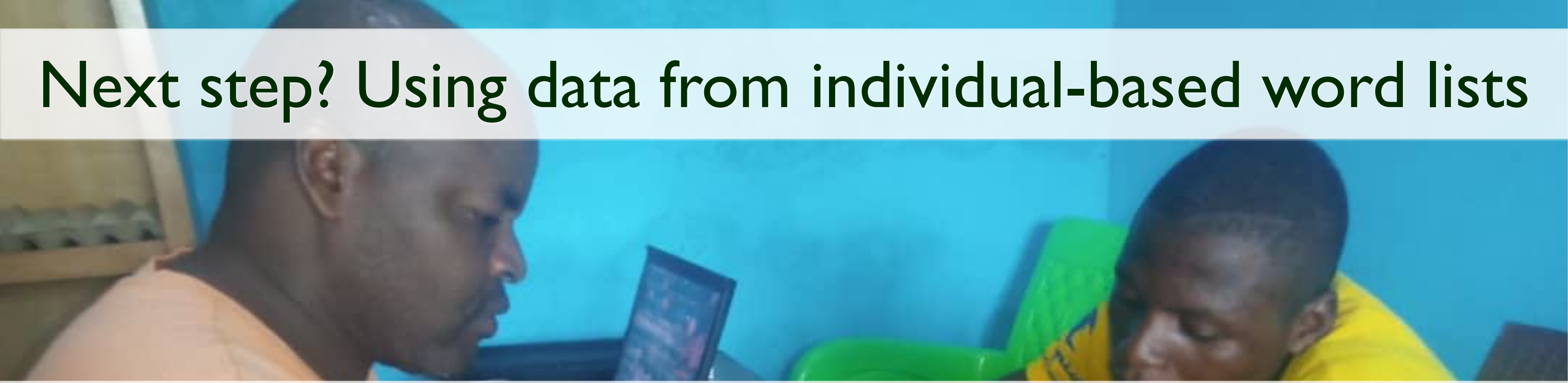


Interpreting the networks

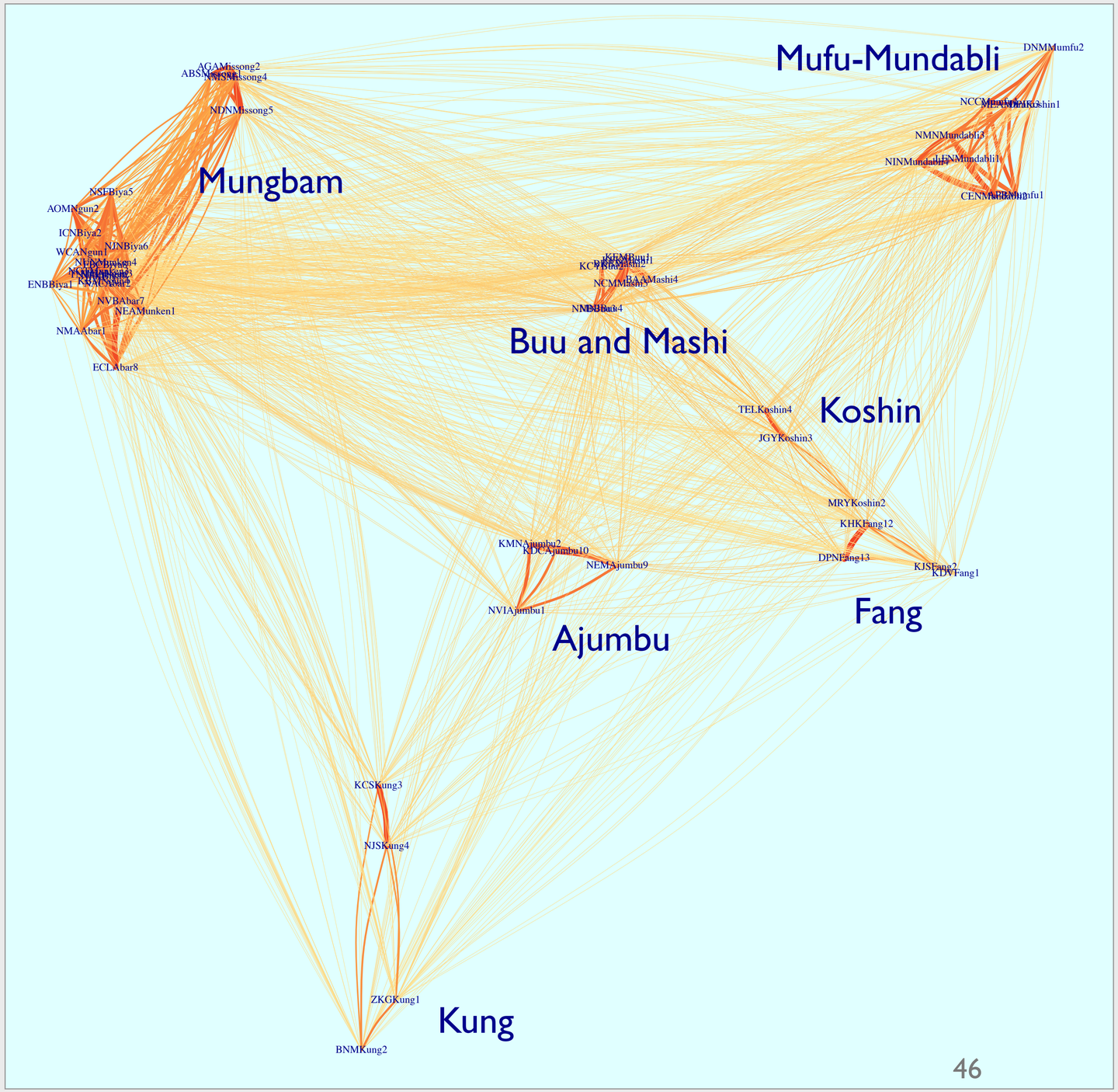
- According to this (imbalanced) dataset, Abar emerges as spatially and linguistically central
- Missong and Mundabli are linguistically relatively central, but not especially spatially central
- The language and spatial networks link people in different ways
- We do not yet have a clear interpretation for these patterns

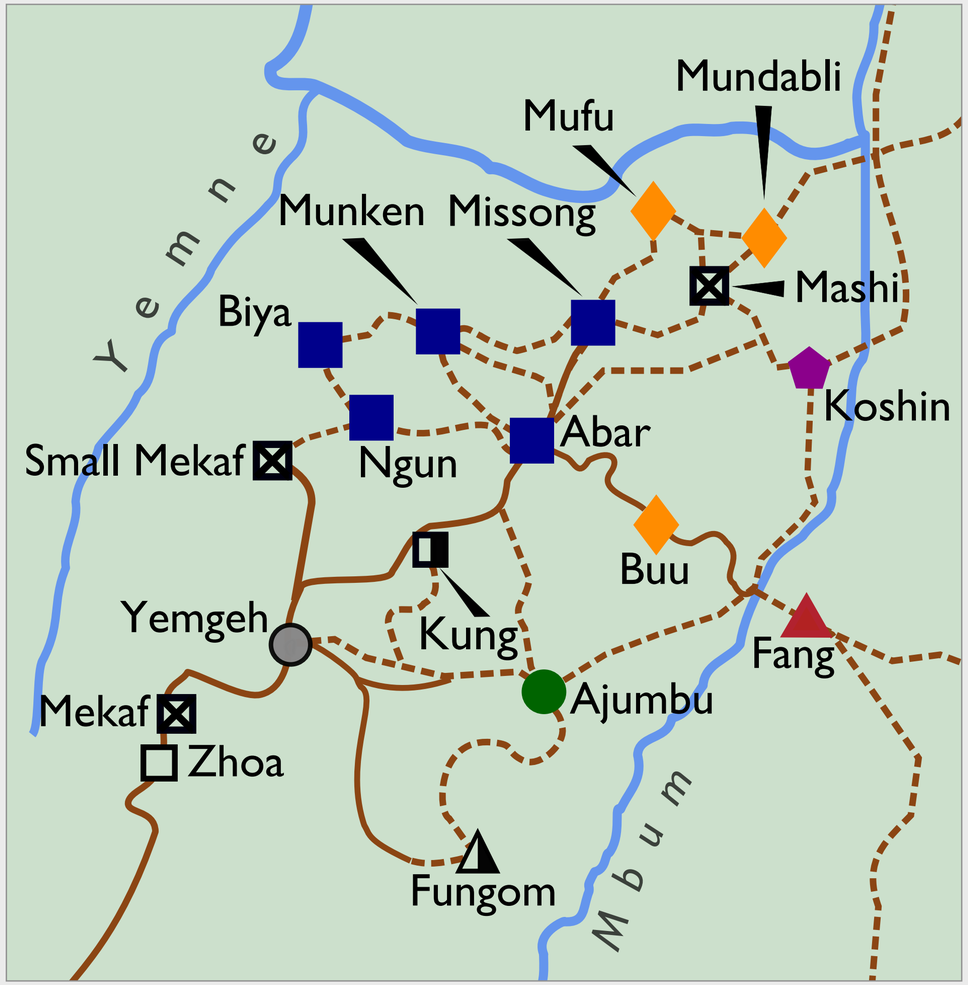


Next step? Using data from individual-based word lists



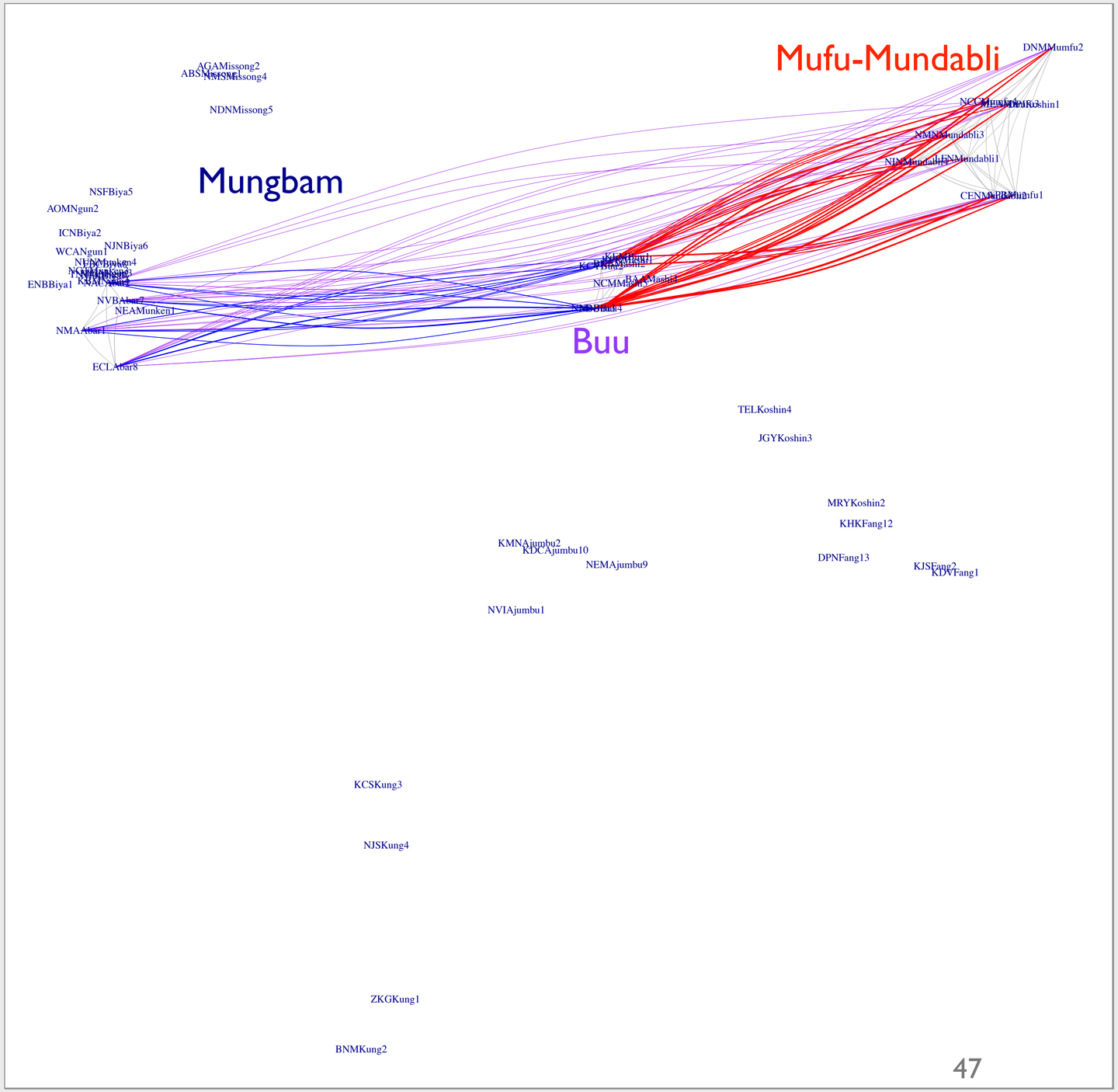
- Based on methods first developed by Angela Nsen Tem (see Mba & Nsen Tem 2020)
- Wordlists collected by Nelson C. Tschonghongei in individual sessions, without standardization/harmonization
- More than 18,000 entries currently across 54 speakers covering all thirteen Lower Fungom varieties
- Detailed sociolinguistic information collected for each speaker to help with analysis of variation

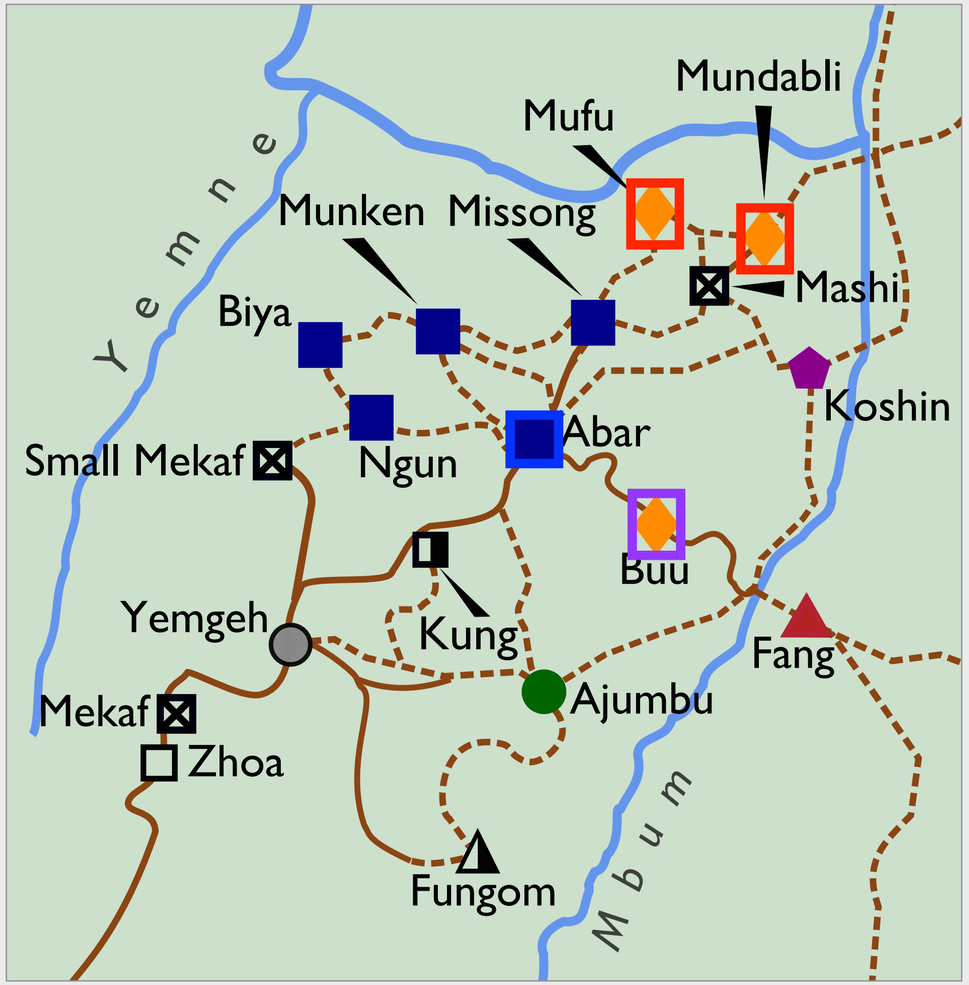




Lower Fungom core area

Network representation based on shared similarity sets





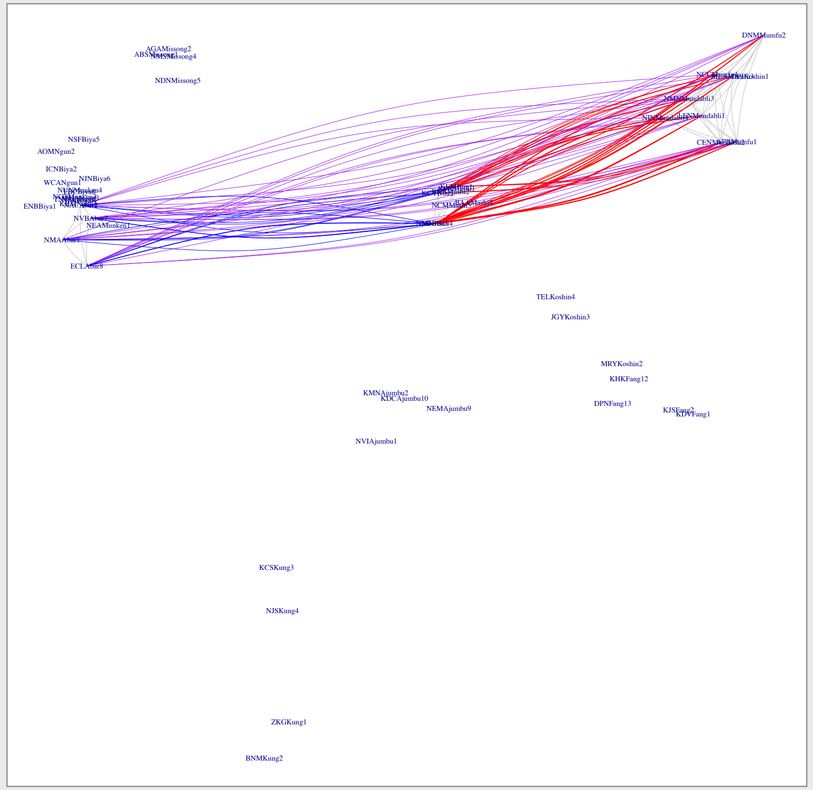
Lower Fungom core area

Links between Abar variety of Mungbam, Buu, and Mufu-Mundabli

Roots shared by Buu with Abar (contact relationship) vs. Mufu-Mundabli (genealogical? relationship)

Shared across all

Concept	Homogeneity
tongue	0.93
child	0.93
axe	0.89
grave	0.87
sieve	0.76
Average	**0.88**



Shared across Abar and Buu doculects

Concept	Homogeneity
breast	0.89
mother	0.88
ear	0.84
horse	0.83
song	0.78
soap	0.76
cat	0.72
forest	0.70
hair	0.70
book	0.69
umbrella	0.68
devil	0.67
bitter leaf	0.66
jaw	0.66
caterpillar	0.65
dust	0.63
faeces	0.63
yam	0.62
air	0.61
intestine	0.57
Average	**0.74**

Shared across Buu and Mufu-Mundabli doculects

Concept	Homogeneity
father	0.79
tooth	0.78
bag	0.75
war	0.75
smoke	0.74
stone	0.73
head	0.71
fowl	0.71
basket	0.71
nose	0.70
sand	0.70
goat	0.69
friend	0.65
house	0.64
farm	0.62
plantain	0.62
belly	0.61
snake	0.59
case (court)	0.59
egg	0.55
oil	0.54
Average	**0.71**

New directions in language and space

- With rich datasets of individuals' multilingual competences, we can create language maps that are more representative of actual patterns of language use
- By treating spatial features and spatial network relationships as explanatory variables, we can uncover new linguistic patterns and describe known patterns more accurately
- In future work, we hope to look at the network distribution of linguistic features in more detail

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