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Abstract

This article examines the structural and spatial organization of violent extremist organizations (VEOs) across the Sahara. Building on the Armed Conflict Location and Event Dataset (ACLED), a public collection of political violence data for developing states, the article investigates structural connections of VEOs and the effect of borders on the spatial patterns of armed groups. Social network analysis reveals that the network involving VEOs had a low density, a low level of transitivity, and contained few central actors, three typical characteristics of negative-tie networks. Al Qaeda in the Islamic Maghreb (AQIM) is unquestionably the most connected VEO, which in purely network terms can be seen as a liability. Spatial analysis shows that, while violence was almost exclusively concentrated within Algeria between 1997 and 2004, cross-border movements intensified in the mid-2000s following the establishment of military bases by AQIM in Mali. As of late, VEOs have primarily concentrated their operations in Northern Mali as well as Southern Algeria, whereas Mauritania, Niger and Chad have been relatively unaffected. It follows that deterrence and containment strategies should be devised for regions rather than states. The findings have significant implications for multinational security and stability operations and the need to coordinate transnationally.

Keywords: violent extremist organizations, terrorism, borders, social networks, Africa, Sahel, Sahara

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1. Introduction

Violent Extremist Organizations (VEOs) and local militias thrive on the vacuum of power that afflicts many states in North Africa. The malaise has been exacerbated by the breakdown in governance that followed the Arab Spring's unrest and led terrorist groups and competing militias to expand their areas of operation (Zimmerman 2013). Decades of support for authoritarian rulers by external actors such as Russia and Iran, the monarchies of the Gulf, and the West, further hollowed out state and society throughout the region to such a degree that the state's monopoly of violence has been eroding. In Egypt, Libya, Algeria and Tunisia, a plethora of non-state actors now possess means of violence that used to be the sole purview of states. The most dangerous groups are composites of terrorist association and militia that instrumentalize a firebrand version of Islam to pursue an expansionist ideological project whose aim is to overcome conventional sovereignty states.

Further south, political and religious violence has been surging. Better known for episodes of drought and occasional acts of banditry, West Africa has progressively become a battleground for Islamists seeking to impose *sharia*, rebels seeking independence, transnational traffickers, and former colonial powers struggling to project their influence by bolstering the territorial integrity of states. At the peak of the Malian crisis in 2012, a temporary coalition of Tuareg rebels and VEOs affiliated with Al Qaeda controlled an area about the size of Texas. They were routed by the French-led Opération Serval in 2013. More recently, Boko Haram has been striving to establish a caliphate over a large part of the Northeastern Nigerian border region, killing thousands and forcing more than half a million civilians to flee their country (Zenn 2012, UNHCR 2015).

The conflicts in Mali and Nigeria exemplify the complexities of instability fuelled by rebellions, religious extremism, and transnational organized crime in the Trans-Saharan region. It also sheds light on the nature of Trans-Saharan conflicts that are characterized by shifting loyalties of individuals to combatant groups. Personal allegiances of commanders and rank-and-file fighters change as new opportunities arise, military personnel frequently join secessionist rebels, while rebels may occasionally join with VEOs, depending on local circumstances and tribal allegiances (Walther and Christopoulos 2013). As Boko Haram, Al Qaeda in the Islamic Maghreb (AQIM),

or the Polisario Front illustrate, cross-border mobility is another important part of military strategy (Zenn 2014). Islamist groups and rebels capitalize on marital, political, and financial ties throughout the region. As a result, they are not confined to one state. Instead, they move freely across sovereign state borders to attack targets, take hostages, and escape from security forces.

Against this background, the objective of this article is to study both the structural and spatial organization of violent extremism in the Trans-Saharan region. Building on the Armed Conflict Location and Event Dataset (ACLED), a comprehensive public collection of political violence data for developing states, the article investigates structural connections among VEOs. It uses social network analysis (SNA) to represent actors involved in violent events between 1997 and 2014 and analyze their structural position. Then it analyzes spatial patterns of violence across the Sahara and the role of state borders on the spatial patterns of armed groups. The article maps violent events in which 37 VEOs operating across the Sahara have been involved and specific spatial patterns that emerge from a chronological record of events.

SNA shows that violent events cluster regionally. Fatalities are concentrated in Nigeria, Northern Algeria, Northern Libya, and the Gulf of Guinea. With the exception of Northern Mali, the Sahel and the Sahara have been less affected by violence than the rest of the region. In many conflicts civilians have paid the highest price, especially in Nigeria and Algeria where civilians have been victims of VEOs, military forces, and various militias. Spatial analysis suggests that violent events involving VEOs have followed different patterns depending on the period under consideration: between 1997 and 2004 violence was almost exclusively concentrated within Algeria between, but cross-border movements have intensified since, following the establishment of military bases by AQIM in Mali. More recently, VEOs have concentrated their operations in Northern Mali as well as in Southern Algeria, leaving Mauritania, Niger and Chad relatively unscathed.

These spatial patterns of violent extremism suggest that deterrence and containment strategies need to be devised at the regional level rather than at the level of states. The findings have significant implications for collective security and stability operations and transnational coordination. On the one hand, existing institutions need to be reinforced. Yet, regional

institutions' ability to solve collective action problems is limited: other than the African Union (Morocco excepted) and the United Nations, many of the affected states do not belong to the same regional organizations. Moreover, these institutions objectives tend to be political and economic. Notably absent are transnational security organizations. Is it mere coincidence that violent transnational non-state actors are strongest and most problematic in a region that is largely devoid of collective security institutions?

2. VEOs, geography and borders

2.1. The geography of VEOs

Space is now widely recognized as a fundamental dimension of terrorists groups, which often conduct operations from a territorial base, leverage geographic havens, compete with sovereign states, and fight for control over aspirational homelands (Cutter et al. 2003, Flint 2003, Medina and Hepner 2008, 2013). As a result, an increasing number of scholars are examining social *and* spatial dimensions of terrorism. As Carley (2006: 3) argues: "If we look only at the social network then the focus of attention is on hierarchies, communication and other social relations. The addition of events and locations facilitates course of action analysis and enables linkage to various strategic planning tools". Social scientists have hitherto investigated spatio-temporal patterns of terrorist activities along several lines of inquiry: some have considered places and distance by locating terror attacks and violent events and their co-occurrence and projecting social ties on geographic space (Krebs 2002, Medina and Hepner 2008, Baghat and Medina 2013). This approach, which focusses on how proximity can influence the formation of social networks, helps us understand the way terrorist groups leverage resources such as social capital, infrastructure, or institutions, and how they communicate over vast distances (Sageman 2008). Other spatial features, such as territorial homogeneity (Dowd and Raleigh 2013) or contiguity (Flint et al. 2009, Medina and Hepner 2011), have been investigated to a lesser extent. Radil et al. (2010), for example, show that rivalry among urban gangs in Los Angeles produces distinct spatial patterns depending on whether the groups are close geographically or topologically. Spatializing social networks, the authors argue, gives better results than conventional spatial analysis that ignores social interactions or typical SNA that would not consider geography.

Such developments have been enabled by new algorithmic techniques for clustering and anomaly detection (Skillicorn 2009), dynamic network analysis (Breiger et al. 2003, Carley 2006, Gelernter and Carley 2015) and geographical information systems (Berrebi and Lakdawalla 2007, Guo et al. 2007, Medina and Hepner 2011, Gao et al. 2013, Hannigan et al. 2013). These new tools can now be applied to large databases, such as the University of Maryland Global Terrorism Database (GTD), the Worldwide Incidents Tracking System (WITS), Jane's Terrorism and Insurgency Center database (JTIC), or the Armed Conflict Location and Event Dataset (ACLED) used in this article.

Recent conceptual and technical developments related to the spatiality of social networks have primarily been applied to case studies located in the Middle East, Afghanistan and Pakistan, and Southeast Asia. By contrast, North and West Africa have received little attention from network science. The bulk of recent studies in the region focus predominantly on the historical development of terrorist groups (Gray and Stocham 2008, Emerson 2011, Cline 2013), on geopolitical challenges related to the rise of non-state actors (EU ISS 2014), and on counterterrorism measures (Larémont 2011, Lacher and Tull 2013, Sheehan and Porter 2014). In most of these studies, however, the social networks underlying political and religious movements and the spatial patterns of attacks are considered as two independent variables and are rarely analyzed in a formal way.

The recent evolution of such groups as Boko Haram and AQIM has, however, called this approach into question by showing that the geographical diffusion of VEOs in West Africa follows established social networks among radicals (Guidère 2011, Menner 2014). As Perliger and Pedahzur (2011: 46) showed in a slightly different context, "many of the social networks engaging in terrorism existed long before they became involved in terrorism activities". This rings true particularly when VEOs extend their activities across sovereign borders, due to the uncertainty of operating in a foreign environment (Lacher 2012). In other words, the spatial strategies of VEOs are constrained by their own prior investment in social ties (friends and kin, coreligionists, countrymen) and by the overall structure of the network that favors actors that are structurally central over more peripheral ones. Current mobility patterns do not simply imitate

the old rules that governed trans-Saharan mobility in the past; they are necessary to maintain an investment in a social network of hosts and exchange partners without which mobility across the region would not be possible (Retaillé and Walther 2013).

2.2. The effect of borders

Border regions are crucial for the development of terrorist groups (Flint 2003: 165, Medina and Hepner 2008: 154, Hudson 2003). The most obvious reason is that, in many regions of the world, borderlands amount to ungoverned spaces whence terrorist groups can attack distant targets and minimize the risks of reprisals (Migdal 2004, Korteweg and Ehrhardt 2006, Brafman Kittner 2007, Innes 2007, Gray and LaTour 2010, Campana and Ducol 2011). Sunni-dominated areas of the Syrian-Lebanon border, for example, are used as safe havens by Syrian opposition forces, whereas Shia-dominated areas are used by Hezbollah to launch attacks or enter Syria (U.S. Department of State 2014). Of the 59 terrorist groups designated by the U.S. Department of State in January 2014, 39 are thought to use a safe haven for their military operations (Arsenault and Bacon 2015). Our own research presented in Appendix 1 confirms that, for at least 26 terrorist groups, such safe havens span a border area. Interestingly, border sanctuaries used by political and religious groups are unevenly distributed and are mainly found in four regions of the world: (1) Pakistan-administered Kashmir, Pakistan's Federally Administered Tribal Areas, Pakistan's North Waziristan, Baluchistan, and Indian-administered Kashmir; (2) the Lebanon-Syria border, the Syria-Iraq borderlands, Southern Lebanon, and Kurdistan; (3) Colombia-Venezuela and Brazil-Paraguay-Argentina triangle; and (4) borders that straddle Algeria and Mali, Niger and Libya, and around the Lake Chad Basin, which are the primary focus of this article.

In North and West Africa, border sanctuaries are largely found in the Sahel and Sahara where territorial discontinuities between states encourage the development of cross-border warfare (Walther 2014). Long considered as artifacts of colonial power, borders impose transaction costs that open markets of opportunity for rebels and jihadists that exploit weak states and their lack of intraregional cooperation, making transnational terrorism harder to address than domestic terrorism (Sandler 2011). Instead of being organized into territorial units, rebels and VEOs co-operate along pre-existing marital, political, and financial networks with political allies and co-

religionists that inhabit the area (Wilkinson 2012). That leaves the impression that they are elusive (Walther and Retaillé 2010). In a sparsely populated region the size of the United States, holding territory has always been pointless. Instead of garrisoning territory, Trans-Saharan terrorist groups aim to control cities and lines of communication. A similar strategy is adopted by the Islamic State of Iraq and the Levant (ISIS), who controls of network of cities, roads, and military bases and oil resources across Syria and Iraq without forming a continuous territorial entity. Connected across both shores of the desert, these groups are governed by the fundamental principles of social flexibility and geographic mobility to fight an enemy that mainly relies on hierarchical structures and static armies.

3. Combining social network and spatial analysis

3.1. The Armed Conflict Location and Event Dataset

The analysis relies on data from the Armed Conflict Location and Event Dataset (ACLED), which provides a comprehensive list of political events by country from 1997 to 2014 (Raleigh and Dowd 2015, ACLED 2015a). The fifth version of the data was used to select 21 countries that were primordially concerned with violent activities in North and West Africa: Algeria, Benin, Burkina Faso, Cameroon, Chad, Gambia, Ghana, Guinea, Guinea Bissau, Ivory Coast, Liberia, Mauritania, Morocco, Libya, Niger, Nigeria, Mali, Sierra Leone, Senegal, Tunisia and Togo. Country data were compiled in a unique file and, because our analysis mainly focusses on political violence, only events coded as violent were selected. These include seven categories: Battle – no change of territory; Battle – Non-state actor overtakes territory; Battle – Government regains territory; Riots and protests; Violence against civilians; and Remote violence. Over the period under consideration, the dataset contains 23,533 violent events involving 1213 different actors.

Since we are looking to gauge the social and spatial organization of VEOs, we selected all violent events involving actors that were clearly identified as VEOs in the database, excluding non-identified Islamist militias and Libyan militias (see Appendix 1). This produced a list of 3014 events related to 37 groups totaling 25,872 fatalities from 1997 to 2014. Nine of these 37

groups showed significant activity across the Sahara and were particularly relevant to cross-border movement between North and West Africa: Al Qaeda, Ansar Dine, Al Qaeda in the Islamic Maghreb (AQIM), Armed Islamic Group (GIA), Al Mourabitoun, Free Salafist Group (GSL), Salafist Group for Preaching and Combat (GSPC), Movement for Unity and Jihad in West Africa (MUJAO), and Those Who Signed in Blood. These groups were responsible for 1513 violent events totaling 10,640 fatalities from 1997 to 2014.

3.2. Social networks: connecting the groups

Networks are the most important unit of analysis in understanding the formation and dynamics of terrorist organizations today. There has been a shift away from understanding terrorism only through the lens of individual or organizational analysis and instead study the social dynamics of networks as a whole (Perliger and Pedahzur 2011). Networks make it possible for terrorist groups to overcome the inherent problems of mobilization and communication between large numbers of people over distances. Social network analysis (SNA), therefore, is the study of the individual members, represented by the nodes of the network, and the relationships between these members, represented by the links. The pattern of exchanges between nodes over time is the bedrock of network analysis.

SNA has a proven track-record of analyzing and disrupting terrorist networks (e.g. Carley et al. 2003, Sageman 2004, Everton 2013, Duijn et al. 2014). This has not always been the case; traditionally, terrorist networks were believed to be hierarchical and centralized. This was based on a historical conception of terrorist groups as operating like hierarchical corporations (Stohl and Stohl 2007). This view has remained popular even in the recent "Global War On Terror" (Zimmerman 2013). SNA, however, seeks to understand networks by mapping out the ties between the various nodes in the group as they are rather than how they ought to be or are expected to be. This allows investigators to determine the structure and function of both the network as a whole, and the role of each person in the group in relation to others.

To study structural relations between actors involved in violent events we built a table – known as an adjacency matrix – in which the rows and columns contained the name of all the actors. An

entry in row *a* and column *b* represents a violent event between *Actor a* and *Actor b*. We counted the number of times the actors had been mutually involved in clashes and considered the number of fatalities as the entries of the matrix of relations. A zero indicates no tie and a negative value (-1) indicates an event without casualties. Note that because ACLED only reports the number of fatalities by event, it is not possible to assign a precise number of fatalities by group. Since ties between actors are reciprocal, the matrix is undirected and symmetric. The matrix can then be used to produce a graph or sociogram, which is a visual representation of the relationships between actors, and calculate several measures of centrality based on the structural position of each actor.

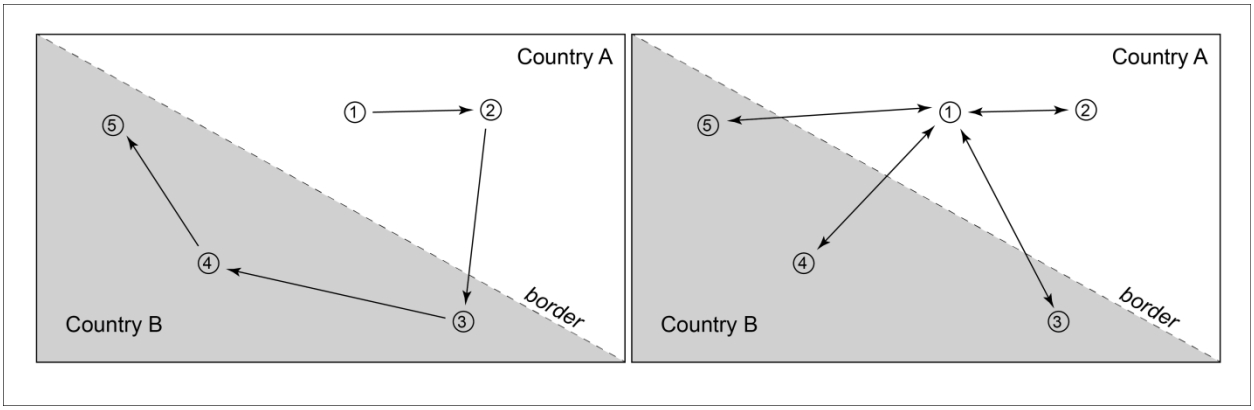
3.3. The spatiality of VEOs: connecting the dots

To understand the spatial strategies of VEOs in the region, we started by mapping violent events listed in the ACLED dataset using their geographical coordinates. In a region where non-state actors are notoriously mobile, locating violent events is, however, not entirely satisfactory because it does not reflect the ability of actors to move throughout states or mobilize personal and tribal networks to strike from a distance. In the absence of reliable data on the movement of VEOs, one of the challenges of our spatial analysis was to understand the spatiality of VEOs and the importance of sovereign borders based on immutable locations.

This was achieved by developing two scenarios. The first scenario ("mobility") assumes that violent events follow a linear chain of events, with VEOs moving from one location to the next, possibly across borders, without returning to their original location. This would reflect the strategy of a group under intense pressure from security forces, or, alternatively, of a VEO mastering the constraints of moving in an arid environment. The second scenario ("sanctuary") assumes that violent events are limited to a particular region whence VEOs operate across borders. This scenario supposes a territorial turf and a clear origin of flows, such as the Kabylie region in Algeria for the Salafist Group for Preaching and Combat or the Maiduguri region in Nigeria for Boko Haram. The difference between the two scenarios is explained in Figure 1, which presents six events for which the exact location (coded from 1 to 5) is known in two countries (A and B). On the left, groups constantly move from one location to another through

four movements, crossing the border on one occasion. On the right, violent events were located in different countries but followed a sanctuary pattern that lead groups to return to their point of origin. In the database, this would be reflected in a succession of events alternating across different countries.

Figure 1. Mobility and sanctuary scenarios



Source: Walther 2015

Once sorted chronologically, we verified whether two successive violent events were located in the same country (or not) and whether spatial patterns followed a "mobility" or a "sanctuary" scenario by looking at the location of events. The limitation of this approach is that if one group decides to operate exclusively across the border without ever clashing with another group in the same country, no violent event will be recorded and the sanctuary pattern will be impossible to detect using the ACLED database.

Instead of mapping the spatial patterns of each of the Trans-Saharan groups, we aggregate the events in which they were involved. The rationale is that trans-Saharan VEOs form several components of a single, flexible network, rather than independent entities. As reminded by Hagen (2014: 2), "AQIM overlaps with a number of nominally independent and 'locally-focused' groups, such as Ansar al Din and the Movement for Unity and Jihad in West Africa. These groups are part of the larger AQ family and cannot be separated from AQ and AQIM". Mergers, name changes and splits are common among them: for example, the Salafist Group for Preaching and Combat (GSPC) – a splinter group of the Armed Islamic Group (GIA) of Algeria – rebranded itself as Al Qaeda in the Islamic Maghreb (AQIM) in 2007. Some of its members

broke off in 2011 to form the Movement for Oneness and Jihad in West Africa (MUJAO) while others formed Al Moulathamoun (2012) and Al Mouakaoune Biddam (2012), a group under the command of Mokhtar Belmokhtar (Wojtanik 2015). In 2013, MUJAO merged with Al Moulathamoun to form Al Mourabitoun.

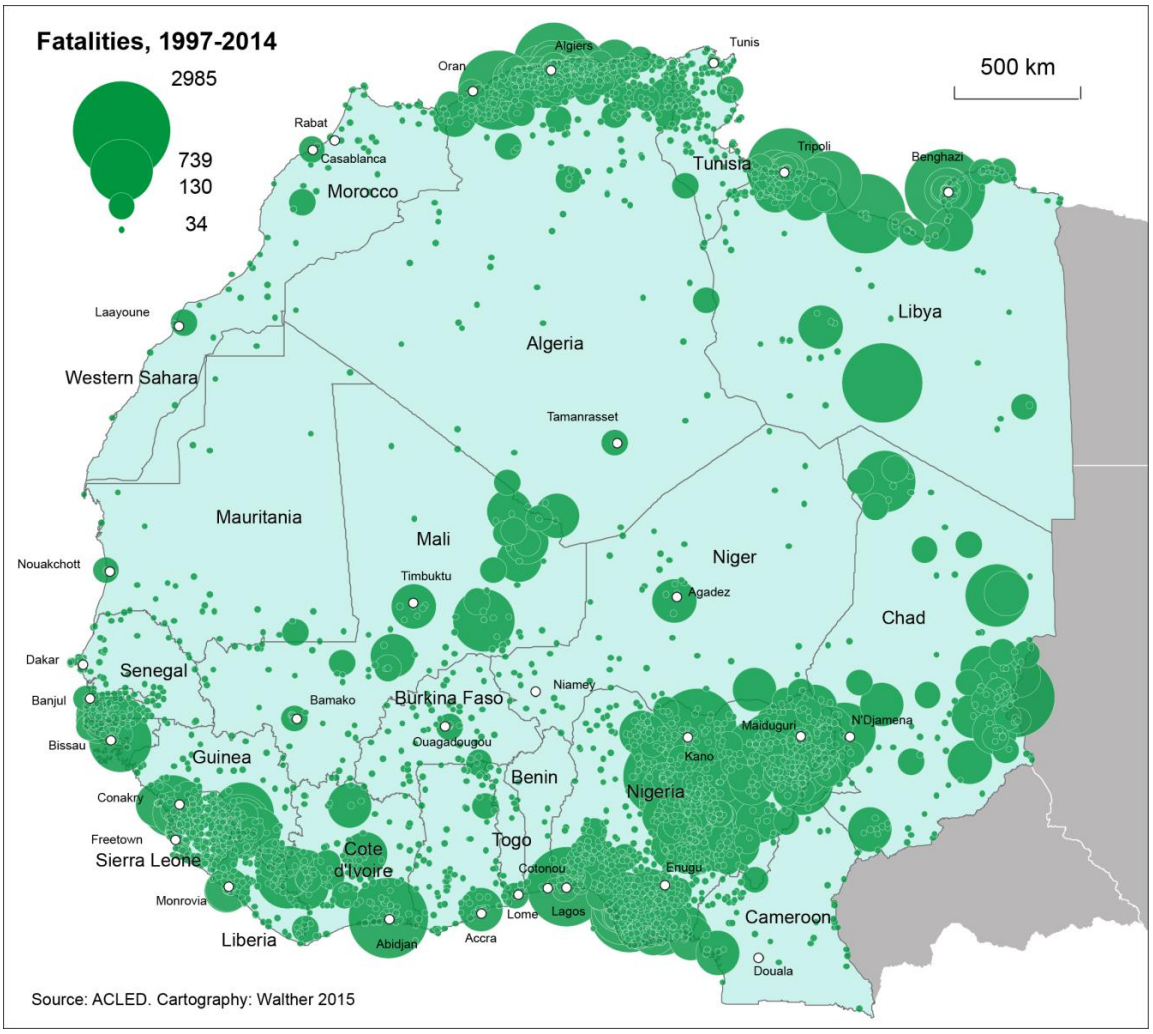
Those groups frequently exchange information, funding, hostages, and conduct joint operations (Walther and Retaillé 2015) as in the attack of the Malian garrison base of Aguelhok by AQIM and Ansar Dine in January 2012, or during the joint attack against the uranium mine of Arlit and the military base in Agades in May 2013 during which Al Moulathamoun and MUJAO killed 24 soldiers and two civilians. Intergroup cooperation is made possible by the fact that Trans-Saharan VEOs, such as MUJAO, Ansar Dine or Al Moulathamoun, are historically members of AQIM's leadership network (Hagen 2014). Certain leaders, such as Mokhtar Belmokhtar, Abdelmalek Droukdel, Iyad ag Ghali, Mohamed Labous, or Djamel Akkacha are well known for having developed multiple allegiances and solidarities between MUJAO, AQIM, Al Mourabitoun, Al Mouakaoune Biddam and Al Moulathamoun (United Nations 2015).

4. Structural and spatial analysis

4.1. The spatiotemporal evolution of violence in the region

The geographical distribution of violent events from 1997 to 2014 (Map 1) shows that violence is not widespread at the regional level. The main clusters of violence, by decreasing order of fatalities reported in the ACLED data, are principally located in Nigeria, Northern Algeria, Northern Libya, the Chad-Sudan border, and along the Gulf of Guinea. Nigeria is especially affected by violence in North and West Africa, with 38,816 fatalities, most of them resulting either from ethnic violence, fights for the control of oil production in the Niger Delta, or from attacks from Boko Haram, which strives to overthrow the Nigerian government and establish Islamic law. In West Africa, the border between Chad and Sudan remains a focus of conflict due to persistent fighting between the Sudanese government and rebels in neighboring Darfur. The portion of the Gulf of Guinea that extends from Abidjan to Banjul has suffered from a succession of civil wars in Côte d'Ivoire, Liberia, Sierra Leone, and Guinea-Bissau.

Map 1. Location of violent events and fatalities, 1997-2014



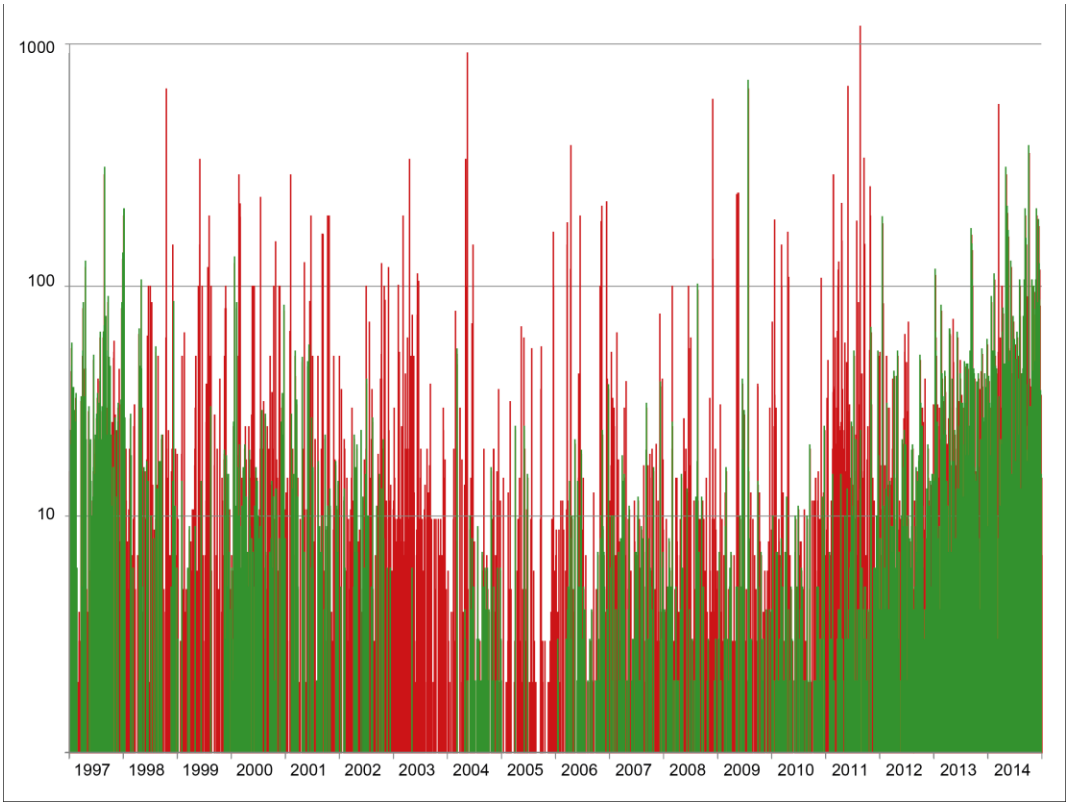
Source: ACLED. Cartography: Walther 2015

In North Africa, Algeria has also been markedly affected by violence, principally due to activity by three organizations in conflict with the Algerian government: GIA, GSPC, and AQMI. VEOs were involved in 89% of the 11,592 fatalities in Algeria. With 9,907 fatalities reported, Libya is the third epicenter of violence, principally because of the overall political instability that followed the ousting of Col. Gaddafi in 2011 and the subsequent civil war. In comparison, the Sahel and Sahara regions are less immediately affected by violence, with the notable exception of Northern Mali where secessionist rebels and VEOs have opposed the government since 2012. Nearly 1,000 of the 2,351 victims of violent events reported in Mali from 1997 to 2014 died in an event involving one or several VEOs, including AQMI, Ansar Dine, MUJAO and Al

Mourabitoun. In Mauritania and Niger, where VEOs have also been active, the number of victims resulting from clashes with VEOs is much lower, with 106 and 64 fatalities respectively.

Over the last 20 years, North and West Africa have experienced episodic violence. As shown in Figure 2, the total number of fatalities was particularly high during the 1990s, the "decade of despair" for Africa due to a rise in the number of conflicts on the continent which contrasted with the general decline observed elsewhere in the world at the end of the Cold War (Williams 2011, Themnér and Wallensteen 2014).

Figure 2. Fatalities related to all groups (in red) and VEOs (in green), 1997-2014



Source: ACLED. Calculations: Walther and Leuprecht 2015

Our data, which capture the last three years of the 1990s, highlight the high number of victims resulting from civil wars in Liberia (1989-1997 and 1999-2003), Sierra Leone (1991-2002), and Guinea-Bissau (1998-1999). The return of political stability to Sierra Leone and Liberia at the beginning of the 2000s coincides with the beginning of the first civil war in Côte d'Ivoire (2002-

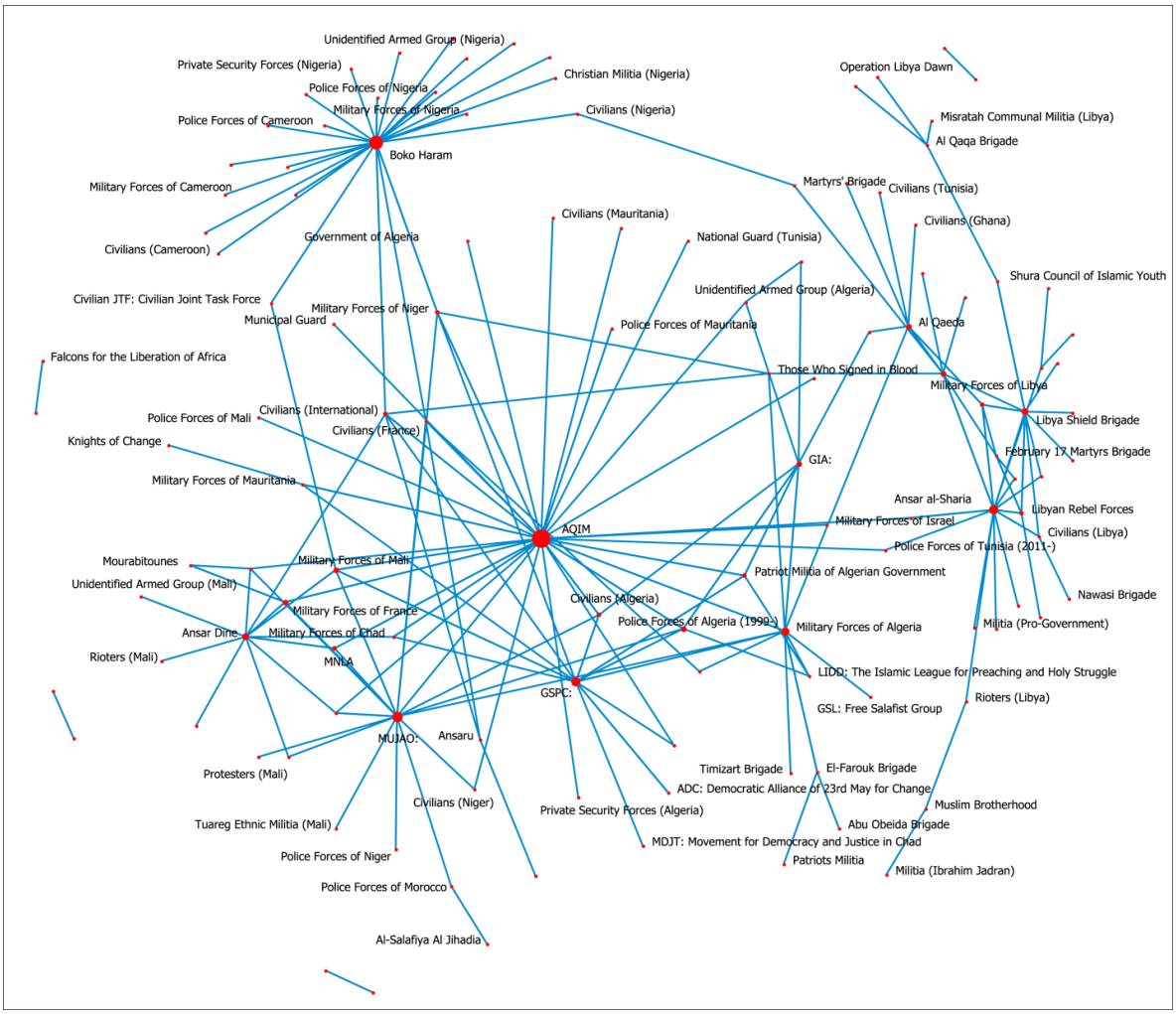
2007). From the mid-2000s onwards, the rise of VEOs, shown in green, is evident. Apart from the peak in fatalities in 2011 due to the second civil war in Côte d'Ivoire (2010-2012), the majority of the victims of recent conflicts are involved in clashes with VEOs, and their number is on the rise.

4.2. SNA of violence

The starting point of our network analysis is to represent actors using a graph where each of the actors is represented as a node connected to the actors with which that actor is in conflict. This representation is known as a sociogram because the distance between the actors is a function of the social distance of the actors and the fatalities between them. The size of the nodes is proportional to their number of ties. This measure of centrality, known as degree centrality, emphasizes the actors that are important by virtue of their overall number of connections. The social network connecting VEOs from 1997 to 2014 (Figure 4) is structured around three main clusters: (1) the Nigerian cluster polarized by Boko Haram; (2) the Trans-Saharan cluster composed of Al Qaeda-affiliated groups such as GSPC and AQIM and their victims; (3) the Libyan cluster composed of a myriad of Islamist brigades.

One of the most interesting features of the network involving VEOs is its low density. With 125 nodes and 175 ties, the density is only 0.011, which means that only 1.1% of potential ties are actually present in the network. The sparsity of ties is typical of networks containing exclusively negative ties because the number of enemies a group can have is often more limited than the potential number of its allies (Huitsig et al. 2012). Low density aside, the network also has a low level of transitivity, which means that two actors in conflict with a third actor are unlikely to be in conflict with each other (Everett and Borgatti 2014). The density of transitive triads is 0.012, which means that in only 1.2% of the triads (a group of three actors) enemies of enemies are in fact enemies: in most cases (98.8%), enemies of enemies are actually friends. This is especially true for VEOs opposed to government forces: if both AQIM and MUJAO are in conflict with the Algerian military, for example, their common cause makes it less likely for them to be adversaries.

Figure 3. Violent events involving VEOs, 1997-2014



Source: ACLED. Calculations by Walther and Leuprecht 2015 using ORA (Carley 2014). Isolates are not shown. The size of the nodes is proportional to the number of ties.

A third interesting aspect of the VEO network is that actors with adverse attributes tend to be in conflict with one other. The tendency to interact more with actors from a different group is known as heterophily (Csaba and Pál 2010), which is the opposite of homophily (van Mastrigt and Carrington 2014). The preference for heterophilous ties can be verified using the E/I index, which calculates the difference between external (E) and internal (I) ties for each group of actors, divided by the total number of ties. When the 125 actors involved in conflict are divided into six categories (government, rebels, militias, civilians, Islamists, and external forces), we find that the

E/I index is high, positive and statistically significant (0.899***). This confirms that VEOs tend to clash with actors that do not belong to their category. But with which ones exactly?

If we report who has been in conflict with whom over the last 20 years and calculate how many victims these confrontations have claimed (Table 1), we observe that the bloodiest conflicts have seen civilians in conflict with state and non-state actors.

Table 1. Bloodiest conflicts between actors, 1997-2014

Actor 1	**Actor 2**	**Fatalities**
Civilians (Nigeria)	Boko Haram	6409
Civilians (Algeria)	GIA Armed Islamic Group	6212
Boko Haram	Military forces of Nigeria	5447
Civilians (Nigeria)	Unidentified armed group (Nigeria)	3556
Civilians (Nigeria)	Fulani Ethnic Militia (Nigeria)	2446
Civilians (Nigeria)	Military forces of Nigeria	2382
NLA National Liberation Army (Libya)	Military forces of Libya	1740
Christian Militias (Nigeria)	Muslim militia (Nigeria)	1739
Civilians (Libya)	NATO forces	1367
AQIM	Military forces of Algeria	1074
Military forces of Cameroon	Boko Haram	1005

Source: ACLED. Calculations by Walther and Leuprecht 2015 using ORA (Carley 2014). Note: a conflict can result from several events. Only the conflicts resulting in the death of more than 1000 people are listed.

Boko Haram is by far the bloodiest armed group in the region, a situation that is a function of it having adopted a strategy of mass killings against both Nigerian civilians (6409 victims) and military forces (5447). In Nigeria, many civilian victims also resulted from conflicts with unidentified groups (3556 victims), Fulani militias (2446), and the military (2382). Clashes involving the Algerian GIA and Algerian civilians were particularly deadly in the late 1990s, with 6212 victims reported in the database. The campaigns of civilian massacres adopted by GIA explain why some of its former members, such as Hassan Hattab, broke from it to form GSPC in

1998. Finally, a number of deadly clashes have opposed the National Liberation Army to the Libyan Armed Forces during the Libyan civil war in 2011 (1740 victims)). More than 1350 victims are also reported as a consequence of NATO military intervention, mostly civilians. Generally speaking, these figures confirm earlier studies that showed that most of the victims of African conflicts were civilians who either died at the hands of state or non-state armed groups, or from the effects of displacement, malnutrition and disease (Williams 2011, ACLED 2015b).

Most VEOs involved in conflict in North-West Africa have several types of enemies. Drawing on Gould and Fernandez' (1989) typology which identifies several types of brokers based on their structural position, we test whether VEOs tend to be coordinators, consultants, gatekeepers/representatives, or liaison brokers. In a triad composed of a broker (A_b) and two other nodes, *coordinators* belong to the same group as the nodes they bridge (A--A_b--A). *Consultants* connect two nodes from a different group than their own (B--A_b--B). *Gatekeepers* and *representatives* connect a source or a recipient to a different group (A--A_b--B or B--A_b--A), while *liaison* brokers connect two nodes from different countries (B--A_b--C). Using the 7-type typology of actors previously discussed, we find that VEOs are both consultants and liaisons, which means that they are in conflict with two or more actors from the same category as well as with actors that belong to different categories. For example, AQIM is simultaneously in conflict with military forces from several governments in the region, civilians, the French military, and ethnic militias in Mali, Mauritania, Niger, and Algeria. The largest number of victims is related to clashes between VEOs and civilians (12,291 fatalities) and between VEOs and North and West African governments (11.283 fatalities). VEOs are also in conflict with militias (1,020 victims), rebels (594), and external forces (426).

At the actor level, we find that the network is composed of very few highly central VEOs (Table 2). In a negative-tie network such as this, being simultaneously in conflict with many others and consequently presenting a high degree centrality score is widely regarded as a liability rather than as an asset (Labianca and Brass 2006). Negative relationships adversely affect VEOs' outcomes in terms of military operations, reduce the ability of VEOs to coordinate their activities across the region, and limit their ability to cooperate to achieve their political or religious goals. Among VEOs, AQIM is unequivocally the most central actor, irrespective of the centrality

measures used. As can be seen in Table 2, which presents the ten most connected actors in the dataset, AQIM has the highest score in degree centrality and eigenvector centrality.

Degree centrality is a local measure that simply counts the number of ties each group has, whereas eigenvector is a global measure which also takes into account the respective centrality of other actors and indicates whether groups have ties to actors that are themselves in conflict with many other actors. Actors with high eigenvector centrality are well connected to the parts of the network that have the greatest degree of warfare. AQIM is simultaneously involved in many conflicts, and is tied to other actors that also have many enemies, such as the military and police forces of Algeria. MUJAO, GSPC and GIA also occupy a prominent structural position in terms of degree centrality due to their conflicts with civilians, and military and police forces of several African countries.

Table 2. Top-scoring nodes for selected centrality measures

Rank	**Degree centrality**	**Eigenvector centrality**
1	AQIM (0.264)	AQIM (0.743)
2	Boko Haram (0.200)	MUJAO (0.421)
3	MUJAO (0.136)	Military Forces of Algeria (0.289)
4	Ansar al-Sharia (0.120)	GSPC (0.257)
5	Ansar Dine (0.096)	Ansar Dine (0.229)
6	GSPC (0.096)	Military Forces of Niger (0.222)
7	Military Forces of Algeria (0.096)	Police Forces of Algeria (0.214)
8	Libya Shield Brigade (0.080)	Military Forces of Mali (0.213)
9	Military Forces of Libya (0.080)	Civilians (International) (0.204)
10	Al Qaeda (0.056)	Civilians (Algeria) (0.201)
Mean	0.024	0.071
Std. Dev.	0.035	0.095

Source: ACLED. Calculations by Walther and Leuprecht 2015 using ORA (Carley 2014). Scores are indicated between brackets.

Other prominent actors include Boko Haram, whose structural position as a central hub in a hub-and-spoke cluster of Nigerian actors explains why it is connected to many other actors who themselves have few connections to one other. As the group is in conflict with virtually everyone, Boko Haram has a high number of ties (or degree) and, therefore, a high degree centrality score. Paradoxically, Boko Haram seems to achieve its goal to establish Islamic law and seize territory in Northern Nigeria despite having virtually no allies, a situation comparable to that of ISIS in the Middle East, which opposes all governments and non-state actors – including Al Qaeda – in the region. Some Libyan actors score high (Ansar al-Sharia, Libya Shield Brigade) but one should note that the Libyan cluster represented here is a partial representation of the multitude of actors in play in this country, due to the fact that Libyan militias, which are particularly numerous in the Libyan conflict, are not represented.

4.4. The effect of borders

The literature presumes that borders matter because they circumscribe sovereign territories that generate transaction costs for those who cross. The fundamental questions, then, are whether borders matter to VEOs in the Trans-Saharan region and, if so, what are their effects and what transaction costs, countervailing or otherwise, they impose on the movement of VEOs. We are particularly interested in whether multinational UN or multinational military missions produce punctuated equilibriums that result in a surge in border coefficients by virtue of having a measurable effect on the transborder movement of VEOs.

To understand the spatiality of radical groups in the Sahel-Sahara better, we map violent events related to all Al Qaeda-affiliated groups over the last 10 years (2004-2014)[1]. Once the location of each event is known, we connect events chronologically through hypothetical lines and verify if the general spatial pattern of the attacks corresponds diachronically to one of the two scenarios described above: the 'mobility' scenario where groups move freely across borders, or the 'sanctuary' scenario where VEOs use a particular region as a rear base. Since the ACLED database contains information about the location of the events that are associated to them but not the movements of VEOs, we use dotted lines to indicate that the spatial patters based on the

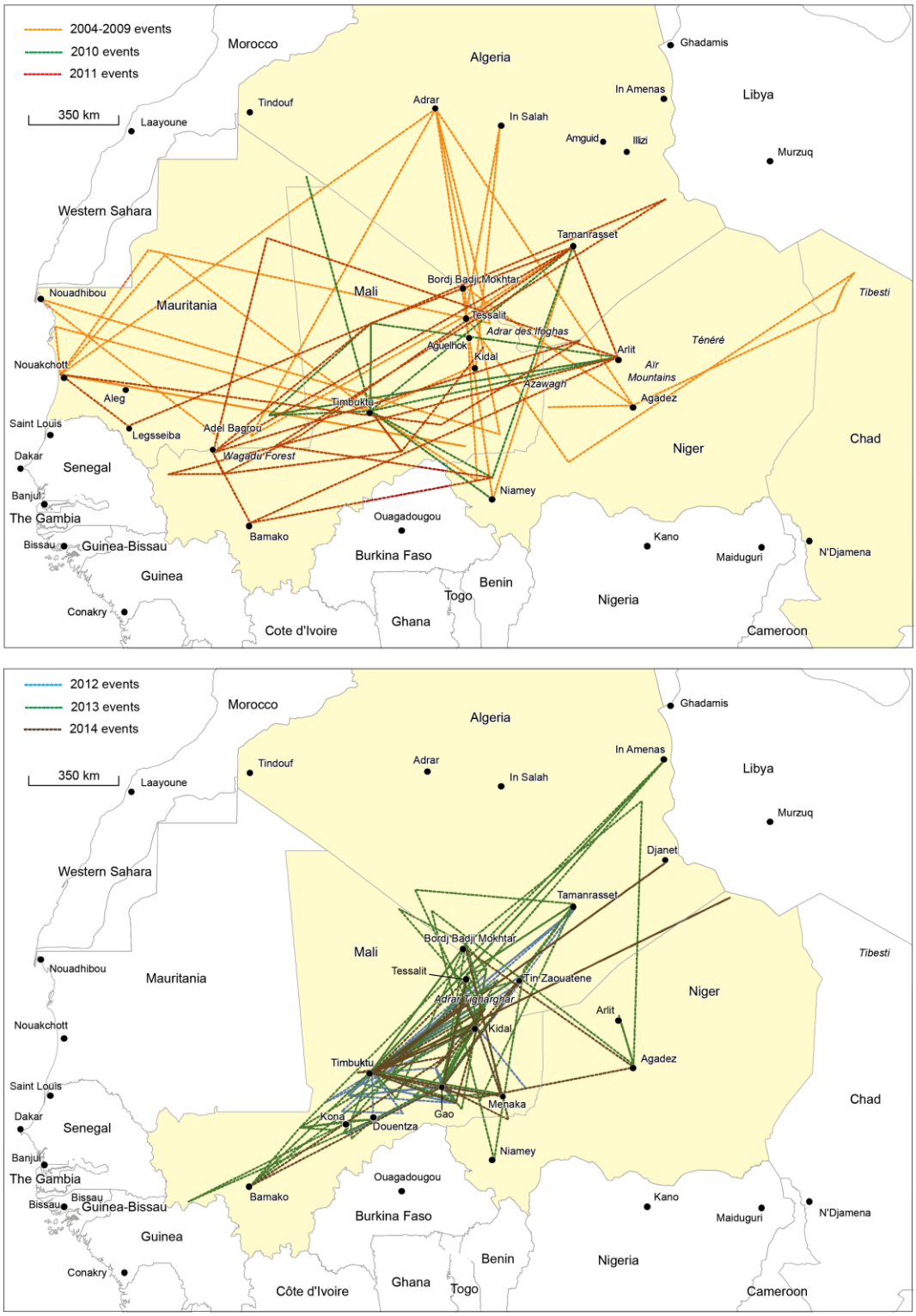
[1] From 1997 to 2004, most events related to the radical groups previously identified are located in Algeria.

location of violent events do not necessarily correspond to actual physical movements between places, but rather to a series of events that are related chronologically. Under no circumstances should our representation of spatial patterns be interpreted as a chronological reconstitution of actual physical movement across the Sahel-Sahara.

The analysis that follows reveals no evidence of a 'sanctuary' pattern in which VEOs make systematic use a particular (border) area as a rear base from which to conduct operations and escape military forces. Although the spatial movement of VEOs changed markedly between 1997 and 2014, it has always been characterized by a high level of transborder activity. Between 2004 and 2010, long-distance movements proliferated (Map 2). During this period VEOs travelled extensively across borders and, in many regions of Mali, Mauritania, Algeria and Niger, without much risk of being apprehended. Expelled from Algeria they were tolerated by the Malian government of President Amadou Toumani Touré's (2002-2012), which sought to capitalize on the divisions within Tuareg society and on a withdrawal of the state to administer the northern part of the country. Successive events repeatedly occurred hundreds or thousands of kilometers apart, in different countries, and without regularity, from Algeria to Mauritania, the Mauritanian-Malian border, and Niger.

One of the best known movements of this period is also the one that marked the beginning of the Saharan expansion of what would become Al Qaeda in the Islamic Maghreb. Between February 21 and April 11, 2003, 32 European tourists were kidnapped in the region between Illizi and Amguid in Algeria by Abderazak el-Para (born Amar Saïfi) and Abdelhamid Abu Zeid (born Mohamed Ghadir), two radical militants of GSPC. As Algerian security forces gave chase, the terrorists and hostages initially journeyed of over 3000 km to northern Mali. After having spent several months establishing alliances with leaders of local nomadic tribes, they moved to Niger through the plains of Azawagh, Aïr Mountains and the Ténéré desert, and ended up in the mountainous area of Tibesti in Chad where they were killed or captured, a second journey of over 2500 km through some of the most inhospitable environment on the planet (Walther and Retaillé 2010). Other long-distance moves have been documented since. For example, the Mauritanian terrorists who killed four tourists in Aleg in 2007 subsequently moved to Mali and Senegal before being captured in Mauritania in April 2008.

Map 2. Events connected chronologically, Trans-Saharan VEOs only, 2004-2014



Source: ACLED. Cartography: Walther 2015

A paradigm shift occurred in 2011. On the one hand, Mauritania and Algeria undertook a series of joint counter-terrorism operations aiming at AQMI's military bases. Such an attack took place in the Wagadu forest on the border between Mauritania and Mali in June. The central intelligence cell created to facilitate co-ordination between Saharan and Sahelian countries, known as the Combined Operational General Staff Committee (CEMOC), first met in Bamako in April 2011.

Despite these institutional initiatives, the level of regional cooperation remained low, because Mali was not trusted by its neighbors, which accused the government of Bamako of colluding with VEOs. Henceforth, Mauritania and Algeria would conduct military operations in Mali when they deemed their interests to be threatened by the activities of transnational groups. The chronological succession of attacks by AQMI in 2011 suggests a high intensity of cross-border movements. For example, AQMI claimed responsibility for a bomb attack in Bamako, the capital of Mali, on January 5, followed by a hostage taking in Niamey, Niger, three days later. These attacks are followed by a car bomb attack in the Mauritanian town of Adel Bagrou conducted by AQMI on February 1, the abduction of an Italian tourist in Djanet, Algeria, a day later, and the killing of a Mauritanian policeman by two members of AQMI in the region of Legsseiba near the north bank of the River Senegal on February 3.

The year 2012 contrasts sharply with the period 2004-2011 in many ways because most events transpired in Mali, and to a lesser extent in Algeria. Following the fall of Col. Muammar Gaddafi in Libya (2011) and President Amadou Toumani Touré (2012), a provisional alliance between Al Qaeda-affiliated groups and secessionists rebels of the National Movement for the Liberation of Azawad (MNLA) launched a wide-ranging military offensive against the Malian army. Over a matter of weeks, all the major cities of Northern Mali were seized, including Tessalit and Kidal in the Adrar des Ifoghas, where the offensive started, as well as Menaka, Timbuktu and Gao. The new groups MUJOA and Ansar Dine were particularly active during this period and started to clash with their former Tuareg allies over the cities of the north of the country and main lines of communication.

Similar spatial patterns can be observed in 2013 when the French-led Opération Serval progressively regained control of Northern Mali. As French and Chadian troops progressed north, VEOs loose Kona, Douentza, Gao, Timbuktu, and are chased out of their stronghold of the Adrar of the Ifoghas, a mountainous stronghold. The rebels of the MNLA seize Kidal and Tin Zaouaten from VEOs, and clash with AQIM and MUJAO. The Algerian army also clashes with VEOs fleeing Mali towards Libya. As in 2012, most events in 2013 took place in Mali and Algeria, along a south-west-north-east axis extending from Bamako in Mali to Tamanrasset in Algeria. The most brazen attack was launched in January 2013 against the gas facility of In Amenas in Algeria where MUJAO and Al Moulathamoun coordinated their activities, resulting in at least 67 deaths. A decade after being expelled from Algeria, Al Qaeda-affiliated groups were back in the country. Later in the year, a Nigerien military camp was hit by MUJAO in Agades in May, military barracks were attacked in Niamey in June by Those Who Sign in Blood, and two French journalists were killed by AQIM in Bamako in November 2013.

The spatial patterns of attacks in 2014 are similar: principally concentrated in Northern Mali and, to a lesser extent, in Southern Algeria, localized events resulted from the French offensive in the Tighaghar Mountains that killed many AQMI, MUJAO and Ansar Dine leaders, and from MNLA rebels clashing with MUJOA. Roadside bombs and suicide car bombings organized by Al Mourabitoun targeting the United Nations Multidimensional Integrated Stabilization Mission in Mali (MINUSMA) became more frequent.

5. Conclusion: Building regional security organizations

The aim of this article was to examine the structure and spatial patterns of violent extremist organizations (VEOs) in North-West Africa, a region characterized by growing political instability over the last 20 years. Building on publicly available data, we analyzed how actors in conflict were structurally connected and found that the network involving VEOs had a low density, a low level of transitivity, and contained few central actors. These characteristics are typical of negative-tie networks. In the region, AQIM is unequivocally the most connected VEO, both in terms of the overall number of actors with which the group is in conflict, and the respective centrality of AQIM's enemies. In other words, AQIM is connected to many other

groups that are themselves involved in many conflicts. In network terms, this is a liability because it reduces the number of potential alliances and opportunities for collaboration with other groups, denies access to resources and information for political campaigns and military operations, and, in general terms, reduces the structural autonomy of highly central actors. As might be expected from a network composed of negative ties, the network involving VEOs is extremely heterophilous, which means that VEOs tend to clash with actors with adverse attributes. This is particularly true for civilians and governments. Conflicts between VEOs and these two categories are orders of magnitude more deadly than conflicts between VEOs and militias, rebels, and external forces, such as the United Nations or foreign armies.

Our spatial analysis suggests that the spatial patterns of Trans-Saharan VEOs have undergone significant change over the last 10 years. Between 1997 and 2004, no significant cross-border movement can be observed. From the beginning of the expansion of VEOs in the Sahara from Algeria in 2004 to their military offensive against the Malian government in 2012, the spatial pattern of violent events observed in the Sahara suggests extensive freedom of movement. The location of violent events suggests a 'mobility' scenario in which VEOs move freely between Mauritania in the West and Chad in the East without necessarily using a particular (border) region as a safe haven. During this period, most Trans-Saharan groups are transient and mobile and their spatial patterns do not suggest control-based attacks launched from across the border of adjacent countries with a contagion effect (Medina and Hepner 2013). Between 2012 and 2014, however, violent events are mainly concentrated in Mali and Southern Algeria

Our results have policy implications related to the governments and external forces involved in deterring VEOs in the Trans-Saharan region. First, because VEOs are socially and spatially connected across the region, there is a need for collective security institutions that can help countries coordinate, build trust, and go beyond ad hoc engagements. Differences make a regional military alliance highly improbable. Nonetheless, building institutional capacity around something akin to an Organization for Security and Cooperation in the Trans-Sahel region and West Africa, possibly but not necessarily under the aegis of the African Union, is likely to pay off. Precedent suggests that states outside the region will always play a supporting rather than a lead role. In addition to supporting UN capacity-building efforts already underway, Western

governments should be prepared to mount a comprehensive Whole-of-Government effort in support of local authorities that will minimize local footprint while optimizing outcomes.

Second, the findings suggest that the social and spatial mobility of VEOs is one of their major strengths. Similar to the Arab revolt of the 20th century during which "a highly mobile, highly equipped type of army, of the smallest size" defeated the immobile and defensive Ottoman Turkish army, military operations of Trans-Saharan VEOs are "more like naval warfare than ordinary land operations, in their mobility, their ubiquity, their independence of bases and communications, their lack of ground features, of fixed directions, of fixed points" (Lawrence 1920: 14). This makes it particularly difficult for intelligence agencies to predict their movements, detect threats and anticipate attacks. The fluidity of personal allegiances and mobility of actors across borders in the region calls for mobile and flexible military responses, such as the French-led Opération Serval. Projecting the general patterns of violence in the region and anticipating the next move of Trans-Saharan groups, irrespective of the identity of the perpetrators, can only be achieved if the social and the spatial are considered as complementary dimensions of radical violence: crossing borders and crossing social boundaries are two sides of the same coin.

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Appendix 1. Violent extremist organizations (VEOs), 1997-2014

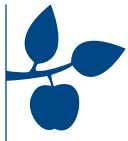
Abu Obeida Brigade, Abu Salim Martyrs' Brigade, Al Qaeda, Al Qaqa Brigade, Al-Burayqah Martyr's Brigade, Al-Salafiya Al Jihadia, Ansar al-Sharia, Ansar Dine, Ansaru, AQIM: Al Qaeda in the Islamic Maghreb, Boko Haram, Brega Martyrs Brigade, El-Farouk Brigade, Falcons for the Liberation of Africa, February 17 Martyrs Brigade, Fighters of The Martyrs Brigade, FIS: Islamic Salvation Front, GIA: Armed Islamic Group, GMA: Mourabitounes Group of Azawad, GSL: Free Salafist Group, GSPC: Salafist Group for Call and Combat, Islamic Emirate of Barqa, Islamic State of Tripoli, Knights of Change, Libya Shield Brigade, LIDD: The Islamic League for Preaching and Holy Struggle, Martyrs' Brigade, MUJAO: Movement for Unity and Jihad in West Africa, Muslim Brotherhood, Nawasi Brigade, Nusur al-Sahel Brigade, Rafallah Sehati Brigade, Soldiers of the Caliphate in Algeria, Those Who Signed in Blood, Timizart Brigade.

Appendix 2. Foreign terrorist organizations, safe havens and border sanctuaries, January 2014

Designated	Name	Main areas of operation	Border sanctuary
10/8/1997	Palestine Liberation Front (PLF)	Gaza, West Bank, Israel, Lebanon	Lebanon (?)
10/8/1997	Palestinian Islamic Jihad (PIJ)	Gaza (West Bank, Israel, Syria, Lebanon)	Lebanon (?)
10/8/1997	National Liberation Army (ELN)	Colombia-Venezuela	Colombia-Venezuela borderlands
10/8/1997	Basque Fatherland and Liberty (ETA)	Spain, France	France
10/8/1997	Liberation Tigers of Tamil Eelam (LTTE)	Sri Lanka, India	India-Sri Lanka
10/8/1997	PFLP-General Command (PFLP-GC)	Syria, Lebanon, Gaza	Lebanon-Syria border
10/8/1997	Harakat ul-Mujahidin (HUM)	Afghanistan, Pakistan	Pakistan-administered Kashmir
10/8/1997	Hamas	Gaza, West Bank, Israel, Lebanon	Southern Lebanon
10/8/1997	Hizballah	Lebanon and global	Southern Lebanon
10/8/1997	Kurdistan Workers Party (PKK) (Kongra-Gel)	Turkey, Iraq, Europe	Turkish-Iraqi Kurdistan
10/8/1999	al-Qa'ida (AQ)	Afghanistan, Pakistan, Iraq, Syria, Yemen, Sahara, Sahel, Somalia and worldwide	FATA, Brazil-Paraguay-Argentina trinational region, Sahara-Sahel
9/25/2000	Islamic Movement of Uzbekistan (IMU)	Afghanistan, Pakistan, Tajikistan	Pakistan's North Waziristan
12/26/2001	Jaish-e-Mohammed (JEM)	Afghanistan, Pakistan, India	Indian-administered Kashmir
12/26/2001	Lashkar-e Tayyiba (LeT)	Afghanistan, Pakistan, India	Pakistan-administered Kashmir
3/27/2002	al-Qaida in the Islamic Maghreb (AQIM)	Algeria, Mali, Niger, Mauritania	Algeria-Mali, Niger-Libya borderlands
1/30/2003	Lashkar i Jhangvi (LJ)	Afghanistan, Pakistan	FATA
12/17/2004	Islamic State of Iraq and the Levant	Iraq, Syria, Jordan	Syria-Iraq borderlands
6/17/2005	Islamic Jihad Union (IJU)	Afghanistan, Pakistan, Central Asia (Uzbekistan, Kyrgyzstan)	FATA
9/1/2010	Tehrik-e Taliban Pakistan (TTP)	Afghanistan, Pakistan	FATA

11/4/2010	Jundallah	Iran, Afghanistan, Pakistan	Baluchistan, Iran-Afghanistan-Pakistan
5/30/2012	Abdallah Azzam Brigades (AAB)	Lebanon, Arabian Peninsula	Southern Lebanon
9/19/2012	Haqqani Network (HQN)	Afghanistan, Pakistan	Pakistan's North Waziristan
3/22/2013	Ansar al-Dine (AAD)	Mali, Libya	Algeria-Mali, Libya-Niger borderlands
11/14/2013	Ansaru	Nigeria	Lake Chad Basin
11/14/2013	Boko Haram	Nigeria, Chad, Cameroun, Niger	Lake Chad Basin
12/19/2013	al-Mulathamun Battalion	Algeria, Libya, Mali, Niger	Algeria-Mali, Libya-Niger borderlands

Sources: U.S. Department of State, Arsenault and Bacon (2015). Border sanctuaries identified by Walther and Leuprecht (2015).



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