The Spatiotemporal Forming of a State of Exception: Repurposing Hot-Spot Analysis to Map Bare-Life in Southern Arizona’s Borderlands

Abstract
Through the use of Hot-Spot analysis, typically reserved for local analysis of crime and law enforcement, I document the dispersal and clustering of migrant mortalities on a temporal scale in the Ajo valley of Southern Arizona in the U.S.-Mexico borderlands. The study maps the influence of border enforcement by time and documents the forming of a state of exception, by finding whether and where migrants had taken other more-remote routes in relation to the constructing of and policing by a Border Patrol checkpoint. The spatiotemporal nature of ‘Hot’ and ‘Cold-Spots’ plus an analysis of migrant mortality locations before and after the establishment of a checkpoint serves as a novel approach to spatial analysis in border studies. It creates a type of remote forensics for verifying the ‘funnel effect’ and the condition of Bare Life it produces where law has taken migrant’s political power and left them with their biological existence (Agamben, 1998). I show a widening of the state and a receding of the migrant into a rugged and remote isolation. Until now, the defining of the borderlands as a State of Exception (Doty, 2007) has been theoretical and qualitative. This paper doesn’t retract from that but rather adds quantitative data and interpretation to theory, making it a needed clarification of biopolitics in a time of growing use of militarization at the U.S.-Mexico border and worldwide.

Background
Hot-Spot Analysis
Until now, Hot-Spot analysis has mostly been used for the purposes of criminology and law enforcement (Levine, 2004, Eck, et al. 2005, Wortley and Townsley, 2016), mapping traffic dangers (Erdoğan et al., 2008; Prasannakumar et al. 2011) and spatial epidemiology (Liu et al., 2012; Thanh Toan et al., 2013), documenting where ‘crime’ is most common by records of enforcement and where disease risk is most prominent by medical reports. The use of Hot-Spots in crime mapping has received critique for it not accounting for bias and reinforcement of ‘broken windows policing’ and racism (Howell, 2009, Kindynis, 2014) in places known for their exclusion and control by the state (Herbert, 2008). In the case of border enforcement, law enforcement officers have been known to collaborate with other law enforcement agencies in data-sharing and analysis (Atabakhsh et al. 2004). The RAND Corporation has also advised CBP and the Border Patrol on how best to use Hot-Spot analysis in intercepting and incarcerating undocumented migrants (Keefe and Sullivan, 2011). In fact, a NASA funded research project advised the Border Patrol to use a combination of high-resolution remote sensing and Hot-Spot analysis in order to identify routes taken in the borderlands (Cao et al., 2007). Unlike kernel density (Soto and Martínez, 2018; Rossmo et al., 2008; Giordano and Spradley, 2017), Hot-Spot analysis relies less on predictive measures but on the statistically significant and known spatial relationships, excluding outliers (Getis and Ord, 1992). The National Institute of Justice described a Hot-Spot in criminology terms as “an area where people have a higher than average risk of victimization” (Eck, et al., 2005). In the case of the state, such reasoning may lead law-enforcement to a biased map of where they suspect violence (Wortley and Mazerolle, 2008) but I argue it can be ‘flipped’ and demonstrate that it can also reveal bias, showing the effects of enforcement by the othering that is made through a State of Exception, “the physical elimination…of entire categories of citizens who for some reason cannot be integrated into the political system” (Agamben, 2005, p. 2). In this case, it is the migrant, defined as a non-citizen by the state and...
excluded from the political rights of society and citizenship. I argue that the Hot-Spots map this “physical elimination.”

State of exception in Border ‘Deterrence’

With the reorganizing of border enforcement in the late 20th century, undocumented migrants have gone from a given to an exception. Where there was once a circular labor migration across the U.S.-Mexico border, there now is a militarized apparatus (Dunn, 1996; Falcon, 2001; Coleman, 2005; Miller, 2014; Jones, 2016; Slack et al., 2016) which funnels undocumented migrants into rugged remote territories (Rubio-Goldsmith et al., 2006). This moving of routes into remote areas first became noticeable after President Bill Clinton’s Operation Gatekeeper which sought to control illegal border crossings through a local border militarization in Southern California (Nevins, 2001). Scholars have argued that the attempts to control movement was in response to NAFTA, the likely crash of the Mexican agriculture economy (Nevins, 2001; Massey, 2002), i.e., the state’s desire to control reserve labor (Marx, 1867). Even government officials had suggested increased migration as a likely effect of the trade agreement before implementation (Stern, 1993). In combination, were the continued migration of Central American refugees resulting from the aftermaths of 1980s Reagan-era warring, like those of today fleeing violence after Clinton’s deportation of powerful gang members to the same Central American nations (Hing, 2018) and the U.S. sponsored coup in Honduras (Hamlin, 2012). While in hindsight, the infrastructures of Operation Gatekeeper and the beginnings of ‘Prevention Through Deterrence’ showed an intensification of excepting migrants, this ‘funnel effect’ has been most apparent with growth in its strategy post 9/11 with a ‘hardening’ border, through the expansion of traffic-stops, surveillance, walls, and a growing number of agents (De Genova, 2009; Miller and Nevins, 2017), effectively creating spaces of exception (Dejanovic, 2004). With the Real ID Act of 2005, the Department of Homeland Security could otherize through these policies and places (Garrett, 2010), making the migrant not only marginalized but, in theory, neutralized. The act served as a way to better control citizenship with a portrayal of social’s ills a result of immigration, whether it was safety from terrorism or economic hardship (Pope & Garrett, 2012). The George W. Bush administration had constructed policy with which the exclusion of belonging and lack of rights without the proper ID exemplified Agamben’s theory of Bare Life (1998). With the US in a state of constant emergency (Kaplan, 2003), the state could better define and divide based on “illegality” (De Genova, 2005).

Although officially established for the stopping and searching of vehicles (GAO, 2009), the presence of Border Patrol interior checkpoints is known to reroute migrants in some form. A shift in migrant routes was documented after the establishment of a checkpoint on Interstate-19 south of Tucson in the 2000s which moved migrants into more remote areas to the west on the Tohono O’odham reservation (Martínez et al., 2014). The implementation of the Secure Border Initiative in the 2000s has also shown a significant correlation into terrain with more physiological costs on the perimeters of the Altar Valley in Arizona (Chambers, et al., 2019), a kind of local funnel effect. Central American migrants began to die in large numbers in south Texas as avoiding a checkpoint lead them into “the desolate ranches and labyrinths of mesquite brush that parallel the highway” (Miroff 2013). With the checkpoints’ clustering of agents, and their surveillance and sensory technologies, migrants move further and further away, i.e. the funnel effect (Rubio-Goldsmith, et al., 2006). A spatial analysis of migrant deaths in Pima County, Arizona and Brooks County, Texas has documented a shift in local and regional routes (Soto and Martínez, 2018) as if the Border Patrol slowly chased the excluded past the “vanishing point” created by an axis of checkpoints and
enforcers (Jusionyte, 2018, p. 51) and into Bare Life, a “negative territory” of both space and life (Acosta, 2012). Migrants are forced into places where they yield little power besides the attempts to survive and hopefully finish their journeys, physically removed by those with power. Much has been done to document this biopolitical phenomenon in concept (Amore, 2006; Doty, 2011; Dines et al., 2015) and history (Sundberg 2015; Boyce, 2016), but little in the manner of mapping it out as a local/micro-spatial condition. Soto and Martinez (2018) and Chambers (et al., 2019) documented local and regional shifts and increasing remoteness in routes but also noted the need for identifying causal mechanisms. Doty (2011) had pointed out that the US border enforcement worked more like a management of local space by authority. Like Foucalt’s security apparatus, it allows for events to happen rather than be implemented by direct authority (2009, p.45). I seek to show the materialization of the funnel effect and state of exception by a mapped and documented example through a spatial analysis of migrant mortalities, providing statistics to theory.

Methods
To map the influence of border enforcement by time and document the forming of a state of exception, I sought to find whether and where migrants had taken other more-remote routes in relation to the presence of agents in an area, i.e. the checkpoint on Arizona State Route 85 running north-south from the Mexico border to Ajo, Arizona. Such remoteness could demonstrate an excluding of the people crossing. I chose the Ajo corridor because of 1) its defined location of a single form of enforcement and 2) its emphasis as an area of concern by a humanitarian group (No More Deaths, 2017). There are obviously other factors such as surveillance technology (Chambers, et al., 2019) and patrolling near the border but my analysis can show any patterns around the checkpoint which is placed well outside the range (Boyce, 2016) of the SBInet tower locations (U.S. Customs & Border Protection, 2019) to its south and west. Apprehensions in the Ajo area have increased in recent years, particularly by families and children (U.S. Customs & Border Protection, 2018), but counts specific to the corridor were not available. Apprehensions are recorded by sector and although Ajo is in the Tucson Sector, the corridor is only 25 kilometers from the Yuma Sector, making it difficult to statistically ‘untangle.’ There is also the issue of the number of recovered remains having a possible bias for the areas nearer the road because of the ease of other parties reaching this area. Still, this study focuses on location. Being an analysis of the spatial influence of the checkpoint does make it suitable to infer and extrapolate to other areas for additional more complex analyses. To test the theory, I needed to determine if spatial patterns of migrant locations, in this case recorded mortalities, clustered in different regions from year to year, especially before and after establishing the checkpoint. In other words, I had to use a statistical analysis of both time and space of the mortalities as they related to themselves in clusters and compare to the location of the checkpoint. Mortality data was provided by the Organization Humane Borders and the Pima County Office of Medical Examiner (Arizona OpenGIS for Deceased Migrants, 2018), and were used as a stand-in for migrant locations overall because the locations of human remains typically show the same pattern of general routes of travel (Chamblee, et al., 2006). In order to identify the spatial clusters of migrant mortalities in relation to time, I calculated the Getis-Ord Gi* statistic, better known as Hot-Spot analysis (Getis and Ord 1992) in order to show where in the landscape mortalities were clustered and where there were common locations for migrants’ remains to be found. The clusters served as a verification of where migrant commonly traveled. The method returned z-scores, which showed whether neighboring mortality locations were significantly correlated by the year the bodies were found, as calculated by
\[ G_i^* = \frac{\Sigma_{j=1}^{n} w_{ij} x_j - \bar{X} \Sigma_{j=1}^{n} w_{ij}}{S \sqrt{\left[ \Sigma_{j=1}^{n} n_j^2 - (\Sigma_{j=1}^{n} w_{ij})^2 \right]}} \]

with \( \bar{X} = \frac{\Sigma_{j=1}^{n} x_j}{n} \)

and \( S = \sqrt{\frac{\Sigma_{j=1}^{n} x_j^2}{n} - (\bar{X})^2} \)

where \( x_j \) was the recorded year of mortality, \( j \) was the location of the mortality, \( w_{ij} \) was a measure of significance based on the distance between mortalities, and \( n \) was the number of mortalities.

The Getis-Ord \( G^* \) methodology maps each location as a ‘Cold’ or ‘Hot-Spot’ or whether it was statistically significant by levels of confidence, 90%, 95%, and 99%. The Spots in the case of this study represent clusters of mortalities from 2001 to the beginning of my analysis in September 2018. Hot-Spots represent more recent clusters and Cold, earlier. There is a chance of error as dates of death are uncertain, especially in the case of skeletal remains, but skeletal exposure is typically within 4 to 6 months and the breaking-down of the bones in 9 months (Galloway et al., 1989). The decay timing gives a justifiable assumption to substitute year found for year of death, especially in the case of clustering in certain areas.

It is also certain that there are uncounted deaths (Eschbach et al., 1999; Ortega, 2018) but my analysis would not be dependent on the uncounted as I only need to compare if there is difference from near the checkpoint and away from it, not whether there were unknown clusters in even more remote terrain.

In order to determine how far these clusters were from the checkpoint over time and whether this was especially the case post-2005, when the checkpoint was established (USGAO, 2005), I conducted two Analyses of Variance (ANOVA) tests: 1) Comparing groups of Hot and Cold-Spots by distance from Border Patrol checkpoint, to verify if the more recent mortalities were further from the checkpoint location, i.e., migrants shifted routes after the checkpoint was established, and 2) Comparing the 73 documented mortality locations before and 143 documented after the establishment of the checkpoint in 2005 by distances from checkpoint, so as to verify if this shift away from the area related to the checkpoint itself. These comparisons would show in what terrain migrants were found before and after the checkpoint and how separated these locations were from the societial spaces of roads and communities. In essence, the Hot-Spots could show whether migrants were in spaces of exception where a life would be more dependent on simple survival.

**Results**

Both ANOVA results (Tables 1 and 2) show very significant differences between the mean values with higher distance values for more recent mortality locations, especially after the establishment of the checkpoint. This means that mortalities have shifted away from the Border Patrol presence into new clusters. Migrants appear to be taking more remote routes in order to avoid interception. The tests of between groups of Hot and Cold-Spots by distance from Border Patrol checkpoint show, as seen in Figure 1, that the locations of more recent mortalities are typically further away from the checkpoint while in the past, mortalities were nearer the roads that now have a checkpoint. Figure 2 shows how the estimated
time of mortality is related to the establishing of the checkpoint. Means and ranges are far more distant in more recent times, especially after the establishment of the checkpoint. Distances shifted after the checkpoint was established, suggesting that not only were migrant routes shifting over time but a conscious decision was made to avoid the known presence of Border Patrol agents.

<table>
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<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
<th>F crit</th>
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<tr>
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<td>46859</td>
<td>132</td>
<td></td>
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Table 1: Analysis of Variance between groups of Hot and Cold-Spots by distance from Border Patrol checkpoint

<table>
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<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
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<td>Within Groups</td>
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<tr>
<td>Total</td>
<td>46859</td>
<td>132</td>
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Table 2: Analysis of Variance between pre- and post-2005 distances from Border Patrol checkpoint

Figure 1: Box and whisker plot comparing groups of Hot and Cold-Spots by distance from Border Patrol checkpoint. From left to right: (1) Cold-Spot - 99% Confidence, (2) Cold-Spot - 95% Confidence, (3) Cold-Spot - 90% Confidence, (4) Hot Spot - 90% Confidence, (5) Hot-Spot - 95% Confidence, and (5) Hot-Spot - 99% Confidence

Figure 2: Box and whisker plot comparing distance from checkpoint by pre- (left) and post-2005 (right) mortalities

A map of these Hot and Cold-Spots, Figure 3, shows the mortalities as points in recognizable clusters from earlier recorded locations to more-recent locations. Mapping by the establishment of the checkpoint, Figure 4 also shows a tendency of migrants to travel to the roads, in order to receive transportation into communities (Lawrence and Widgen, 2012), rather than the remote areas before 2005.

Figure 3: Hot and Cold-Spots showing more recent and earlier mortalities in the Ajo valley
In order to clarify that these remote regions were places a migrant would find more need to simply survive, I inspected the locations of these Hot-Spots and what such terrain would mean for their physiological condition. Results are consistent with the effects of enforced borders (Rubio-Goldsmith et al., 2006; Rietveld, 2012; Martinez, et al., 2013) but also give detail to a local scale. The most southern and recent mortalities stretch from the edges of farmland at the border in the Sonoyta Valley, across canyons and washes to the Ajo Mountain Range. The most prominent points lie within the mouths and passes of canyons at the base of the mountains, avoiding wider valleys and major roads, likely in attempt to avoid detection (Dejanovic, 2004; Chávez, 2011) and possibly evidence of the influence of not only the checkpoint but also SBInet surveillance and general patrolling of roads. It is unlikely that the impact is strictly of large surveillance as the Cold- and Hot-Spot contradictions moved specifically away from the checkpoint towards the range of SBInet towers and yet also in more ‘hidden’ locations. This ‘hiding’ suggests a compounding variables that will need further study. Similar terrain is found in the hotspots of the North where migrants were in the Souceda and Sand Tank Mountains, near but before reaching Interstate Highway 8 after trying to reach past the checkpoint. When migrants are pushed into more remote areas that it is more costly in energy expenditure (Chambers, et al., 2019) and risking an extreme state of exhaustion and mortality (Chamblee, et al., 2006; Rubio-Goldsmith, 2006). The Hot and Cold-Spots between areas demonstrate the separation over time as migrants were diverted away from the checkpoint. As time passed, a prominent division formed between new and old routes where the more-recent migrants have been in more rugged terrain and further from the checkpoint, highways, and the town of Why, Arizona as shown in the Figures. Migrants found themselves at the base of the steep Growler Mountains, pushed up against a ‘wall’ of rock in order to avoid the Border Patrol, as shown in the difference in terrain between Hot- and Cold-Spots in Figure 5.

Discussion and Conclusion

Agamben described life in the terms of bios, how a person lives, and zoē, biological existence and survival (1998). He theorized that the state controls this bios, i.e., Bare Life. In the case of concentration camps, a threshold was met where life was structured in a space for the state to fully control and make Bare Life people’s state of existence, separated from a life of ‘living.’ In that instance, this was conceived and operated in a pseudo-science by race (Giaccaria and Minca, 2011). Sofsky (1999) emphasized how the forcing of Bare Life was dependent on both isolation and limiting of spaces, which has been suggested as an aspect of migrant detention centers (Mountz, et al., 2013) and refugee camps (Rajaram and Grundy-Warr, 2004; Chambers, et al., 2018) and hinted at for the Sonoran desert (Dejanovic, 2004; Chamblee, et al., 2006: 23) but this study shows a defined space where migrants are excluded by the state. In the case of the rugged terrain of the Sonoran Desert, migrants are separated from society by their state-defined citizenship, overwhelmingly connected to race, place of origin and social class (Rodriguez, 1996; Romero, 2008; Doty, 2011; Jones, 2016). In order to control “reserve labor” (Marx, 1867) and the composition of race in a colonial state (Sundberg, 2015), the checkpoint can functions as a both a “material construct” (Davis, 2016, p. 108) and a mechanism of carcerality without built enclosure. Border Patrol restricts the accessible space of migrants by forcing them into remote, less-easily traversable spots.
(Boyce et al., 2019), excluding them from places even without built walls (Rubio-Goldsmith, et al., 2006; Burridge, 2009; Chambers, et al., 2019). These spaces are ultimately concentrated and constrained. Badiou described a world “artificially kept separate from general humanity” (2008: 60) and Gregory (2006). My study shows how borders in general and the Ajo corridor in specific function as such a world — a “zone of indistinction between the law and its suspension.”

Where an agency may use Hot-Spot analysis to map the ‘crime’ of border crossing, my work has repurposed the knowledge to draw what policy has done. My analyses show that not only have migrants shifted their routes further from the U.S. Border Patrol’s checkpoint in the Ajo valley corridor, but that migrants are now finding themselves in remote mountains and canyons away from known Border Patrol presence. The Hot-Spots of recent mortalities shows migrants going around this presence of the state by following the periphery of the valley. The Border Patrol has effectively pushed migrants not so much in deterring them but in isolating them. Migrants are excluded by the state to localities where they can no longer be part of the global world. The exclusion of the checkpoint is a part of a larger more expanding border which “move national borders both outward, beyond sovereign territory, and inward, away from official checkpoints” and “affixed to migrant’s bodies (Mountz, et al., 2013, p. 532). A of exception becomes evident in the Cold-Spot, the place migrants once were and the Hot-Spot, where they now hide. Before, migrants would have been found at more traditional crossing points with chance of survival but history and my research show that the growth of the ‘prevention through deterrence’ tactic has allowed the state’s power to balloon and the migrant’s to constrict, excluding the migrant to Bare Life, geographically separated from the regular spaces of society in the U.S.. Before social death (Cacho, 2012) in their final destinations, before detention, and before deportation, the state looks to force migrants to hide themselves, isolated by vast desert and abrupt mountains. Some may escape but likely still be diverted into another sort of isolation after the success of reaching their destination. In such a case, these remote spaces of exception may help demonstrate the blurry line between bio and necropolitics (Mbembé and Meintjes, 2003).

Still, this ‘hiding’ or use of exception in order to avoid the state could demonstrate with consideration of successful crossings attempts to refuse bare life (Doty, 2011). For this reason, I recognize an opportunity for a more in-depth comparative analysis of the hot-spots of exception to other data sources such as remnants of crossing other than mortalities and anonymous social surveys of successful crossers. I believe there is also a need for further analysis to map the interactions between multiple forms of coinciding enforcement like that of the surveillance and patrolling. The nature of the practices that create bare life and the risks of assisting these practices limit options but my study shows opportunity for re-inventing the tools of mapping criminality to serve the excepted (Walsh, 2013). What such research of Hot-Spots can do is take theory of borders and biopolitics out of a strict abstract sense and into maps of their materialization. The Hot-Spots can serve as a documentation of the political and material realities of border policy.

Citations
Acosta, A., 2012. Hinging on Exclusion and Exception: Bare Life, the US/Mexico Border, and Los que nunca llegarán. Social Text, 30(4 (113)), pp.103-123.


Marx, K., 1867. Progressive Production of a Relative surplus population or Industrial Reserve Army. *Capital Volume One (Das Kapital).*


