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Language Diversity in West Africa: An Ecological Approach

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Analysis of a linguistic atlas reveals an ecological gradient in the diversity of languages in West Africa. As one moves south from arid into lusher ecoclimatic zones, the average size of ethnolinguistic groups decreases. Various factors are considered which may have contributed to this distribution. I argue that the ethnolinguistic map is primarily a reflection of the systems of generalized exchange and mutual dependence into which people enter. It is hypothesized that such social networks function to reduce subsistence risk due to variations in the food supply. If this hypothesis is correct, the average size of ethnolinguistic groups should be inversely proportional to the degree of ecological variability they face. This prediction is tested and found to hold strongly for a large part of West Africa. There is also limited evidence of a correlation between linguistic diversity and topography. It is concluded that ecological risk has been a key historical force in West Africa and that the ethnolinguistic mosaic can be used as a valuable ''fossil record'' of people's adaptive social and economic strategies.

0. INTRODUCTION

Why Africa should be the most multilingual area in the world is a challenging question which can only be answered by conjecture.

J. Berry, in *The African Experience* (1970)

Though West Africa is one of the most linguistically diverse areas in the world, our understanding of why this should be so is just about summed up by the above quotation. As Renfrew (1991) has pointed out, the question of why there are so many (or so few) different languages in different parts of the world has received very little theoretical attention.

The topic tends to fall through the gap between disciplines. Research in comparative linguistics aims at reconstructing paths of language divergence, but it relegates the causes of divergence to ''external factors,'' which ''cannot figure in a linguistic model, except as unknowns'' (Nichols 1992:209). Language leaves no direct traces in the archaeological record, and early historical documents seldom take an interest in the speech habits of ordinary people. Ways must therefore be found of making the present day distribution of languages and peoples yield information about its evolution.

In anthropology, there is a large body of theory which seeks to explain the formation of different types of political structures—tribes, chiefdoms, states, and so forth (e.g., Carneiro 1970; Friedman and Rowlands 1977; Johnson and Earle 1987; Graber 1993)—but hardly any dealing with the formation of language groups. This is due at least in part to the connection of language with ethnicity and to the classical view of ethnicity as a ''primordial'' affiliation (Shils 1957), unchanging and immune to economic and ecological processes. Indeed, ethnicity is often invoked as an independent variable in explaining patterns of social and economic behavior. For example, for Dalton (1970:66), one of the ''important reasons for the small scale of traditional African economy and society'' was the absence ''of widely shared language.'' However, as all of the many hundreds of languages found

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in Africa can be traced to just four ancestral stocks, the explanation is ultimately circular, for why could so many languages have diverged if not because of the small scale of traditional African economy and society?

More recent explorations of the phenomenon of ethnicity have stressed its dynamic aspect. Particular social formations are apt to fission or coalesce as individuals modify their practices and allegiances, and so in the long term, ''ethnic loyalties reflect, and are maintained by, the underlying socio-economic interests of group members'' (Patterson 1975:305; see also Otite 1990; Van den Berghe 1981). In this view, ethnolinguistic identity is part of the set of:

> adaptive social strategies employed by functionally interacting human beings . . . sociocultural systems . . . can be understood as adaptation gambits selected for by population subgroups (Migliazza 1982:498).

In the case of Nigeria, for example, Otite writes that:

> the Nigerian ethnic map is a fast changing picture created from changing manipulations and adaptations of surviving strategies in changing environments. (Otite 1990:36)

If we take a snapshot of this map as well as we understand it at the present time, it will reveal a great deal about the ''surviving strategies'' people have been using in recent history. The ethnolinguistic map thus gives us a kind of fossil record of people's socioeconomic behavior.

There are a large number of factors which could influence the size of ethnolinguistic groups, and in every region they will be intertwined in complex and locally specific ways. Thus, the history of any particular group is a unique case and would require detailed longitudinal research to explain. However, there are also striking broad trends, even within the single region of West Africa; Mali's 10 million inhabitants have 31 languages, while much smaller Cameroon's 12 million have 275, and tiny Togo has twice as many languages as vast Niger. Such magnitudes of variation tempt us to seek general explanations, and in the case of nonindustrial societies, the main candidates for general historical determinants are to be found in physical geography, technology, and perhaps above all ecology and the challenge of living in different and difficult environments (Braudel 1973: chapter 1).

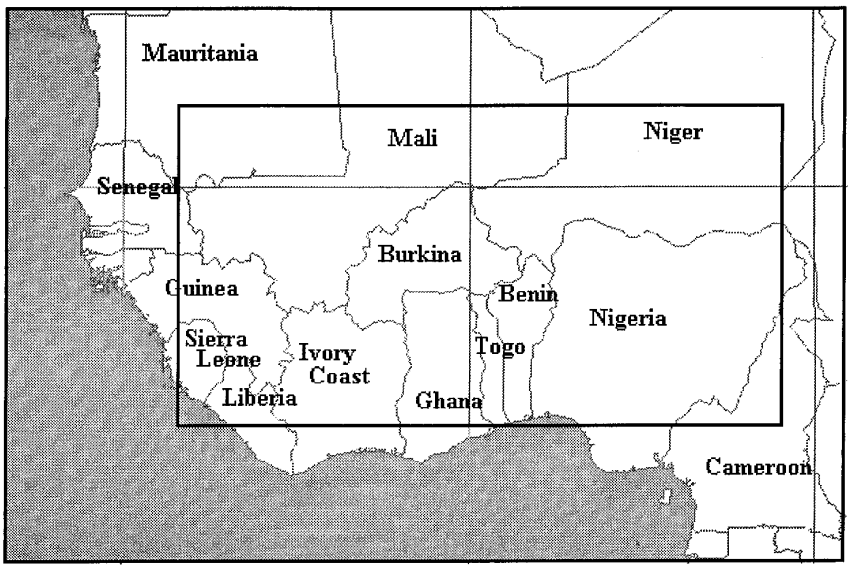
In this paper, I present a large scale analysis of the linguistic geography of a large part of West Africa,[2] using Moseley and Asher's (1994) linguistic atlas as a starting point. In Section 1, some basic facts about the linguistic geography of West Africa are given. In Section 2, I consider various factors which could have influenced the distribution of languages. In Section 3, a theory based on the economics of subsistence is proposed to explain why ethnolinguistic groups are larger in some areas than in others. The theory's predictions are tested on the data in Section 4.

1. LINGUISTIC DIVERSITY IN WEST AFRICA

The maps in Moseley and Asher's (1994) linguistic atlas show 708 distinct languages in the area under consideration. However, all of these languages are categorized by linguists as members of just three genetic phyla—the vast Niger–Kordofanian group, which includes all the Bantu languages of central and Eastern Africa, as well as the majority of West African languages; the Nilo–Saharan group, which includes Songhai and Kanuri; and the trans-Saharan Afro–Asiatic group, which includes Hausa and Tamasheq.

West Africa is made up of a number of different ecoclimatic zones, which fall in broadly West–East bands, from rainforest in the south near the coast, via savanna whose

[2] The area from 6° to 18°N and from 12°W to 14°E is studied. This includes parts or all of Nigeria, Ghana, Benin, Togo, Ivory Coast, Liberia, Burkina Faso, Sierra Leone, Guinea, Mali, Niger, and Cameroon (see Map 1).



MAP 1. The area of the study.

aridity increases as one moves north, to the Sahel and the fringes of the Sahara. The study area represents a broad transect through these different zones (Map 1).

To investigate the distribution of languages, the area was divided into 2° square sectors, much as an ecologist interested in species diversity would divide a study area into quadrats. The languages shown in Moseley and Asher (1994) within each sector were counted. They are listed in the Appendix. The maps show the languages spoken as mother tongues in rural areas. Thus they do not reveal the ranges of second languages or lingua francas or provide much information on the urban linguistic situation. Clearly, the making of maps imposes definiteness to linguistic boundaries which is not necessarily present on the ground. However, the present analysis does not require precise localization of linguistic boundaries, as it examines numbers of languages within large units of area and numbers of speakers per language. The editors of the atlas have also had to make many difficult and arguable decisions about the dialect/language distinction. They tend to use a very fine-grained classification, giving, for example, Igbo as a cluster of languages rather than as a single language with dialects. Delimiting languages is a perennial problem which, even if the necessary data were available, might prove impossible to solve unequivocally on linguistic grounds alone (Haugen 1966). For present purposes, it is simply assumed that the atlas' system is basically self-consistent, and any anomalies produced are randomly distributed and thus more likely to obscure trends than bring them into being artifactually. Fortunately, the differences in linguistic diversity across the study area are of such a great magnitude to be fairly robust with regard to this kind of uncertainty in the data.

The number of languages per sector varies from fewer than 5 in the most of the northern part to more than 50 in the sectors in the southeastern corner of the area. Thus the area's great diversity is very unevenly distributed.

We can use the number of languages to calculate the average land area occupied by a language within each 2° sector (henceforth Area) by simply dividing the area of the sec-

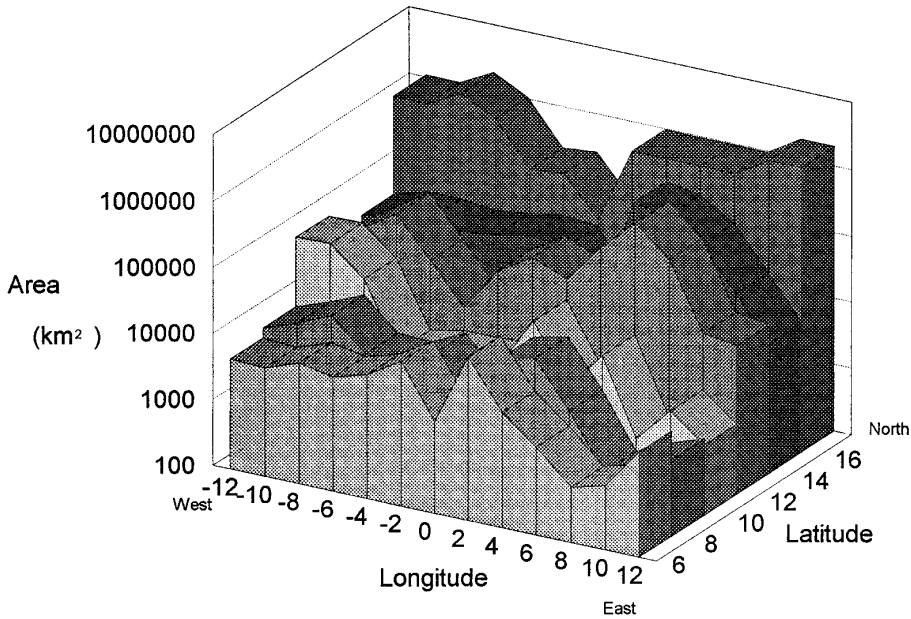


FIG. 1. The average language Area in each 2° sector across the study area.

tor by the number of languages spoken entirely within it. Due to the shape of the earth, the sizes of the sectors are slightly different at different latitudes; they were calculated from Raisz (1962:148). Where a language is spoken in two sectors, it was deemed to add one half to the number of languages in each sector for the purposes of calculating the mean language size. For example, the sector 6°N12°W has eight languages which are spoken solely within it, four languages which are spoken in it and one other sector, one language spoken in it and two other sectors, and one language spoken in it and four other sectors. The size of the sector is 48,869.53 km^2. The mean language Area is therefore

$$48{,}869.53/(8 \times 1) + (4 \times 0.5) + (1 \times 0.33) + (1 \times 0.2) = 4638 \text{ km}^2.$$

The results of calculating Area (to the nearest km^2) for all 78 sectors are shown in Fig. 1. Two features stand out. First, there is a tendency for area to greatly decrease as one moves south, from the arid Sahel down into the lush Guinean forests. Several previous studies have noted that linguistic diversity tends to increase as one approaches the equator (Breton 1987; Nichols 1990, 1992; Mace and Pagel 1995). It is thus closely correlated with biological diversity in general. A possible explanation for this association is discussed in Section 3. Second, the very highest diversity is found between 6°N and 10°N and 6°E and 12°E. This is the area of the highlands of central / eastern Nigeria and Cameroon. Again, the association of areas of linguistic diversity with mountainous terrain is common and will be further discussed below.

One explanation for the observed distribution would be that there are simply more people in the lusher areas where there are more languages, with the languages having approximately the same number of speakers. This seems unlikely: by way of example, the area around Kano in linguistically homogenous Hausaland is one of the most

densely populated in West Africa. Fortunately, the hypothesis can be examined quantitatively.

To do so, data on the number of speakers for each language were gathered. Wald (1994) gives speaker data for over 400 of the 708 languages in the study area. These figures are standardized to 1990. Grimes (1988) and Grimes (1993) provide data on many of the remaining languages, bringing the total to 547. I have similarly standardized these figures to 1990 from the date of their collection (mostly during the 1970s and 1980s) using the average national population growth rate for the appropriate country.[3] Following Wald (1994), I have not applied a growth factor to languages spoken by fewer than 1000 people, as such languages are likely to be in decline, and a figure of 1000 speakers indicates 1000 or fewer.

The speaker figures are given with the languages in the Appendix. For each of the 2° sectors, the median number of speakers for all the languages for which data was available was calculated. These medians are shown for the whole study area in Fig. 2. It is clear that, far from being constant over the area, the average number of speakers per language varies in the same way as the average language size: there are fewer speakers per language as one moves toward the equator, and there are fewer people per language in the highlands than other areas at the same latitude. There is also a marked upturn in number of speakers per language in the center of the southern edge of the area. This coincides with powerful, dense, highly urbanized groups such as the Yoruba and their neighbors in Nigeria and the Asante and their neighbors in Ghana.

[3] These figures are calculated from mid-year estimates in the UN *Demographic Yearbooks* for 1970 and 1990 as 2.88% for Benin, 2.6% for Burkina Faso, 3.6% for Cameroon, 1.94% for Guinea, 2.58% for Ghana, 5.25% for Ivory Coast, 4.08% for Liberia, 2.45% for Mali, 3.45% for Nigeria, and 3.27% for Togo. No estimate is available for Sierra Leone, and the growth rate for Guinea has been used instead.

In the next section, I turn to possible explanations for these patterns. I treat each of the main contributory factors in turn. These are physical isolation, political organization, trade, transport, and a factor to do with the organization of the subsistence economy which I shall call the extent of generalized exchange.

2. GEOGRAPHICAL INFLUENCES ON THE DISTRIBUTION OF LANGUAGES

2.1. Physical Isolation

Early scholarship tended to see ethnolinguistic divergence as a natural consequence of physical isolation imposed by topography. For example, Mabogunje (1976:5) sees the linguistically diverse central Nigerian highlands as a ''refuge zone for weaker . . . more primitive groups'':

> Driven to the hill tops or cut off within broad valley slopes, these small groups or fragments of groups have continued to chart their own existence, oblivious of, and forgotten by, the world.

More recent anthropological work has thrown this isolationist position into question (Barth 1969). Small ethnolinguistic groups from various regions have been shown to have been involved in intergroup contact for centuries without thereby losing their distinctiveness (Solway and Lee 1990; Hays 1993; Migliazza 1982; Hoffman 1984). Languages or dialects can have high levels of contact and fail to converge (Weinreich 1970:106–109), or actually diverge *faster* because of proximity or increased contact (Migliazza 1982:501; Labov 1972). Furthermore, many temperate areas of the world have physical barriers without having the level of linguistic diversity found nearer the equator; as one ecologist has put it, mountain passes in the tropics always seem to be higher (Janzen 1967).

In the case of West Africa, the societal isolation model seems particularly inappropri-

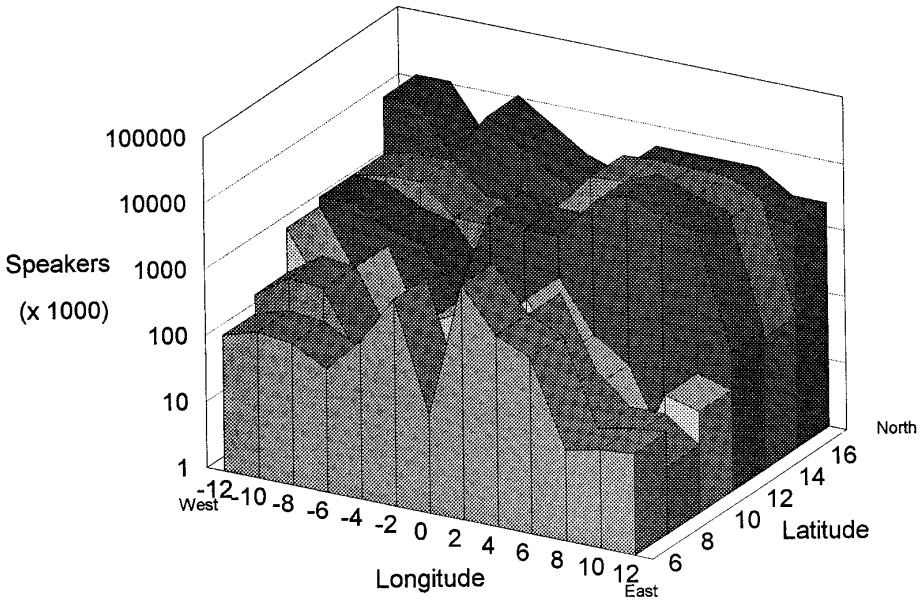
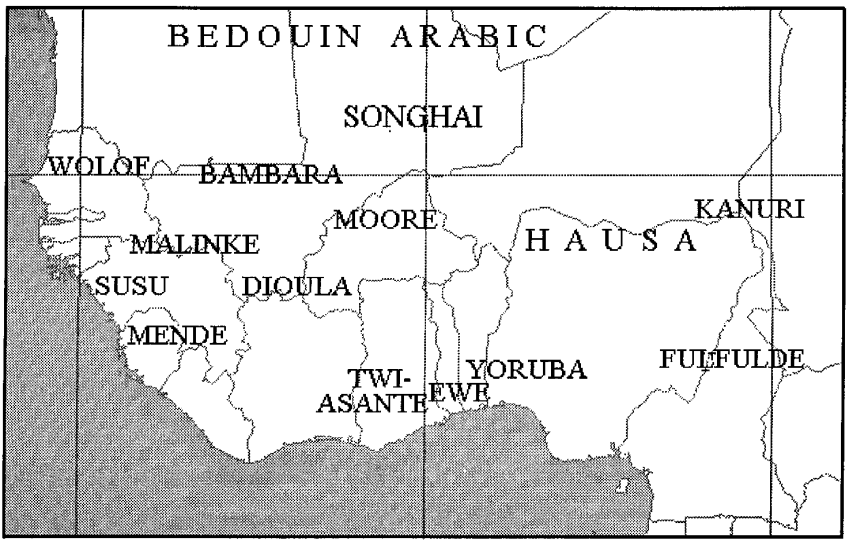


FIG. 2. The median number of speakers per language in each 2° sector across the study area.

ate, as both the physical geography and the cultural history seem to show.

Isolation is not imposed by the physical geography. West Africa has few areas of elevation of over 1000 m and may be described as ''over the whole, an immense, but non-uniform plateau'' (OAU 1979: text to plate 3). This is not to say that there is no relationship between topography and linguistic diversity. The most diverse area is, after all, the highlands, and I will discuss why this should be so in Section 3. However, the highlands are mainly high plateau rather than true mountains, and there is plenty of evidence that the reason for ethnolinguistic fragmentation is not that the groups lived in complete isolation. Mechanisms of intergroup contact and exchange were highly developed there (Sharp 1982; Isichei 1982), as throughout West Africa (Hart 1983; Brooks 1993). As well as material, there was often also a flow of personnel across ethnic boundaries. As Brooks (1993:27) has put it, ''individuals and families change their language and modify their social and cultural practices in ways that are often perplexing to outsiders.'' With boundaries fluid and the possibility of groups fissioning and setting off to form new settlements in the interior always present, in some areas ''it is no exaggeration to suggest that tribal identification was as much a matter of individual choice as of the ascribed status of birth'' (D'Azevedo 1971:18).

Aside from the historical evidence of intergroup contact and fluidity, the most visible evidence that an isolationist model is inappropriate comes from the language distribution itself. West African society is characterized by a high degree of multilingualism. For as long as can be determined, the whole area has been covered by lingua francas, which were spoken as second languages (Map 2; Heine 1973), in addition to a high degree of local multilingualism. This seems to have been *particularly* developed in the highlands (Sharpe 1982). We thus cannot argue that linguistic diversity arose from lack of access to common norms. It seems, on the contrary, that people have generally maintained distinct norms despite the availability of languages of wider communica-



MAP 2. Sketch map of the locations of major West African lingua francas (after Heine 1973).

tion. This finding requires us to shift away from thinking of ethnolinguistic diversity as a natural consequence of physical geography, toward thinking of it as an emergent consequence of people's behavior, and this leads us naturally to wanting to know why people's behavior would create groupings of the size we do find. As Hays (1993:148) put it, talking about Papua New Guinea, ''if it is people as much as 'Nature' that create, maintain, or ignore boundaries, we need to know how and why.''

2.2. Political Organization

If the distribution of languages is determined by people more than physical geography, an obvious explanation for the extent of particular languages would be that they have been spread by particular empires or states. This, after all, is how the Romance languages were spread across Europe.

In West African history, one finds a wide range of different political systems. On the northern savanna, there is a thousand-year history of large states, beginning with the medieval empires of Ghana and Mali and continuing through Songhai and Kanem–Bornu, to the Hausa and Hausa-influenced city–states and their eventual unification under the caliph at Sokoto in the 19th century. In the southern forest belt, there is a rather more recent history of smaller city–states and kingdoms, such as Benin, Dahomey, Asante, and Oyo. In the interstices between these states, particularly in the so-called ''middle belt,'' one finds a vast number of groups lacking large-scale or centralized systems of authority (Horton 1976).

There are some obvious correlations between state formation and language spread. The spreads of Asante and Yoruba in the south are probably products of combined demographic and political expansion, aided in the Asante case by access to gold (Iliffe 1995:79) and in both cases partly by external trade (Wolf 1982). The northern areas, where languages tend to be larger, also have longer traditions of large empire. However, we should not exaggerate the importance of political factors, for two reasons.

First, political boundaries are not generally linguistic ones. The Igbo language has a domain almost as wide as that of Yoruba,

yet among the Igbo, formal political structures only extended up to local village groups, and even these seem to have been less important than village- or lineage-level bodies (Uchendu 1965). Similarly, Mendeland was unified in self-consciousness and language, but never in political arrangements (Little 1951:72), although the *poro* secret society provided an integrative institution above the level of the chiefdom. The domain of the Hausa language always seems to have been wider than that of any one of the Hausa city–states, and the Tamasheq language of the Tuareg retains substantial unity over a very wide area despite political fragmentation and geographical dispersal (Nicolaisen 1963).

Second, it is not the case that political development normally leads to homogenization in mother tongues. The area of the ''pure'' Hausa states, the *Hausa bakwài,* was more or less identical to the domain of the Hausa language. However, there is no evidence that it was state formation which spread that language. Hausa is the only known indigenous language of the area (Adamu 1984:266). Its primary range probably predates state formation, and I will argue below that its substantial uniformity can be attributed to the nature of production and exchange in rural Hausaland. As Hausa political and economic influence spread, the domain of Hausa as a second language spread too, but it did not extinguish other mother tongues until very recently. Adamu (1976:4) argues that to this date, ''in none of the areas surrounding Hausaland has the process of 'Hausanisation' (Hausa acculturation) obliterated completely any of the ethnic groups.''

At the height of Hausa political power, the Sokoto caliphate contained people speaking literally hundreds of different languages. In the empire of Mali, the language of the élite was used for administrative purposes, but despite good communications and some cultural unity, ordinary subjects continued to speak their traditional languages among themselves (Niane 1984:152, 153; Levtzion 1985:153, 154). This is also true of the Mossi states in Burkina Faso. One will look in vain for the footprint of these great states on a map of first languages; one finds it instead in a map of lingua francas (Map 2), where Malinke, Moore, and Hausa appear in the expected places. For states to become linguistically homogenous, a degree of integration of ordinary people into the state-level economy is required which is rare in the pre-industrial world and certainly not present in most of West Africa even today.

In short, the spread of political systems gives a potential explanation for the distribution of first languages only in a small number of cases. It does not seem likely to explain the overall north–south trend or the extreme diversity of the highlands. We therefore turn to other factors.

2.3. Trade

Anthropologists have come to recognize that the pre-colonial West African economy was emphatically not a system of economically isolated ''tribes'' (Hart 1983; Brooks 1993; Wolf 1982[4]). In addition to numerous forms of local intergroup exchange, a highly developed system of long-distance trade, dominated by the Hausa and Dioula diasporas, overlaid the whole region under discussion in precolonial times (Hopkins 1973). However, trade need not lead to linguistic homogeneity. It can take place by means of intermediary languages, or pidgins, or local bilingualism, and so, as long as it remains a single-purpose, restricted form of exchange, it need have no effect on the mother tongue situation (Ehret 1988). Hausa trade networks cover all of West Africa. This, coupled with Hausa political dominance, has made it the lingua franca of a wide area, but as I have already argued, it did not until very recently

[4] This change of academic perspective can be observed particularly clearly by comparing Mabogunje (1976) with Mabogunje and Richards (1985).

become the mother tongue of anyone outside traditional Hausaland.

Of course, exchange is vitally important in creating social ties and therefore spreading languages. However, we need to distinguish different domains of exchange. Specialized commercial exchange need not lead to linguistic convergence; more generalized exchange does. I will set this distinction out fully in section 2.5.

2.4. Transport

Many authors have simply ascribed the greater extent of the northern societies to the greater ease of mobility in savanna, as opposed to forest, environments (Smith 1969:4; Hart 1982:30). As an explanation this has some promise, as it would partly account for the north–south trend. However, many of the most diverse areas, including the middle belt, are open savanna, so it certainly cannot be the main factor. I will test the importance of the forest/savanna distinction quantitatively in section 4.2.4.

Others have argued for the importance of nonpedestrian transport and communication. Smith (1970) describes the importance of the canoe in maintaining the unity of the states on the Niger river. Mabogunje has argued that horses and donkeys, less widely available in the south of the study area, significantly increase the mobility of people in the northern half (Mabogunje 1976:27, 28), and a special connection between African state formation and cavalry has been urged by Goody (1971). Whatever the merits of these arguments in explaining differential political developments, they cannot account for the distribution of language diversity. Canoes were used just as widely among the numerous small groups of the Niger Delta as in Yorubaland or on the Niger bend. Ponies were widely used in the central Nigerian highlands, for both economic and military purposes (so much so that Blench [1993:94] describes the area as having a ''pony culture''), and yet the languages here are the smallest of all.

The logic of the mobility argument is the same as that of the geographical isolation position: if people could form larger groups they would, but sometimes they are prevented from doing so by the difficulty of communications. I will present an argument below with the contrary logic: people form small groups because there is no economic payoff in forming larger ones, even though it would be feasible to travel more widely if they so desired. I do not deny the importance of mobility and transport in conquest or commerce. However, I have argued that political domination and purely commercial trade are not of prime importance in determining the spread of mother tongues. I shall argue that the local activities associated with subsistence are more important, and in rural areas even today, forms of transport other than walking account for only a small proportion of journeys and are not used at all by most people (Bryceson and Howe 1993).

2.5. The Extent of Generalized Exchange

I have argued that linguistic boundaries are not a natural consequence of physical isolation or poor communications. They are not usually determined by the domains of different political élites, and they can be traversed by trade networks without disappearing. If this is the case, we might well ask why they have developed or persist at all. To understand why this may be, we need to distinguish different domains of communication and exchange.

The existence of intergroup exchange does not mean that ethnolinguistic groups have no economic reality. The long-distance trade and other regional mechanisms such as agriculturalist–pastoralist symbiosis failed to integrate West Africa into one economy because their scope was limited in three ways (Hopkins 1973). First, they were generally limited to specialized products which could

be produced by one group and not another, such as metals, salt, and cloth, and low-bulk, high-value foodstuffs such as the kola nut. Second, they tended to cater mainly to higher income groups within the population. Third, their extent was never such as to become the central component of subsistence strategies, except for the cases of a few professional traders. Thus intergroup trading can be seen as a *specialized* form of exchange for most communities: it was localized in space and time, it was restricted to particular commodities, and reciprocation (payment) tended to occur immediately.

Local, within-group exchange, on the other hand, had the character of *generalized* exchange.[5] That is to say, it involved all categories of goods, including most importantly land and staple crops, and more inclusive modes of exchange, such as sharing, gift giving, loans, and other forms of mutual aid. It involved a complex tissue of social obligation, counterobligation, and mutual dependence which bound extended families together through multiple and multivalent ties, as Otite's (1990:19–23) characterization shows:

> Ethnic groups are cultural expressions of kith-and-kin ideologies . . . members learn to trust one another as overstretched classificatory brothers and sisters; show more loyalty to the group . . . kith-and-kin obligations were extended to others of the same group wherever they met and identified as such.

Only where exchange becomes sufficiently generalized for people to wish to be identified with each other is linguistic convergence likely to occur (LePage 1968:192). Ethnolinguistic groups are thus best characterized as informal networks of intensive generalized exchange, which function as ''lines of transmission of material and information through reciprocity and reciprocal roles'' (Braun and Plog 1982:507). This is not to imply that every Fulani household, for example, is economically and socially related to every other, which is clearly not the case. If each one has links to a few dozen others, which in turn are linked to a few dozen more, the group contained within four or five links of the starting point can be enormous, as ''small-world'' experiments have shown (Bernard and Killworth 1979). The more numerous and dispersed each household's contacts, the larger the overall network will be.

It seems to be the size of the network of generalized exchange which determines the extent of the language and of ethnic solidarity. In Hausaland, where a homogenous language is spread over a very wide area, the interdependence of rural compounds (*gidàajee*) in the provision of food is extreme (Nicolas 1967; Raynault 1977). All foodstuffs have traditionally entered informal markets which, acting as channels of social communication, are ''an integrating force in rural Hausaland'' (E. P. Scott 1976:215). The importance of this generalized exchange is captured in Watts' study of the Hausa rural economy:

> Hausa communities in the nineteenth century were characterised by a rapid circulation of wealth through complex patterns of exchange and gift-giving . . . The system of gift and countergift provided the very fabric of village, and indeed inter-village cohesion. (Watts 1983:123)

Where languages are smaller, on the other hand, generalized exchange networks seems to be less widespread. Villages in the central Nigerian highlands are remarkably self-sufficient, and so the Kofyar, for example, ''were traditionally little dependent on exchange'' (Netting 1968:17).

The question of why there are more languages in some areas than others can therefore be more or less restated as the question of why households in some areas are involved in larger or more dispersed networks of generalized exchange than others. I now turn, in Section 3, to a theory which purports to explain this and which is tested in Section 4.

[5] My distinction between specialized and generalized exchange is partly based on Sahlins' (1972) between balanced and generalized reciprocity.

3. ECOLOGICAL RISK AND SOCIAL NETWORK

[In the world of the peasantry] between 80 percent and 95 percent of people lived from the land and from nothing else. The rhythm, quality, and deficiency of harvests ordered all material life.

F. Braudel, *Capitalism and Material Life, 1400–1800* (1973)

For a people who owns everything in common, everything we spend merely returns to us.

Wole Soyinka, *Season of Anomy*

Braudel's statement applies to any system where the economy is dominated by the needs of subsistence, as that of West Africa has been, and to a large extent still is. The staple crops of West Africa are yams and other roots, and rice, where rainfall is abundant and lasts through the year. Further north, sorghums and millets, which are well adapted to the constraints of a four- or five-month growing season, are the mainstay. Further north still, aridity and the lack of tsetse fly favor pastoralism and agro-pastoralism. For pastoralists, the constraints imposed on life by ecology are just as severe and have similar social consequences as for farmers (Horton 1985:114).

The basic economic unit of West African societies is the extended family or compound group (Brooks 1993:34; Hopkins 1973:21). As we have seen, it is the larger networks of generalized exchange which are also formed which ultimately give rise to different ethnolinguistic groups. A major economic theory concerning the formation and maintenance of social networks is the ''ecological risk hypothesis,'' which states that their most important function is to ''provide household social insurance against the 'normal' risks of agriculture through an elaborate system of social exchange'' (J. Scott 1976:9; Braun and Plog 1983).

The degree to which the amount of food available from the land fluctuates, both over the course of one year and between years, is thought to be the most important constraint on subsistence economies. The risk of a crisis, during which insufficient food is available, increases as the number of different crops which can be grown decreases. It also increases as the number of different crop sowings which can be made through the year decreases. In both cases, this is because households have fewer independent opportunities to produce food, increasing the probability of all of them being hit by disaster. Risk also increases as the year-to-year variability of climate increases. Subsistence agriculturalists are thought to orient their socioeconomic behavior toward minimizing the risk of starvation during a low in the food supply, rather than toward maximizing their expected income.

Despite the importance of climate to subsistence economies, it is often difficult to identify the effects of climatic variations in the historical record. De Vries (1980) suggests that this is because societies develop strategies to deal with the worst scenarios to which they are likely to be subject. To understand the effect of subsistence risk on society, therefore, we should look at differences between societies which correlate with ecology, rather than events in individual societies following bad years. The ecological risk hypothesis states that a key adaptation to risk is the social one: people mitigate fluctuating food availability by means of exchange with other households in their network. This is how Watts (1983:123) explains the evolution of such a large gift economy in Hausaland: ''[gifts] in a strategic sense acted as enormous local investment networks'' which evened out the variability inherent in agricultural production. The vast Kanuri exchange networks gave them access to products from outside the desert when needed (Fuchs 1983, 1984). Similarly, for a Tiv *ya*, ''large numbers of latent relationships can be activated'' when necessary, and when the harvest arrives earlier in some parts of Tivland than others, the Tiv 'send hunger' by redistributing food across the region:

> This movement of food is not organised; it takes place on a kinship or friendship basis and is morally important to the Tiv. (Bohannan and Bohannan 1968:143)

Thus ecological risk is minimized by having a network of social linkages to turn to, and the social linkages so established are no doubt the very same ones which are the lines of transmission of linguistic norms. Where groups are too small for their environment and suffer stress, they will seek to increase exchange with their neighbors and may fuse with them. As Minnis (1985:20, 21) puts it: ''social groups faced with food provisioning problems will have to enlarge their social/economic network so as to have access to a more reliable food supply. . . . The greater the provisioning problem, the wider the social network necessary.''

There is no advantage in making networks any bigger than necessary, however. Social linkages are costly to maintain. The demands of the social economy in large groups can be so great as to seriously deplete production surpluses (see, for example, Nicolas [1967] on Hausaland). Furthermore, linkages outside the immediate settlement can only be maintained if there is direct contact, through visiting, or common market or social locations. Where transport is basically pedestrian, this is a costly business in time and energy.[6] Thus social linkages, though they reduce the variation in available energy, also tend to reduce the mean. It follows that we should expect people to enter into networks of a size proportional to the amount of ecological risk they face. Where networks grow unnecessarily large, groups of villages or families will have a high incentive to move toward self-sufficiency and save themselves the costs of communication and integration. If the domain of generalized exchange was rather restricted in the central Nigerian highlands, this was because there was no need for it to be wider. ''There is no annual 'hungry time' in the hills''; ''hunger was rare, and serious famine was known only in legend'' (Netting 1968:80, 5).

The ecological risk hypothesis thus predicts that the size of ethnolinguistic groups should increase in proportion to the amount of ecological risk that they face. The social response to risk is effective for two slightly different reasons, and these give rise to two distinct hypotheses to be tested. First, increasing the spatial extent of social networks improves the reliability of access to food supplies because rains, crop failures, etc., can be very localized, and a larger network gives access to more micro-environments and types of land. This *spatial averaging* of risk gives us the first hypothesis.

Hypothesis 1. The spatial extent of ethnolinguistic groups will increase as the degree of ecological risk to which they are normally exposed increases.

Second, increasing the number of productive individuals in a network reduces the variance in the food supply per person as a simple consequence of the law of large numbers, which states that the total of a set of observations of a quantity increases linearly with the number of observations, while the variance of the observations increases only with the square root of the number of observations.[7] This *numerical averaging* gives the second hypothesis.

Hypothesis 2. The number of people per ethnolinguistic group will increase as the degree of ecological risk to which they are exposed increases.

The two hypotheses are not quite equivalent unless the population density of an area is uniform. As this is not the case in West Africa, I will test them separately.

A further hypothesis can also be formulated. If the cost of travel increases, for example because the terrain is mountainous, the

[6] As the Hausa proverb has it, *Zùmùntaa à k'afàà takè:* good relationships depend upon feet.

[7] See Weissner (1977) for this argument applied to hunter–gatherers.

relative utility of distant linkages will be reduced. This gives the third hypothesis.

Hypothesis 3. The size of language groups will decrease as the terrain becomes more difficult to cross.

This hypothesis strictly applies only to the spatial extent of ethnolinguistic groups. However, I will test it against both their spatial extent and their numerical size.

4. TESTING THE THEORY

All three of the above hypotheses were tested on the West African linguistic data shown in Figs. 1 and 2.

4.1. Data Collection

4.1.1. Measures of linguistic diversity. The two measures of linguistic diversity are the average language Area, pertinent to Hypothesis 1, and the median number of speakers per language (Speakers), pertinent to Hypothesis 2, for each of the 2° sectors. These have already been calculated (Section 1).

4.1.2. Ecological and relief measures. As temperatures are high and fairly uniform, and day length is relatively invariant through the year, the amount and seasonality of rainfall are the most significant constraints on the ecology of West Africa (Oguntoyinbo 1981). There are a number of ways of measuring the riskiness of an environment. Clearly, the total annual rainfall is relevant. However, above a certain limit, this may not of itself be crucial. More important is the proportion of the year in which useful plant growth can occur. This can be calculated using the $P > 2t$ rule, which states that the growing season is the number of months in which the monthly rainfall (in millimeters) is greater than twice the monthly temperature (in degrees centigrade). This rule has been found to be highly effective by agronomists and ecologists (Le Houérou 1989). The length of the growing season constrains the type of crops which can be grown, the number of different sowings which can be made, and the number of different crops which can be employed in the course of the year. It also dictates the proportion of the year when new pasture growth is produced. It is thus the key measure of variability in food production through the year. As within-year variability in precipitation is correlated with between-year variability (Oguntoyinbo 1981), the growing season formula also gives an indication of the likelihood of annual drought.

Measures of total annual rainfall, monthly rainfall, and monthly and annual average temperatures were obtained for at least one weather station in each of the sectors of the study area from Wernstadt (1972), and Jackson (1961). Where there was no station within the sector, data from the nearest available points were averaged. The annual average rainfall (Rain) and average annual temperature (Temp) were used in the analysis. The monthly temperatures and rainfall figures were used to calculate the length of the growing season (Growing), as described above.

Data on vegetation type (Veg) were also obtained for each sector from the vegetation maps in Wiebecke (1971). These were coded using the following scheme: 1, desert and semi-desert; 2, savanna and grassland; 3, light forest; savanna woodland and secondary forest; and 4, rainforest.

Three measures of relief were also collected. First, the highest point in each sector was recorded from spot heights on relief maps in OAU (1979). This variable is referred to as the maximum altitude (MaxAlt). In a couple of cases there was no spot height within the sector and the maximum altitude was estimated from contours. Second, the average altitude of each sector was estimated from the same maps (AvAlt). Third, a measure of the amount of variability in altitude was obtained by drawing a pair of diagonal transects across each sector on the maps and counting the number of 100-m contours crossed (VarAlt).

TABLE 1
Ecological and Linguistic Variables for All the Sectors Studied

Lat.	Long.	Langs	Speakers[a]	Area[b]	Growing	Rain	Temp	Veg[c]	MaxAlt	AvAlt	VarAlt
16	−12	2	10849	1060946	1	239	32.75	2	522	200	7
16	−10	2	10849	1060946	1	292	32.75	2	230	150	3
16	−8	1	2293	1930963	0	108	32.75	2	338	200	7
16	−6	2	10849	1060946	1	250	32.75	2	259	200	0
16	−4	4	4897	242265	1	246	32.75	2	565	300	0
16	−2	3	2293	270065	1	157	32.75	2	253	250	1
16	0	4	1484	69844	2	262	32.69	2	250	300	6
16	2	2	4897	953566	2	228	32.88	2	525	350	7
16	4	2	4897	953566	2	150	32.88	2	426	350	5
16	6	2	4897	953566	1	158	31.44	1	687	400	11
16	8	2	4897	953566	1	150	31.44	1	1998	500	11
16	10	1	2293	1930963	1	150	31.44	1	390	350	1
16	12	1	2293	1930963	1	150	31.44	1	370	350	1
14	−12	5	1500	36960	4	731	32.31	2	336	100	13
14	−10	6	1897	52942	3	696	32.19	2	392	200	6
14	−8	6	1897	52942	3	508	32.19	2	298	250	3
14	−6	5	700	45855	3	504	31.13	2	275	250	1
14	−4	4	688	53132	3	477	31.13	2	777	300	7
14	−2	4	688	65310	2	361	33.44	2	516	250	2
14	0	5	2000	56843	3	349	33.44	2	1155	250	0
14	2	3	7500	10084	3	459	33.25	2	247	200	0
14	4	3	8000	442469	2	373	32.06	2	685	350	11
14	6	4	7750	360654	3	477	32.06	2	746	400	4
14	8	5	7500	173144	1	221	32.06	2	624	400	12
14	10	5	4500	39243	2	394	32.06	1	439	350	1
14	12	6	93	9038	1	198	30.56	1	318	300	1
12	−12	8	1500	28932	5	1360	31.66	2	522	200	31
12	−10	3	1500	64582	4	1146	31.66	2	602	300	17
12	−8	2	800	137081	5	1052	31.31	2	494	300	20
12	−6	6	590	35650	4	848	30.44	2	526	300	6
12	−4	11	129	8541	4	852	32.06	2	526	250	3
12	−2	4	2750	40448	4	771	31.89	2	519	300	2
12	0	5	2000	83582	4	806	32.00	2	369	250	0
12	2	5	2000	50572	4	585	32.63	2	218	200	6
12	4	3	8000	192546	4	702	31.56	2	346	250	1
12	6	2	13702	581574	4	719	31.56	2	750	400	7
12	8	3	8000	212890	2	691	31.44	2	750	350	3
12	10	5	6250	20584	2	392	31.00	2	630	250	4
12	12	6	120	17465	2	392	31.00	2	350	250	1

10	−12	4	1077	75644	6	1472	30.13	2	1036	500	44
10	−10	3	160	78061	6	1541	30.13	2	807	400	18
10	−8	6	450	29146	6	1305	30.30	2	726	350	39
10	−6	21	30	3034	5	1363	30.38	2	749	350	31
10	−4	19	100	3862	6	1082	30.12	2	458	250	14
10	−2	19	180	3881	6	1094	31.75	2	447	250	7
10	0	17	139	4123	7	1273	29.88	2	356	200	10
10	2	7	484	23781	5	1018	30.75	2	491	250	13
10	4	22	83	3253	6	978	31.00	3	508	200	14
10	6	12	38	11745	6	1328	28.00	3	640	500	7
10	8	64	3	875	5	1087	28.88	3	1594	500	28
10	10	23	45	2900	4	782	29.63	2	750	500	31
10	12	47	32	1146	5	957	31.22	2	1442	400	19
8	−12	12	223	6517	9	2153	29.19	3	1948	400	63
8	−10	12	505	10164	9	2266	27.25	3	1656	400	29
8	−8	8	450	16778	7	1491	29.88	2	995	350	21
8	−6	13	50	5593	7	1302	29.88	2	603	300	31
8	−4	15	50	5447	6	1033	29.25	2	635	250	9
8	−2	10	21	9435	7	1322	31.31	2	210	150	14
8	0	23	26	2653	7	1368	29.13	2	850	300	37
8	2	8	75	13498	7	1193	29.69	2	625	300	22
8	4	8	750	17475	7	1260	30.19	3	750	250	29
8	6	17	64	4217	6	1354	30.44	3	919	250	33
8	8	97	23	554	7	1209	30.44	3	1698	500	34
8	10	58	23	942	6	1000	28.81	2	2042	500	39
8	12	45	10	1453	6	1414	28.81	2	2049	500	64
6	−12	14	114	4638	9	2934	29.56	4	645	200	26
6	−10	17	160	4291	9	1858	29.56	4	1752	300	24
6	−8	16	140	6597	9	1777	27.94	4	1189	300	28
6	−6	11	74	5229	8	1207	29.94	4	618	150	33
6	−4	11	240	7330	9	1376	28.81	3	725	200	15
6	−2	4	1296	15052	9	1475	28.81	3	788	250	16
6	0	23	30	2454	10	1416	30.00	2	1000	300	25
6	2	4	3458	29316	9	1803	29.68	3	362	200	15
6	4	12	755	5585	9	2758	29.94	4	750	250	28
6	6	26	450	2164	7	1811	30.50	3	312	200	30
6	8	80	23	680	7	1377	30.69	3	1795	300	33
6	10	59	30	948	8	2180	30.69	3	3008	500	60
6	12	15	33	3905	6	1414	28.81	3	1710	750	17

[a] Thousands.
[b] km^2.
[c] 1, desert and semi-desert; 2, savanna and grassland; 3, light forest, savanna woodland, and secondary forest; 4, rainforest.

4.2. Results

4.2.1. Choosing among the ecological measures. All of the variables collected are shown in Table 1 for each sector, along with the number of languages, Area, and Speakers (see Section 1). The total annual rainfall increases from north to south. Similarly, the growing season increases from 1 or 2 months at 16°N to 9 or 10 months at 6°N.

In order to conduct correlation and regression analyses on the data, it was necessary to log some of the variables to reduce their skewness and kurtosis values to an amount not significant at the 1% level. These were Area, Speakers, Rain, Temp, AvAlt, and MaxAlt.

Table 2 shows the coefficients of correlation between all the variables. Both ln[Area] and ln[Speakers] correlate highly significantly with the length of the growing season, the total annual rainfall, and the annual average temperature. They also correlate with two of the three measures of relief. However, the maximum altitude and the variability of altitude are themselves correlated with all of the ecoclimatic variables. It is thus unclear whether it is the relief or the ecoclimatic variables which are driving the correlation with linguistic diversity. The ecoclimatic variables are also highly correlated among themselves.

In order to determine which factors are significant amongst these variables, a principal components analysis was carried out. Two component factors were picked out by this procedure. As Fig. 3 shows, one factor is an ecoclimatic one that correlates positively with rainfall, growing season, and vegetation type.[8] The other is related to relief and is independent of the first. Temperature is, unsurprisingly, negatively related to both factors. Growing and ln[AvAlt] correlate almost perfectly with the first and second factors, respectively. It was thus considered legitimate to use just these two as independent variables in testing Hypotheses 1, 2, and 3.

4.2.2. Testing Hypotheses 1, 2, and 3. By linear regression:

$$\ln[\text{Area}] = 13.00 - 0.59\ \text{Growing}$$
$$(r = 0.73,\ \text{d.f.} = 76,\ p < 0.001).$$

This relationship is shown in Fig. 4. The addition of ln(AvAlt) as an independent variable does not contribute significantly to the regression. Thus the predictions of Hypothesis 1 but not Hypothesis 3 are met.

By multiple regression:

$$\ln[\text{Speakers}] = 16.49 - 0.47\ \text{Growing} - 1.42\ \ln[\text{AvAlt}]$$
$$(r = 0.65,\ \text{d.f.} = 75,\ p < 0.001).$$

Thus the predictions of Hypothesis 2 are met. In this case, adding ln[AvAlt] contributes significantly to the regression. However, the effect is slight, only increasing the r value from 0.60 to 0.65, and it may simply be due to the fact that population densities are slightly lower in the more mountainous sectors, which produces a smaller number of speakers for a given language area.

The relationship between Growing and ln[Speakers] is shown in Fig. 5. The effect of relief has been partialled out by adding 1.42 ln[AvAlt] to ln[Speakers]. The spatial measure is clearly better predicted by the ecology than the numerical one. ln[Area] and ln[Speakers] are highly correlated, and much of the additional scatter in Fig. 5 is due to relatively small groups where population is unusually sparse (the desert edge) or very numerous ones where it is unusually dense (Hausaland and Southern Nigeria). It therefore seems likely that it is the spatial process rather than the numerical one which is driving the correlations.

4.2.3. Outliers. From the plots of the rela-

[8] Vegetation type (Veg) is strictly speaking a categorical variable; however, it is included in this analysis because it can be thought of as an ordinal scale of increasing vegetation lushness.

TABLE 2
Correlations between the Measures of Linguistic Diversity and the Ecological Variables

	ln[Area]	ln[Speakers]	Growing	ln[Rain]	ln[Temp]	ln[AvAlt]	ln[MaxAlt]
ln[Area]	1						
ln[Speakers]	0.85**	1					
Growing	−0.73**	−0.60**	1				
ln[Rain]	−0.76**	−0.60**	0.92**	1			
ln[Temp]	0.62**	0.66**	−0.76**	−0.70**	1		
ln[AvAlt]	−0.11	−0.24†	0.01	0.04	−0.35*	1	
ln[MaxAlt]	−0.45**	−0.46**	0.46**	0.43**	−0.55**	0.67**	1
VarAlt	−0.60**	−0.59**	0.66**	0.66**	−0.61**	0.33*	0.67**

† $p < 0.05$.
* $p < 0.01$.
** $p < 0.001$.

tionships (Figs. 4 and 5), two groups of deviations are apparent. First, there a couple of sectors from the Sahel with much more linguistic diversity than would be expected. These sectors contain a number of small groups such as the Buduma, Mober, and Putai. Of these, at least the Buduma ''subsist primarily by fishing'' on Lake Chad (Murdock 1965:137). This protects them to a great extent from the extreme seasonality that affects pastoralism and agriculture at this latitude, and so it is not unexpected that they

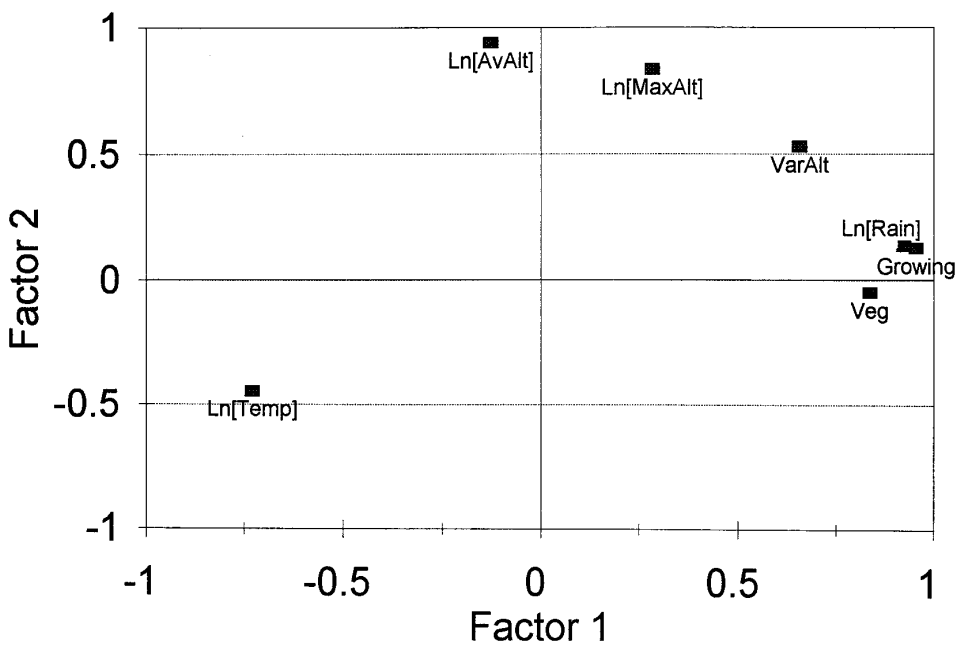


FIG. 3. Factor loading plot from principal components analysis of the ecological and relief variables.

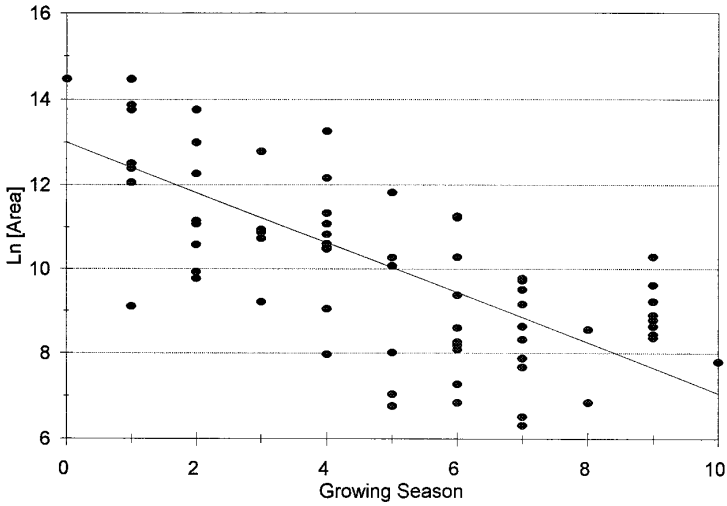


FIG. 4. The average language Area regressed against the length of the growing season.

should form smaller groups than their non-lacustrine neighbors.

If the regressions are rerun with the two main lacustrine sectors excluded, the relationships are slightly improved (ln[Area] = 13.24 − 0.63 Growing, $r = 0.76$, d.f. = 74, $p < 0.001$; ln[Speakers] = 16.96 − 0.51 Growing − 1.45 ln[AvAlt], $r = 0.69$, d.f. = 73, $p < 0.001$).

The second deviation is the already-noted turn-up in the size of groups at the longest growing seasons. It is much more marked on the Speakers graph than the Area one, and so it is partly a simple consequence of

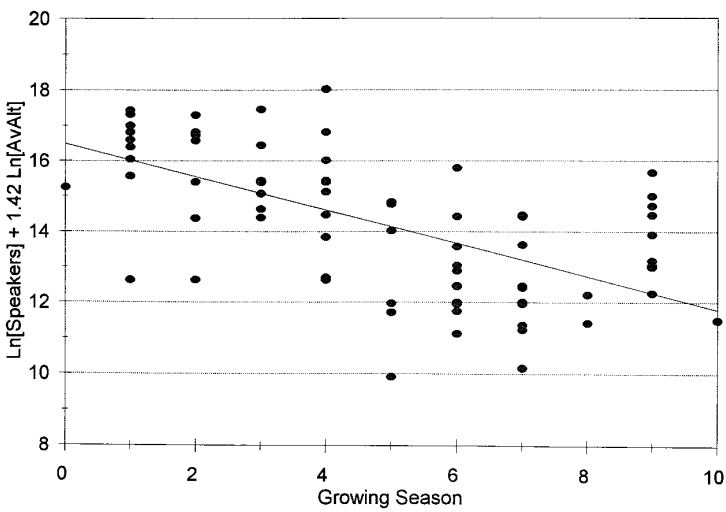


FIG. 5. The median number of speakers per language regressed against the length of the growing season once the effects of the average altitude have been taken out.

the high density of population of the southern central area. However, it is also evident in the language Area graph. One endogenous factor which could have contributed is the fact that agricultural production in the rainiest areas can be depressed by the lack of direct sunlight (Kassam and Kowal 1973). More important are the powerful expansions of Yoruba and Asante states already discussed in Section 2.2.

4.2.4. Alternative explanations. As mentioned in Section 2.4, a possible alternative explanation for the overall trend is simply the greater ease of mobility in savanna, as opposed to forest, environments. As dense forest is found only at the longest growing seasons, this could be argued to be producing the correlations. However, closer examination of the data reveals that this is unlikely to be the case. Although all the southern parts of the study area have some woodland, only 5 of the 78 sectors have rainforest as their dominant vegetation type. The regression relationships hold equally strongly when these 5 are excluded from the analysis (ln[Area] = 13.11 − 0.63 Growing, $r = 0.73$, d.f. = 71, $p < 0.001$; ln[Speakers] = 16.83 − 0.50 Growing − 1.46 ln[AvAlt], $r = 0.66$, d.f. = 70, $p < 0.001$). Furthermore, within the 6° latitude band, where one finds both dense rainforest and the savanna of the ''Dahomey gap,'' there is no significant difference in linguistic diversity between the forest and nonforest sectors (Area: Mann–Whitney $U = 15$, $n = 13$, n.s.; Speakers: Mann–Whitney $U = 18$, $n = 13$, n.s.). It thus seems that the difference between forest and savanna is not of itself an important factor.

4.2.5. Testing the robustness of the relationship. Regression analyses such as those used here assume the statistical independence of the data points. There are a couple of ways in which this assumption may have been violated in this study, and it is therefore necessary to check that the results are not artifactual products of such violations.

Firstly, many of the northern sectors are covered by the same few large languages and are therefore not really independent samples of ethnolinguistic group size. They are, in several cases, just repeated samples of the same groups. To check that this was not inflating the significance of the relationships, the analysis was rerun with the areas most dominated by the very large languages treated as single points. All of the 16°N band (which is dominated by Bedouin Arabic) was combined into one supersector, whose values for Growing, AvAlt, and Area were the means of the component 2° sectors and whose value for Speakers was their median. Similarly, single supersectors were created from the areas between 14°N12°W and 14°N0°E (dominated by Soninke and Songhai), between 14°N02°E and 14°N12E (Tamasheq), between 12°N12°W and 12°N06°W (Bambara), between 12°N04°W and 12°N02°W (Moore), and between 12°N0°E and 12°N12°E (Hausa).

Even with the adoption of this harsh reduction in the sample size, the regressions produced basically the same results, albeit with lower r values and fewer degrees of freedom. Indeed, ln[AvAlt] now contributed significantly to the ln[Area] relationship

$$\ln[\text{Area}] = 18.67 - 0.40\ \text{Growing} - 1.24\ \ln[\text{AvAlt}]$$
$$(r = 0.53,\ \text{d.f.} = 42,\ p < 0.005)$$

and

$$\ln[\text{Speakers}] = 17.81 - 0.29\ \text{Growing} - 1.90\ \ln[\text{AvAlt}]$$
$$(r = 0.44,\ \text{d.f.} = 42,\ p < 0.01).$$

The second way in which the assumption of independence may have been violated arises from the fact that some of the groups in the study are culturally related to each other. The problem, which arises frequently in cross-cultural comparison, is that groups may share traits not because they have independently adapted to the

environment in a certain way, but because they have inherited them from a common ancestor (Mace and Pagel 1994). In the present case, if all the Afro-Asiatic groups lived in the north and were large, and all the Niger-Congo groups lived in the south and were smaller, there would appear to be a correlation between ethnolinguistic group-size and growing season. However, it might simply be that large group size was a result of some cultural practice common to all the Afro-Asiatic groups which had nothing to do with ecology. To show that this is not what is producing the results and that the correlation represents a genuine adaptation, it would be necessary to demonstrate that large group size had independently evolved a significant number of times as a response to ecological risk.

A good case can be made that this is in fact what has happened. The largest groups have widely different linguistic affiliations—Fulfulde is Atlantic (Niger–Congo), Bambara is Mande (also Niger–Congo), Hausa is Chadic (Afro-Asiatic), Tamasheq is Berber, and Bedouin Arabic is Semitic (both Afro-Asiatic), while Songhai and Kanuri are Nilo-Saharan. In all the branches of the Niger–Congo phylum and in the Chadic branch of Afro-Asiatic, one also finds numerous very small groups further south. Indeed, for the sectors where Niger–Congo peoples are found, there is a significant rank correlation between Growing and the median number of speakers counting just the Niger–Congo languages ($r_s = -0.65$, $n = 67$, $p < 0.001$). The same is true for Chadic ($r_s = -0.45$, $n = 23$, $p < 0.05$). It seems that the relationship between ecology and linguistic diversity obtains independently within the major phylogenetic groups and is not just an artifact of history.

Another possible problem with the results is that they are in some way artifacts of the linguistic boundaries used. For example, the results could be argued to be biassed by the fact that very large northern languages such as Fulfulde have been considered as single languages with dialects while Yoruba has been treated as a small cluster of languages. On balance, there seems to be no linguistic case to answer here. As Mann and Dalby (1987) put it, ''it is generally agreed that all the speech forms of the widely dispersed fulbe (and tukuloor) [i.e., Fulani] people are substantially interintelligible.'' Nonetheless, it is worthwhile investigating the extent to which the results are sensitive to different classifications of languages.

We can do this in a rudimentary way by dividing the number of appearances and number of speakers for each of the largest northern languages by the number of distinct dialects of that language for which there is recorded evidence. Thus Fulfulde was divided into 23, Hausa into 2, Tamasheq into 7, Kanuri into 9, Bedouin Arabic into 3, Songhai into 11, and Zarma into 2 (source: Mann and Dalby 1987). This change affected 51 of the 78 values of Area and 35 of the 78 values of Speakers, although the rank correlation between the old and the new sets of values was very high (New vs old Area, $r_s = 0.92$; new vs old Speakers, $r_s = 0.92$; $n = 78$, $p < 0.001$ in both cases). The regressions were rerun using these values. They gave essentially the same results, with r values that were only marginally lower, though the gradients were less steep:

$$\ln[\text{Area}] = 11.37 - 0.37\ \text{Growing}$$

$$(r = 0.62,\ \text{d.f.} = 76,\ p < 0.001)$$

and

$$\ln[\text{Speakers}] = 13.81 - 0.24\ \text{Growing} - 1.25\ \ln[\text{AvAlt}]$$

$$(r = 0.52,\ \text{d.f.} = 75,\ p < 0.001).$$

Although there is probably no linguistic case for this division of the larger northern languages, it is interesting that it makes no significant difference to the conclusion, as

the groups are so vastly larger than those further south. Overall, the relationship between language group and ecology seems remarkably robust.

5. DISCUSSION

The observed distribution of linguistic diversity strongly supports the hypothesis that social networks are responsive to ecological risk. The predictions of both the spatial and numerical hypotheses are met, but the spatial measure is better predicted by the ecological variables. This may be because the dramatic recent growth in population has swelled some groups disproportionately. There is also limited and more equivocal evidence of a relationship between diversity and topography.

The facts that the effects of relief appear to be so slight and the forest/savanna distinction appears to be of no importance give an interesting indication of just how empirically inadequate theories based simplistically on physical geography are. Furthermore, the strength of the correlations tends to justify my argument in Section 2 that subsistence factors are more important than political or commercial ones.

There is a great deal of variability in the data, which has been consistently underemphasized in the present analysis by taking averages over a large number of groups, by taking logarithms of group sizes, and by the simplification inherent in the production of the maps themselves. Beyond the broad trends outlined there are clearly many other influences, and a great deal of locally specific historical process going on. It is not my intention to deny those myriad determinants or attempt to reduce West African history to a single dimension, but rather to understand a common theme. The interaction of ecological variability with specific demographic, cultural, and political situations is something that demands further research of a much more fine-grained character than that undertaken here.

In conclusion, the present analysis seems to indicate that, among the many influences on the evolution of communities in West Africa, subsistence risk has been one of the most important, leading people to form social networks of different sizes over the region. Whether the same factors have been important in other parts of the world remains to be shown, though Nichols' (1990, 1992) finding that linguistic diversity at the global level is inversely correlated with latitude and seasonality suggests that they might well be. It is clear that the ethnolinguistic map is a very useful source of information about people's adaptive socioeconomic behavior across space and time. We can thus envisage the fruitful development of what Breton (1991:ix) calls ''geolinguistics'' and Mace and Pagel (1995:120) call ''linguistic ecology'': the investigation of the spatial, temporal, environmental, and societal factors associated with the distribution of human languages.

APPENDIX

The languages appearing in each sector of the study area are listed in Table A sector by sector, along with the number of speakers to the nearest thousand. Where no other indication is given, the source is Wald (1994).

TABLE A

Language	Speakers
16N12W Mauritania	
Bedouin Arabic	2293[a]
Fulfulde	19404
16N10W Mauritania	
Bedouin Arabic	2293[a]
Fulfulde	19404
16N08W Mauritania	
Bedouin Arabic	2293[a]
16N06W Mali	
Bedouin Arabic	2293[a]
Fulfulde	19404
16N04W Mali; Timbuktu, r. Niger	
Bedouin Arabic	2293[a]
Fulfulde	19404
Songhai	675
Tamasheq	7500
16N02W Mali; Gao, r. Niger	
Bedouin Arabic	2293[a]
Songhai	675
Tamasheq	7500
16N00 Mali	
Bedouin Arabic	2293[a]
Songhai	675
Tadakshak	31[a]
Tamasheq	7500
16N02E Mali, Niger	
Bedouin Arabic	2293[a]
Tamasheq	7500
16N04E Niger	
Bedouin Arabic	2293[a]
Tamasheq	7500
16N06E Niger	
Bedouin Arabic	2293[a]
Tamasheq	7500
16N08E Niger	
Bedouin Arabic	2293[a]
Tamasheq	7500
16N10E Niger	
Bedouin Arabic	2293[a]
16N12E Niger	
Bedouin Arabic	2293[a]
14N12W Mali, Mauritania	
Bambara	1500
Bedouin Arabic	2293[a]
Fulfulde	19404
Soninke	1000
Xasonke	107
14N10W Mali, Mauritania	
Bambara	1500
Bedouin Arabic	2293[a]
Fulfulde	19404
Kakolo	15[a]
Manding	9000
Soninke	1000
14N08W Mali, Mauritania	
Bambara	1500
Bedouin Arabic	2293[a]
Fulfulde	19404
Kakolo	15[a]
Manding	9000
Soninke	1000
14N06W Mali	
Bozo	131
Dogon	700
Fulfulde	19404
Songhai	675
Soninke	1000
14N04W Mali	
Bozo	131
Dogon	700
Fulfulde	19404
Songhai	675

TABLE A—*Continued*

Language	Speakers
14N02W Mali	
Dogon	700
Fulfulde	19404
Kurumba	129
Songhai	675
14N00 Niger; r. Niger	
Fulfulde	19404
Songhai	675
Tadakshak	31[a]
Tamasheq	7500
Zarma	2000
14N02E Niger	
Fulfulde	19404
Tamasheq	7500
Zarma	2000
14N04E Niger	
Fulfulde	19404
Hausa	8000
Tamasheq	7500
14N06E Niger	
Bedouin Arabic	2293[a]
Fulfulde	19404
Hausa	8000
Tamasheq	7500
14N08E Niger	
Bedouin Arabic	2293[a]
Fulfulde	19404
Hausa	8000
Kanuri	4500
Tamasheq	7500
14N10E Niger	
Bedouin Arabic	2293[a]
Fulfulde	19404
Kanuri	4500
Tamasheq	7500
Teda-Daza	360
14N12E Niger; N.W. of I. Chad	
Bedouin Arabic	2293
Buduma	120
East Kesherda Daza	93[a]
14N12E Niger; N.W. of I. Chad	
Sugurti	93[a]
Wandala Daza	93[a]
Yidena	93[a]
12N12W Senegal, Mali	
Bambara	1500
Fulfulde	19404
Manding	9000
Maninka	1800
Marinkaxamuro	—
Soninke	1000
Xasonke	107
Yalunka	120
12N10W Mali	
Bambara	1500
Maninka	1800
Yalunka	120
12N08W Mali; r. Niger, Bamako	
Bambara	1500
Minianka	100
12N06W Mali; San	
Bambara	1500
Bobo	160
Bwamu	180
Fulfulde	19404
Minianka	100
Soninke	1000
12N04W W. Burkina Faso	
Bwamu	180
Dogon	700
Fulfulde	19404
Moore	5100
Kurumba	129
Lyele	100
Marka	129
North Samo	75
Nuni	65
Pana	30
South Samo	75
12N02W B. Faso; Ougadougou	
Bisa	400
Fulfulde	19404

TABLE A—*Continued*

Language	Speakers
12N02W B. Faso; Ougadougou	
Moore	5100
Kurumba	129
12N00 Burkina Faso, Niger	
Fulfulde	19404
Gurma	566
Hausa	8000
Songhai	675
Zarma	2000
12N02E E. Burkina Faso	
Dendi	23
Fulfulde	19404
Gurma	566
Hausa	8000
Zarma	2000
12N04E Nigeria; Sokoto	
Fulfulde	19404
Hausa	8000
Zarma	2000
12N06E Northern Nigeria	
Fulfulde	19404
Hausa	8000
12N08E Nigeria; N. of Kano	
Fulfulde	19404
Hausa	8000
Kanuri	4500
12N10E Northern Nigeria	
Bade	110
Duwai	—
Fulfulde	19404
Hausa	8000
Kanuri	4500
12N12E Nigeria; W. of I. Chad	
Buduma	120
Fulfulde	19404
Jetko	—
Kanuri	4500
Mober	60
Putai	1[a]
10N12W Central Guinea	
Fulfulde	19404
Limba	353
Maninka	1800
Yalunka	120
10N10W Guinea; r. Niger, Siguiri	
Maninka	1800
Wasulunka	—
Yalunka	120
10N08W Mali	
Bambara	1500
Maninka	1800
Minianka	100
Senari	450
Supyire	450
Wasulunka	—
10N06W S-W. Burkina Faso	
Bolon	9
Chembara	100
Dogosyhe	50
Dioula	1200
Jalkuna	1
Jeri	10
Karaboro	38
Kirma	50
Komon	6
Loghon	5
Minianka	100
Natioro	5
Samogo	180
Sembla	8
Seme	15[a]
Senari	450
Supyire	450
Tusya	30
Tyurama	50
Viemo	5
Wara	5
10N04W Burkina Faso, Ghana	
Birifor	100
Bobo	160
Bwamu	180
Dagaari	630
Dogosyhe	50

TABLE A—*Continued*

Language	Speakers
10N04W Burkina Faso, Ghana	
Dyan	50
Fulfulde	19404
Gan	100
Ko	16[a]
Lobi	317
Lyele	100
Marka	129
Nuni	65
Padogho	1
Pwo	50
Sisaala	140
Tyefo	7
Wali	84
Wile	100
10N02W Burkina Faso, Ghana	
Bisa	400
Buli	237
Dagbani	409
Furi	—
Gurenne	581
Gurma	566
Kasem	128
Konkomba	356
Konni	3
Kusaal	200
Mampruli	137
Moba	180
Moore	5100
Nabit	39
Nankanse	—
Nuni	65
Sisaala	140
Talni	77
Tampulma	8
10N00 N. Togo, Benin, B. Faso	
Bariba	484
Bieri	50
Buba	—
Chakosi	60
Dye	24
Fulfulde	19404
Gangam	34[a]
Gurma	566
Konkomba	356
Kusaal	200
Lamba	140
Li-Tamare	105
Mampruli	137
Moba	180
10N00 N. Togo, Benin, B. Faso	
Niende	—
Tayari	—
Wama-Tamkamba	10
10N02E Benin, Nigeria	
Bariba	484
Busa	75
Dendi	23
Fulfulde	19404
Gurma	566
Hausa	8000
Shanga	15
10N04E Nigeria; Kainji reservoir	
Achipa	4
Agara'iwa	—
Auna	—
Banga	8
Busa	75
Cinda	—
Duka	622
Fulfulde	19404
Hausa	8000
Ibeto	—
Kakihum	180
Kamuku	27
Laru	1
Lela	90
Lopa	1
Nupe	750
Poka-kori	24
Reshe	45
Salka	110
Shanga	15
West Kambari	150
Zarma	2000
10N06E N. central Nigeria	
Achipa	4
Basa Kaduna	1[a]
Baushi	3
Cinda	—
Duka	38
Fulfulde	19404
Gurmana	—
Hausa	8000
Kadara	74
Ngwoi	1
Nupe	750
Ura	—

TABLE A—*Continued*

Language	Speakers
10N08E Nigeria; S. of Kano	
Achipa	4
Amo	4
Bankal	39
Basa Kaduna	1[a]
Butu-Ningi	1[a]
Baushi	3
Birawa	4[a]
Buji	3
Chokoba	1
Dass	9
Dirya	4
Doka	—
Dulbu	1[a]
Dungu	1
Fulfulde	19404
Galambi	1
Geji	3
Gera	20
Geruma	5
Gubi	1
Gure-Kahugir	8
Gurmana	—
Gusu	2
Guta	6[a]
Gwa	1
Gyem	1
Hausa	8000
Idong	30
Jaku	49
Jara	60
Jera	35
Jere	5
Jimbin	2
Jimi	1
Ju	1[a]
Kadara	74
Kaivi	1
Kibalo	1
Kono	2
Kinuku	1
Kir-balar	1
Kitimi	1
Kuda-Chamo	5[a]
Kurama	18
Lame	2
Luri	1[a]
Mangas	1[a]
Miya	5
Moro	3
Ngwoi	1
Nupe	750
Pa'a	11
10N08E Nigeria; S. of Kano	
Polci	7
Ribina	2
Rumaya	2
Ruruma	2
Sanga	5
Shani	1
Siri	2
Tala	—
Ura	—
Warji	72
Zamani	1
Zangwal	—
10N10E N-E. Nigeria; Gombe	
Bole	45
Bura	270
Dera	15
Dera (Kanakuru)	15
Dirya	4
Fulfulde	19404
Galambi	1
Hausa	8000
Jaku	49
Jara	60
Kanuri	4500
Karekare	59
Kirifi	15
Kubi	1
Kupto	—
Kwami	—
Maha	—
Ngamo	27
Ngizim	59
Pabir	—
Putai	1[a]
Tera	69
Waja	45
10N12E N-E. Nigeria	
Bana	45
Besleri	10
Bata	59
Besum	—
Bura	270
Buwal	—
Cuvok	—
Daba	45
Durbeye	9[a]
Fulfulde	19404

TABLE A—*Continued*

Language	Speakers
10N12E N-E. Nigeria	
Ga'anda	18[a]
Gamargu	15
Gavar	19
Gavoko	30
Gelvaxdaxa	30
Giziga South	66[a]
Gu'de	106[a]
Higi	305
Hwana	36[a]
Hya	—
Jimjimen	5[a]
Ka'da	75
Kanuri	4500
Kilba	120
Kyibaku	30
Lamang North	20[a]
Mabas	1[a]
Matakam	84
Matal	26
Mbedam	—
Mefele	—
Mofu South	32[a]
Ngwaphyi	—
Ngweshe	—
Njanyi	21
Pabir	—
Parekwa	23
Psikye	46
Putai	1[a]
Roba	45
Sharwa	1
Tsuvan	—
Vimtim	—
Wandala	285
Xede	32
Zelgwa	20
Ziziliveken	—
08N12W Sierra Leone	
Bandi	130
Bombali	190[a]
Kono	300
Kisi	500
Kuranko	255
Kurike	190[a]
Lele	92
Limba	353
Maninka	1800
Mende	940
Sanda	190[a]
Yalunka	120
08N10W Southern Guinea	
Dan	509
Kisi	500
Kohno	168
Konyanka	—
Kpelle	750
Manding	9000
Maninka	1800
Manya	—
Mau	120
Tura	29
Wasulunka	—
Woj	—
08N08W Ivory Coast	
Dan	509
Manding	9000
Mau	120
Nowola	—
Senari	450
Tura	29
Woj	—
Wor	—
08N06W Ivory Coast	
Ben	7
Dyimini	63
Dioula	1200
Jeri	10
Kirma	50
Komono	6
Kulango	108
Nafara	38
Nyarafolo	50
Palaka	50
Tafire	50
Tagbana	100
Wor	—
08N04W Ivory Coast	
Birifor	100
Deg	21
Dyimini	63
Dioula	1200
Gonja	146
Jeri	10
Kulango	108
Lobi	307
Loghon	5
Nafaanra	50

TABLE A—*Continued*

Language	Speakers
08N04W Ivory Coast	
Safalaba	3
Siti	6
Tegesye	50
Vagla	8
Wali	84
08N02W N. Ghana	
Asante	2070
Chakali	2
Chumburung	15
Deg	21
Gonja	146
Hanga-Kamara	5
Konkomba	336
Nanuni	—
Sisaala	140
Tampulma	8
08N00 N. Togo	
Adele	17
Animiere	—
Bago	484
Bariba	33
Basari-Tobote	5
Basila	8[a]
Bazanche	—
Chala	1
Chumburung	15
Delo	8
Gichode	10[a]
Kabre	785
Kasele	—
Konkomba	356
Lamba	140
Likpa	39
Mahi	26[a]
Miyobe	15
Nanuni	—
Naudem	135
Nawuri	9
Tem	315
West Yoruba	3458[b]
08N02E Benin, Nigeria	
Bariba	33
Busa	75
Central Yoruba	3458[b]
Chumbuli	1
Fon	2275
Fulfulde	19404
Mahi	26[a]
Yom-Tanla	—
08N04E Nigeria	
Amgbe	—
Auna	—
Busa	75
Central Yoruba	3458[b]
Cinda	—
Laru	1
North-East Yoruba	3458[b]
Nupe	750
08N06E Nigeria	
Absa	150
Amgbe	—
Basa Kaduna	—
Dibo	64
Ebira	510
Egan	2
Gade	44[a]
Gbagyi	700
Gbari	300
Gbede	—
Gwandara-Gwari	45
Koro	23
Kakanda	5
North Idomoid	84
North-East Yoruba	3458[b]
Nupe	750
Pongu	4
Tumi	1[a]
08N08E Nigeria	
Absa	150
Ake	1[a]
Alago	53
Angas	150
Arum-Chesu	—
Atakat	—
Aten	4
Bada	10
Badara	10[a]
Bankal	39
Birom	220
Boghom	75
Bokas	63

TABLE A—*Continued*

Language	Speakers
08N08E Nigeria	
Bowol	—
Chakfam-Moshere	5
Chawai	32
Chip	6
Dass	9
Deomak	—
Duguza	2
Eggon	90
Eloyi	38
Fyam	21
Fyer	3
Gerka	8
Gingwak	29
Gworam	—
Guruntum	15
Guta	6[a]
Gwandara-Gwari	45
Ham	60[a]
Hausa	8000
Horom	1
Ikulu	6
Irigwe	43
Jaku	49
Jidda-Abu	—
Jipul	—
Jortol	—
Kadara	74
Kafanchan	—
Kagaro	9
Kagoma	6
Kaje	320
Kamantam Kambari	14
Kanufi	—
Karfa	1
Katab	48
Koenoem	3
Kofyar	60
Koningkom	—
Koro	23
Kuchichere	—
Kulere	8
Kurama	18
Kwangalak	—
Kwanka	224[a]
Lungu	12
Mabo-Barkal	—
Mada	45
Mama	35
Mernang	—
Montol	30
Migili	55
Mundat	—
Nandu-Tari	4
Nindem	—
Ninzam	53
North Idomoid	84
North-West Badara	—
Numana-Gwanfu	23
Nungu	38
Piti	2
Pyapun	—
Rukuba	75
Saya	75
Sha	1
Shagawu	35
Shall-Zwall	—
Sholio	6
South-West Badara	—
Sura	60
Surubu	2
Tal	15
Tambas	3
Tapshin	1[a]
Tarok	150
Tiv	2000
Turkwam	6
Wase	—
Wukari	90
Wurkum	—
Yashi	1
Yeskwa	20
Zarek	—
Zari	4
Zeem	—
08N10E Nigeria	
Awak	—
Bachama	30
Bali	1
Bambuka	15
Bandawa-Minda	10[a]
Bangwinji	—
Bashar	30
Bata	59
Bile	1
Boghom	75
Burak	2
Cham-Mwana	—
Chomo	—
Dadiya	2
Dera (Kanakuru)	30
Dong	—
Fulfude	19404
Gengle	—

TABLE A—*Continued*

Language	Speakers
08N10E Nigeria	
Gurunthum	15
Gwom	—
Hausa	8000
Jaku	49
Jan	22[a]
Jiru	—
Kam	—
Kamo	3
Kanam	—
Kona	5
Kugama	—
Kulung	23
Kumba	—
Kushi	4
Kutin	1
Kwa	1
Laka	60
Lamja	—
Lelau	—
Libo	—
Ligri	—
Lo	2
Longuda	48
Lotsu-Piri	2
Mbula-Bwaza	35
Mumbake	15
Mumuye	425
Munga	—
Nnayekenyake	—
Panyam	—
Pasam	—
Pero	30
Piya	3
Roba	45
Tangale	150
Teme	—
Tula	29
Waja	45
Waka	—
Yandang	15
08N12E Nigeria, Cameroon	
Banga	8
Bata	59
Bele	10[a]
Besum	10[a]
Bveri	10[a]
Chamba Daka	129
Dama	—
Dooyayo	20
Duli	1[a]
Durbeye	10[a]

Language	Speakers
08N12E Nigeria, Cameroon	
Fali	10[a]
Fulfulde	19404
Gey	2[a]
Gimine	3
Gimme	3
Gudu	1
Handa	—
Ka'da	75
Kaang	10[a]
Kobo	—
Kolena	3[a]
Koma	23
Kugama	—
Laka	60
Leko	—
Libo	—
Mambay	3
Mapeo	—
Marke	—
Mboi	3
Mbula-Bwaza	35
Ndera	23
Ngong	0
Nimbari	1[a]
Njanyi	21
Nnayekanyake	—
Pam	—
Peere	23
Samba	42[a]
Teere	—
Tingelin	10[a]
Vere	30
West Mbum	10[a]
Wom	25
Yungur	68
06N12W Liberia; Monrovia	
Bandi	130
Bassa	249
Dan	509
De	8
Gola	74
Kpelle	750
Krim	13
Kuwaa	11
Loma	390
Manya	48[a]
Mende	940
Mmani	5
Sherbro	175
Vai	97

TABLE A—*Continued*

Language	Speakers
06N10W Inland Liberia	
Daloa	—
Dan	509
Ganyoa	—
Gbee	6
Glio-Ubi	5
Godie	210
Guro	168
Kohno	9
Kuya	225
Mano	225
Manding	9000
Mau	120
Nyabwa	32
Subre-Kaberwa	—
Tura	29
Wobe	160
Wor	—
06N08W Inland Ivory Coast	
Daloa	—
Dan	509
Ganyoa	—
Glio-Ubi	5
Godie	210
Guere	1776
Guro	210
Kranh	85
Kuya	9
Manding	9000
Mau	120
Nyabwa	32
Subre-Kaberwa	—
Tura	29
Wobe	160
Wor	—
06N06W Ivory Coast	
Abey	74
Atie	240
Baule-Ando	2000
Dida	173
Gban	33
Guro	210
Lakota	—
Mwa	9
Nwa	15
Vata	—
Yaure	30[a]
06N04W Ivory Coast, Ghana	
Abron	741
Anyi	1328
Asante	2070
Atie	240
Baule-Ando	2000
Deg	21
Jeri	10
Kulanyo	108
Nafaanra	50
Nzema	450
Sefwi	166[a]
06N02W Ghana; W. of I. Volta	
Juang	—
Asante	2070
Dangme	1296
Krachi	33
06N00 Togo; Lome, I. Volta	
Adja	581
Ahlong	3
Akpafu-Lolobi	16
Akposo	110
Asante	2070
Avatime	17
Bowiri	8
Delo	8
Ewe	3238
Fon	2275
Ga	1225
Ge	284
Gwa	23
Kabre	785
Kebu	30
Lelemi	31
Likpe	17
Logba	5[a]
Nkonya	45
Nyangbo	3
Santrokofi	5
Tafi	1
West Yoruba	3458[b]
06N02E Nigeria, Benin; Lagos	
South-East Yoruba	3458[b]
South-West Yoruba	3458[b]
Fon	2275
West Yoruba	3458[b]

TABLE A—*Continued*

Language	Speakers
6N04E Nigeria; Benin City	
Akoko	—
Akpes	—
Central Ijoid	509
Edo	1000
North-East Yoruba	3458[b]
Okpamheri	45
Ora-Emai-Ialeha	60
South-East Yoruba	3458[b]
South-West Yoruba	3458[b]
Uhami-Iyayu	—
Ukaan	27
Ukue-Ehwen	—
06N06E Nigeria; r. Niger, Benue	
Absa	150
Akoko	—
Central Igbo	2887[b]
Ebira	510
Esan	300
Etsako	180
Ghotuo	9
Ibie	—
Idoma	450
Igala	850
Ikpeshi	—
North Idomoid	84
North-East Yoruba	3458[b]
Nupe Tako	28
Ogori-magongo	—
Okpamheri	45
Okpe-Idesa-Oloma	—
Ora-Emai-Ialeha	60
Osimili Igbo	2887[b]
Ososo	—
Ouibala Igbo	2887[b]
Plains Igbo	2887[b]
Sasaru-Engwan-Igwe	4
Savannah Igbo	2887[b]
Ulukwumi	3458[b]
Uneme	—
06N08E Nigeria; S. of Makurdi	
Abinsi	—
Aghem	20
Akpa	23
Alege	1
Atong	—
Bajwa	—
Basho	—
Batomo	—

Language	Speakers
06N08E Nigeria; S. of Makurdi	
Beba'	—
Bebe	—
Befang	—
Bekware	153
Bete-Bendi	56
Boki	131
Bumaji	—
Caka	5[a]
Central Idomoid	3
Efium	15
Efutop	23
Ekajuk	38
Eloyi	25[a]
Eman	1[a]
Enyom Igbo	2887[b]
Esimbi	25
Etulo	3
Evand	6
Iceve	5
Igede	140
Ihatum	—
Ikom-Ololumo	37
Ipulo	3[a]
Iyeve	—
Jimi	1
Koring	80
Kukele	100
Kohumono	45
Kpan	—
Kutep	39
Legbo	65
Leyigha	13
Manta	20
Mbe	25[a]
Mbembe	110
Menka	15
Meta'	53
Migili	55
Modele	—
Mundum	—
Nde	18[a]
Ndoe	11[a]
Ngie	35
Ngishe	6[a]
Ngwo	35
Nkem	18
Nkum	9
Nnam	1
North Idomoid	84
Nsele	1
Nta	5
Obanliku	75

TABLE A—*Continued*

Language	Speakers
06N08E Nigeria; S. of Makurdi	
Otank	3
Leko	45
Savannah Igbo	2887[b]
South Idomoid	14[a]
Takum	0[c]
Tiv	2000
Ubang	—
Ufia	18
Ugare	—
Uhuum	—
Ukpe-Bayobiri	18
Utagwang	18
Uzekue	5
Wandala	285
West Idomoid	60[a]
Wi-Isu	—
Wukari	90
Yala	75
Yatye	23
Yukeben	3[a]
06N10E Nigeria, Cameroon	
Aghem	20
Babamki	—
Bafut	52
Bambili	12[a]
Bamum	231
Bamunka	20
Batu	38
Baya	—
Bitare	128
Bu-Za-Ngem	—
Bum	—
Chamba Daka	129
Chomo	—
Dirim	17
Dzodinka	3
Fam	—
Fulfulde	19404
Icen	7
Jibu	30
Kamazung	—
Kanswei Nsei	20
Kom	145
Konja	23
Koshin	—
Kotopo	—
Kpan	—
Kuo	12
06N10E Nigeria, Cameroon	
Kutep	39
Leko	45
Lamnso'	150
Limbum	75
Mambila	120
Mba	—
Mbembe	40
Mbogno	—
Meta'	—
Mfumte	30
Missong	4
Mmem	—
Mundum	—
Mvano	—
Mungaka	60
Naki	3[a]
Ncane	—
Ndoro	15
Njikun	—
Noni	35[a]
Nsari	—
Somyewe	—
Takum	0[c]
Taram	3
Tikar	20
Tiv	2000
Uhuum	—
Veng'o	16
Vute	33
Wi-Isu	—
Yamba	26
Wushi	14
06N12E Cameroon; Ngaoundéré	
Bamnyo	—
Dan Muure	—
Dii	51
Fulfulde	19404
Kali	—
Kuumbere	—
Muure	—
Nduuvum	—
Njoyame	—
North-West Gbaya	173[a]
Peere	22[a]
Suga	15
Vute	33
West Mbum	10[a]
Zongbi	—

[a] Source: Grimes (1988) or Grimes (1993).
[b] Calculated from a figure for the language group given by Wald (1994).
[c] Used as a second language only; no mother-tongue speakers.

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