Making Orange Green? A Critical Geographic Approach to Carbon Footprinting Tennessee Football Tourism

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Abstract

The idea of the Southeastern United States as a region has long infatuated the popular American imagination. While it is a site of historic and present trauma for some, collective Southern regional identity is constructed as a geographic imagined community of belonging. This place-based identity is expressed in many ways, one of which is through college football fandom. Southeastern Conference (SEC) football has long been associated with the presumed region of the South, and a popular expression of both SEC football fandom and southeastern regional identity is the tourism act of attending college football games. This thesis is a critical environmental investigation into that tourism.

The global tourism industry contributes to global anthropogenic climate change through the emission of greenhouse gasses. As such, carbon footprinting can help quantify the sustainability of individual tourism events in terms of emissions. This case study seeks to assess the carbon footprint of six seasons of University of Tennessee college football, an SEC institution with one of the largest football stadiums in the United States. Using an extensive geographic sample of ticketing data from Tennessee's home games during the 2014-2019 seasons, a total carbon footprint was estimated to be 232,864,549 kg CO_2eq.

This study presents both a methodology for studying spectator sporting events in sport tourism and evidence for the need for tourism organizations and governments to account for and reduce the impact of greenhouse gas emissions. It also demonstrates grounded consequences for the often trivialized ideas of fandom and place-based identity in a fresh way by examining an environmental impact of an identity expression. This thesis highlights the paradox that Tennessee football fandom, an expression of place-based identity, is simultaneously an agent in social placemaking and environmental place-destroying.

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CHAPTER 1 – GEOGRAPHIC, LITERARY, & METHODOLOGICAL CONTEXTUALIZATIONS

Introduction

Since its origins 150 years ago as an offshoot of English rugby, American college football has over time been woven into the fabric of the culture of the United States. Today, it is impossible to holistically consider the country's cultural geography without discussing the sport, its societal impacts, and how it alters the cultural landscape. People's affinity for the sport varies across space, but where its fandom is strong, the economic, social, cultural, and environmental impacts of college football are significant. One such region of the US that has received some attention is the so-called South (Southeastern US).

Existing popular and academic literature alike have presumed a connection between southern college football and regional identity, pride, and consciousness. Indeed, some scholars have gone as far as to suggest that a strong "pigskin cult" runs throughout the Southeast, in which the playing and watching of football serve as an important social ritual (Morgan and Klimasewski 2015). These connections are deeply geographic, and the discipline of geography is well suited to examine topics of fandom and place attachment. I have previously examined fandom, southern identity, and college football through spatial analytic and cartographic methods (Cooper 2017), but there is more work needed to combine these approaches with qualitative methods and recent theoretical innovations within and outside of geography.

For too long, sports geography has simply consisted of positivistic spatial examinations of sports phenomenon (primarily participation and athlete origins) across space. There has lacked serious examinations of how sports fandom works in conjunction

with other regional phenomenon as a placemaking agent and critical ways in which sports fandom alters society and the environment. Because of the weakness of sports geography as a geographic subfiled (Koch 2017), the wider discipline of geography has under-analyzed the role that sport plays in society and has failed to seriously consider sport scholarship as a viable, valuable academic contribution.

This thesis serves to address these deficiencies through a critical examination of the environmental effects, namely the carbon footprint, of Tennessee football tourism. The University of Tennessee supports a southern college football program that fosters a robust fandom that is intertwined with state and regional identity. Fandom and identity serve as catalysts that encourage and foster a yearly ritualistic tourism phenomenon whereby eight times a year, some Tennessee football fans travel to Knoxville, TN to attend football games in one of the United States' largest sports stadiums.

This thesis seeks to not only study the spatial distribution of these fans but to also critically consider the environmental effects of their travel. If, as I've previously argued, we accept that southern college football does work to help fans express and preserve their state and regional identity (Cooper 2017, Cooper & Davis 2019), then it is worth considering the impact of fandom and identity on sustainability. The triple bottom line of sustainability includes three pillars: economic, social, and environmental (Collins & Cooper 2017, 148; also see Elkington 1994), and all are worth examination. While each of these would be interesting and worthwhile research angles, the current work is limited to estimating and evaluating the environmental consequences of Tennessee football fandom.

Disclosure on the Inclusion of the Journal Article

This thesis is presented to the University of Tennessee, Knoxville in the "Use of Journal Articles in Thesis" format. The article in question, "Making orange green? A critical

carbon footprinting of Tennessee football gameday tourism" (Cooper 2020a) was published online in the *Journal of Sport & Tourism* on 14 February 2020. I am the sole author of this paper and have compiled, processed, and analyzed the data and completed all the writing myself. The paper as seen in Chapter 2 of this thesis is not a carbon copy of the journal article. It is in fact a bit longer than the manuscript submitted for publication as it develops the idea of sustainable tourism more fully and presents more expanded results. This expansion represents a substantial difference from and improvement to the original article. The dataset analyzed was increased from 4 to 6 years thanks to my partners at the University of Tennessee ticketing operations office's contributions 2014 and 2019 ticketing data after my submission to the journal but before the defense of the thesis. These additions allowed for the expansion of the longitudinal study, and with it, I uncovered more interesting trends such as declining attendance simultaneous with an increased per-capita driving distance to games. Chapters 1 and 3 were not a part of the journal submission and serve here to further contextualize and demonstrate the full implications of the piece.

Intellectual Foundations

This project was birthed from a desire to more fully study sport and fandom as expressions of a regional identity. The quantifying of greenhouse gas emissions is an important end in and of itself, but this case study must also be contextualized in terms of tourism's identity production and its relationship to place. Besides just the geographic precision of the data used in the article, this thesis is also a work of geography because of the dynamics of the place-based identity which informs and encourages the sports tourism studied here. This thesis seeks to demonstrate one tangible, recognizable consequence of regional identity in a fresh way by examining the environmental consequences of an identity expression. We must not assume that these ideas of place attachment are not necessarily

neutral or value-free. The role of identity in encouraging tourism has been noted (Carter et al. 2019); thus, if we accept that southern college football gameday tourism is identity-induced, then we can evaluate that tourism's power to make place, alter space, and create imagined communities as a consequence of identity. The carbon footprinting of Tennessee football tourism quantifies one palpable consequence of a social idea of regional identity, and it will implicitly highlight the paradox that this fandom as an expression of place-based identity is in fact simultaneously an agent in social placemaking and environmental place-destroying.

Place-Based Identities of Imagined Communities

Identity is an intersectional, interdisciplinary concept that is complex and multifaceted. One element people often consider when they think about and define themselves is place: where someone is from, feels a sense of belonging, or experiences trauma can contribute towards ones sense of self. Geography is not lacking in literature on place and its role in identity construction (Proshansky et al. 1983), but postcolonial, postmodern conceptions of place attachments and belonging are transforming the conversation and ultimately downplaying the power of vernacular place identity. Yet even while regional, national, and placed identities are not "discrete" and impossible to discuss and demarcate in straightforward ways in a globalized world of relational geographies (Cresswell 2013), we must not forget the ways in which people as collectives attempt to categorize, classify, and control ideas of identity (Douglas 1966). The power of popular collective groupings of individuals defining themselves and their groups has tangible, daily social and environmental consequences. Both "roots" and "routes" matter, and geography is well positioned to contribute to theoretical and practical discussions on their origins, manifestations, and spatial consequences.

The base unit of a community is the individual who defines him/herself/themselves

by and against significant elements of themselves, a "backdrop of things that matter" (Taylor 1991, 40). Because of the "fundamentally dialogical character" (Taylor 1991, 33) of human nature and identity construction, identity is crated within communities of recognition. It is also human nature to conceive of life and human being in terms of binary categories, often framed in terms of cleanliness and uncleanliness (Douglas 1966). Collective community understanding of what is clean, pure, or dichotomously acceptable and what is not simultaneously "create[s] unity in experience" (3) and "standardizes [communal] values" (48). The community collectively understands what makes them members and non-members Others (Said 1978).

A group identity is constructed when the individuals in the community begin to define themselves significantly based upon their membership within this community. At a large geographic scale, this community is "conceived as a deep, horizontal comradeship" or "fraternity" (Anderson 2016, 7). Even when it is impossible for true, personal community between all members, the "image of their communion" reverberates within "the minds of each" (Anderson 2016, 6). This is the imagined community. At the large geographic scale, the community "is imagined as limited" with "finite, if elastic, boundaries, beyond which lie other" communities (Anderson 2016, 7). The rigid, communal values of purity and danger are transcribed onto space as geographic binaries of the community within borders and the Others outside these borders. The self-defined members create a bounded place in the space of their invented community by imagining themselves as belonging to the place through the values they share.

Inherent in the idea of the geographic imagined community, which can include communities of sports fans, is the premise that members not only construct their own and their group identity with membership as a "horizon of significance" (Taylor 1991, 39) but that this membership entails a sense of belonging. The increasingly popular geographic

concept of home is a useful one by which to consider this idea of belonging. Blunt & Dowling (2006) present a seminal and comprehensive geography of the idea of home, a multiscalar "spatial imaginary…a place/site, a set of feelings/cultural meanings, and the relations between the two" (2-3). Home and belonging for Blunt & Dowling is a deeply geographic concept, but this is connected to physical structures and land as much as it is about the ideas of the people who engage in (re)constructive place and home-making. Home as a place and imaginary of belonging "constitutes identities – people's sense of themselves are related to and produced through lived and imaginative experiences of home" (Blunt & Dowling 2006, 24). To paraphrase using Taylor's (1991) language, belonging to a spatial imaginary one claims serves as a significant horizon against which one's identity is constructed.

This sense of belonging in the geography of home is key in understanding a geographic perspective of Anderson's (2016) imagined fraternity of horizontal comradeship (7). The multiscalar geographic nature of this belonging is also particularly important for understanding the current case study of college football fandom because the imagined community is not only about nations and nationalism; they can manifest at the regional scale as well (Paasi 2003 & 2011).

Though these ideas of home, belonging, and the imagined community are not cited thoroughly in this thesis' substantive article in Chapter 2, they've been very influential in my formation and execution of the research at hand. Imagined communities are at play at multiple scales and in multiple forms when it comes to southern football fandom. Communities of fandom are very similar to Anderson's imagined community (Hills 2002) in their dialogical and othering nature, and indeed sports fandom can serve as a connection to home and offer a sense of belonging and identity (Gibson et al. 2002, Baker 2018). Identity with both the formal region of the state of Tennessee and the vernacular region of the US South both intersect with the imagined fan community of Volunteers to influence the

gameday tourism studied here. All of these groups can serve as a home and do placemaking work and ultimately environmental damage in east Tennessee.

Sports Geography

In addition to being a work of cultural and environmental geography, this thesis will also be naturally positioned within sports geography. John Rooney is one of the most prominent figures of this small corner of the discipline. He helped launch and edit the now defunct journal, *Sport Place*, as well as helped shape the trajectory of the geographic study of sport. He twice published comprehensive atlases of American sport (1974 and with Pillsbury 1992). One of his greatest methodological contributions came from an early work (1969) that mapped the origin and diffusion of collegiate football players in the United States. Mappings of the popularity of playing different sports remains common today, although it has been criticized and rightly so to some degree for being under-theorized and not connecting those mapped patterns to larger understandings of how society and space as well as sport work. This weakness in the traditional literature is something I have sought to address and help mitigate.

British author John Bale is also one of the major founders and thinkers behind sports geography who has sought to connect a spatial analysis of sport with social theory. His hallmark book (Bale 2003), now over 15 years old, seeks to understand sports from postmodern and postcolonial geographic perspectives that bring what might be labeled as an inconsequential topic of study into a legitimate and grounded geography discussion. Notably, Bale writes on imaginative sports geographies, sports' regional dimensions, the facilitation of place attachment through sport, and (perhaps most importantly here) sports fandoms.

Despite "the institutional weakness of 'sports geography' as a disciplinary subfield" (Koch 2017), sports is receiving increased attention within geography (Wise & Kohe 2020).

The tradition established by Rooney (1969) of examining player production continues to be researched with modern computing and GIS capabilities (Andris 2018). More critical angles are being taken to study sport in human geography, building upon Bale. A wider breadth of literature is addressing the player production topic by examining migratory routes and flows of players to the competition arena (Connor 2014 & 2017, Wise 2015, Wise & Harris 2016). Other studies are examining sports on and off the field through bottom-up qualitative methods (Gellweiler et al. 2018, Koch 2018a) emphasizing the role that local voices can play in understanding geographies of sport (Wise 2017). Of particular importance for this study, there is currently growth in literature studying connections between sport and geographical ideas of belonging (Koch 2018b), identity (Wise 2016, Koch 2015 & 2018a, Wise & Kohe 2020), territoriality (Wise & Kirby 2018), community (Mitchelson & Alderman 2011), and home (Kraszewski 2008, Baker 2018).

The continued emergence of this brand of literature about sport culture and its connection to space, identity constructions, and societal impacts have benefitted this thesis and informed the article contained within, even if space did not allow for a full unpacking of these concepts in the article itself. And although the article itself will not address these aspects much, the work will advance the conversation by demonstrating the environmental implications of sport fandom. Even with this new sub-disciplinary focus however, more work using both quantitative and qualitative methods needs to be done regarding how sport creates and recreates places, alters landscapes, and affects sense of place. Additionally, the current literature on sports geography fails to fully account for regionalism and regional identity. This thesis seeks to address both of these deficiencies.

Fandom and Identity

The study of fandom is one valuable avenue through which geographers can study the intersection of sports and identity formation, even though the critical study of sports

fandom, especially by geographers, remains under-developed. Yet, geographers have offered helpful analyses of fandom in other popular culture arenas, such as music (Kruse II 2005, Alderman 2008, Sonnichsen 2019). Gunderman & Harty's (2017) study of fandom surrounding the Grateful Dead band provides an especially important guide to fan geographies analysis by using toponyms to understanding fan identity construction and expression. While not a geographer, Matt Hills (2002) presents a sophisticated look into cultures of fandom and the way they are created, experienced, communicated, and studied. While Hills looks at television and music fandoms primarily, his conceptualizations of these subgroups as identity creators and facilitators is certainly applicable to the sports fandom realm as well. He inverts Anderson's (2016) idea of the imagined community to present fandom as a "community of imagination" that is facilitated by media and works in relation to "the discursively inexplicable intensity and emotionality of fandom" (180).

Sports fandom too is fed by ideas of belonging, community, home, and identity. Harris (2008) recognizes the way in which rugby works in Wales as an agent of imagining the nation as a space of belonging and citizenship in the context of Anderson's (2016) imagined community. This is an analysis of sports tourism and its impact on multiscalar identities, but specific focus is given to the way in which sports also contributes to placemaking processes. Kraszewski (2008) and Baker (2018) also examine sports belonging. Both consider the ways in which American football fandom is connected to place attachment and the idea of home, specifically when the fan is removed from the gameday spectate. The ideas of "sport and home are intimately connected" (Baker 2018, 15), and "a primary function of sports fandom in contemporary America [is that] it allows displaced populations to negotiate home and home identities" (Kraszewski 2008, 140). Both note the role of media in this remote fandom experience. Roseman & Shelley (1988) also recognized the importance of the fan experience and the negotiation of place identity away from the

spectate. They mapped radio station affiliates to see the spatial patterns of college football fanbases. Cooper & Davis (2019) updated this study with a stronger emphasis on the way fandom is related to identity and belonging at the multiscalar regional level. Zhang et al. (2018) further consider the role of American football fandom as a conductor for place attachment by examining experiences of alumni upon their return to their college campuses for homecoming, a common ritual within the college football season.

Southern Identity and SEC Football

A number of scholars have suggested the existence of an association between Southeastern Conference football fandom and southern regional identity. The Southeastern Conference (SEC) is an organization that administers athletic competitions between teams of 14 academic institutions broadly located in the southeastern United States; the University of Tennessee is a member institution. A plethora of popular literature marketed for fans connects the conference with the US South (Barnhart 2000, St. John 2004, Glier 2012, Finebaum & Wojciechowski 2014). Academics have cited this connection as well. Abbott (1990) suggests that the formation and organization "of college conferences is [tied to] a sense of regional cultural identity" (211-212). Gruensfelder (1964) agrees; in his thorough thesis on the development of the SEC, he writes that the conference was administratively formed "along geographical lines" with schools in the "Central and Western regions [of the South assuming] a new organization and a new name- The Southeastern Conference," or the SEC (66). Rooney & Pillsbury (1992) argue that the South and football are "virtually synonymous" because "football is a way of life" in the region (70). Others (Borucki 2003, May 2012) connect regional identity to ideas of superiority and pride and the mythology of the Lost Cause in the performance of SEC football teams, and Bain-Selbo (2009) describes college football fandom in the South as a civil religion built upon this very Lost Cause myth of superiority. Morgan & Klimasewski (2015) seek to quantify this power and dominance of

Southern teams, noting that the narrative of superiority is "likely one of the strongest forces defining regional identity in the South" (216) and that a discussion of the "cultural geography of the South would be amiss without [including] football" (215).

Southeastern conference football fandom also exists as an extension of the Southern political economy. College football does not operate on social forces alone; rather, it is an industry designed to accumulate wealth and capital for the member institutions. This is accomplished in part through the type of gameday tourism explored here. I have previously noted how game-going often involves "a lucrative expression of fandom" like the purchasing of a ticket or donation to a school's athletic fundraising foundation (Cooper 2017, 70). Often, these same game-going fans purchase merchandise licensed by their chosen team to wear to the competition, thereby expressing their fandom and identity through another form of economic consumption (Lee et al. 2011; Cooper 2017, 106; Cave & Buda 2018; Cooper 2020b). Larger, corporate actors also participate in this economy. The Southeastern Conference itself is a money-making organization for its member institutions, and it accumulates wealth primarily through lucrative television contracts built primarily upon college football (Hagood 2017). The Associated Press (2020) reported the SEC redistributed $44.6 million per school in 2020. This is a massive amount of money flowing into Knoxville as positive feedback cash to enhance the athletic branding and tourism experience of University of Tennessee football. And though this money comes from corporate actors, the basic infrastructure is still built upon marketing the college football experience to the fans as a component of a mythologized Southern tradition, way of life, and identity expression.

Changes in Southern Studies

This thesis will also be situated within the area of southern studies, a longstanding interdisciplinary corner of scholarship in and about the United States. The majority of the work done in southern studies comes from literary scholars or historians (Wilson 2017), but

valuable contributions have been made by scholars from other fields, including geography (Jordan 2003, Davis 2011, Bohland 2013, Winders 2013). The idea of a Southern identity is nothing new (Cash 1941), and efforts have been made to document the transformation of this collective regional identity as it has not remained static since Europeans first settled in the region in 1607 (Cobb 2005). Much of the work on regional development and its identity history has looked at the way the South responded and is responding to the aftermath of the Civil War. Grantham (1994) does this through the lens of the New South, a region connected to the rest of the world through its modernization, industrialization, urbanization, and globalization. Others (Woodward 1960, Cobb 2005) track the inherent inequalities in a region whose identity is constructed and built upon ideas of racial inequalities that exclude a critical mass of Others: in this case, black southerners.

A classically valuable contribution to regional and southern studies came from John Shelton Reed in 1976. Reed played a formative role in connecting mapping the study of southern identity by constructing a business-naming methodology of delineating the South. The basic idea, Reed argued, was simple: the South as a vernacular region is self-defined by those who lived there; those same people living in the South were also more likely to use the regional terms “Southern” and “Dixie” to name their businesses. The ratio of both “Southern” and “Dixie” (as they were found to be spatially and conceptually distinct with the latter being a name charged with Lost Cause ideology) counts to “American” counts were interpolated that resulted in two maps for the two perceptual regions, the South and Dixie.

Reed’s methodology was, for its time, revolutionary for sociologists and geographers. This study has been updated numerous times (Reed et al. 1990, Alderman & Beavers 1999, Ambinakudige 2009, Cooper & Knotts 2010a, 2017), and the methodology has been appropriated to study other vernacular regions of various sizes (Zelinsky 1980, Shortridge 1985 & 1987, Cooper et al. 2011, Alderman 2015) with a prominent focus on intra-state

regions (Good 1981, Lamme III & Oldakowski 1982 & 2007, Barker 2005, McEwen 2014, Liesch et al. 2015). While Reed's original methodology remains widely used and is beneficial to cultural geographers' understanding of the spatial extents of vernacular regions, it is necessary to connect this top-down mapping and measuring macro-level patterns of identity with more critical, qualitative studies of identity expression and meaning-making (Rose-Redwood et al. 2010) and the consequences of popular expressions of these identities.

A core geographic unit of analysis underpinning this study is the region. Regional studies have declined in their prominence in geography within a postmodern tradition; indeed, some have critiqued the region and regional studies as inherently essentialist. Tim Cresswell sardonically questions, "How do you advocate the region without simultaneously withdrawing into what David Harvey has called 'militant particularism' (1996)?" (2013, 76; also see Harvey & Williams 1995). Cresswell fairly critiques the preoccupation of regional geographers in the twentieth century for their work focused on defining and demarcating "a clearly bounded and exclusive space" (2013, 76). Geographers in southern studies are particularly guilty of this as they have long operated under the assumption of the South as the most unique and "sturdiest" of the US regions (Zelinsky 1980, 8). Howard Odum (1936) and his UNC pupil Rupert Vance (1932) described the physical and social geography of the South with aims to progress the region into the future away from a limited agrarian tradition view of a Lost Cause South (see Davidson et al. 1930). These works viewed the South as an essential, recognizable entity. Reed (1976) imagined the South as a real region also, but he viewed it as a folkway defined by those who identified with it. In his boundary-making research with the folk at the center, he revolutionarily transferred the agency of demarcating the South it to its inhabitants. However, Reed fails to adequately account for intraregional racial histories and dynamics that in many ways rendered the "South" he was discovering a limited region reflecting white southern-ness.

Yet this methodology and framing is still essentialist, and there is a tendency to speak of the South this way still in postmodern, postcolonial times. Cooper & Knotts (2017) provide a valuable update to John Shelton Reed's South and Dixie mapping project in a larger volume on the "resilience of Southern identity" and conclude that, based on "considerable evidence [that] cultural distinctiveness" and a popular recognition of this distinctiveness "remains an important component of Southern identity" (16). Though their study presents a multi-pronged approach to examining regional identity, it is not wholly critical; the manner in which they tell about the South as a discoverable entity epitomizes it as a work of contemporary Southern essentialism.

In the context of the US south, more scholars are beginning to question the reification of essentialism, even as they recognize the value of a particular focus on the South and southern identity. Beyond a simple acknowledgement that "there is diversity within the construction of Southern identity" (Purcell & Moore 2019, 249), there is a desire to examine the area's routes rather than just its roots (Wilson 2017, 37), meaning studying regions in ways that complicate essentialist ideas "by focusing on more mobile, multiple, and transcultural geographies" (Blunt & Dowling 2006, 199). Caroline Nagel (2018) calls for an unbounding of the South in this way. She argues for a "reimagining [of] regions as nodal points in webs of intersecting political, social, and economic processes, rather than as bounded, static spaces" for the promotion of sound scholarship that does not obscure the inequalities and contradictions historically and contemporarily observed in the United States (Nagel 2018, 683). Jansson (2017) worries that failing to do so results in an internal othering, a "Southering," that is essentialist and thus fails to adequately and accurately explain social and relational American geographies. A critical eye, these authors argue, will see a contemporary area of the US abounding with creolization where "the South is now defined not by opposition to the nation but by its integration with the world" (Wilson 2017,

38). Studies concerning the complicated movements of bodies (Winders 2011 & 2013) and goods (Olsson 2012) demonstrate this ilk of scholarship well.

While this postcolonial understanding of an unbounded south is useful and moves the discussion of the socio-cultural geography of the South in a beneficial, critical direction, it is important to recognize, as Nagel does, that "regions become 'facts' capable of generating social and institutional action as long as people believe in them" (Nagel 2018, 683). Paasi (2003 & 2011) stresses that this is not inherently positive action; he is careful to avoid a fetishism of the region as a unit of analysis with positive connotations. Distinct from static, essentialist geographic bodies, Paasi's region is one that is time-and-space specific, fluid in its influences from elsewhere spaces and engaged in perpetual transformation (2011, 11). He sees the region as a space that is "invented, produced, or constructed by particular people in society" (Cresswell 2013, 60) facilitated by regional identity, "a key element in the making of regions as social/political spaces" (Paasi 2003, 2). Identity itself too "is a social process" produced in a spatial context (Paasi 2003, 2). Regions, identity, and their interplay are not passive, static processes but ones that have social and political consequences.

This is true in the southern United States. As Nagel concedes, "Indeed, for many Americans, Southern identity continues to be meaningful at individual and collective levels" (2018, 683). Scholars of the south should be careful to avoid the positive assumptions of the region. Historical context, a necessary component of understanding regional identity (Paasi 2011, 12), is important to keep at the forefront of discussions of southern identity as the racist Lost Cause movement is a closely related place-based southern identity (Webster & Leib 2016). The point, however, is this: in its moral totality, "the idea of southern distinctiveness has a 'reality' in the sense that it has framed and continues to frame social relations, the production of knowledge, and the construction of space. In this respect, the importance of the South to everyday life goes well beyond the region's empirical differences

from the rest of America" (Alderman & Good 1997). The South is not a preexisting space but is rather socially constructed and maintained by those who act as if it exists, and these actions have social, relational, and placemaking consequences.

The socially constructed nature of the region is extremely important to recognize and should not be forgotten when seeking a full and complete understanding of a place. Regions matter not only because people, both its perceived inhabitants and perceived outsiders, believe they exist, but because people incorporate the imaginary region into the work and play of their lives. Regardless of its scale, people make real and material decisions based on the idea that they are a part of a regional community. The geography of belonging works at many scales (Blunt & Dowling 2006). Geographers' understanding of the multiple manifestations of "Region;" formal, functional, and vernacular (Domosh et al. 2010); are valid and valuable scales at which to study these ideas of belonging, community, and home because, as with other scales, people make tangible, real, and consequential daily and life decisions based on that belonging. These decisions have the power to make place, alter space, include some, and exclude others.

Concluding Thoughts

Though the article in Chapter 2 is written from a tourism studies perspective for an audience of tourism scholars, this thesis in its totality will also pull from and contribute to the areas of sports geography, southern studies, identity, critical regional studies, and GIS quantitative methodologies. A connection between Southeastern Conference football fandom and southern identity has been presumed in literature. Because of the potential power that fandom and identity can have in (re)creating places; influencing place-based economics; facilitating group belonging; and ultimately affecting the environment, this connection is here explored with both critical and quantitative methodologies to further examine and better understand how membership within these imagined communities does

work in the US South. Tourism is a powerful force in the creation, expression, and maintenance of identity through ritual and festival. Because Tennessee football tourism is so intertwined with regional identity, the carbon footprinting of six years of gameday travel allows us to explore a concrete environmental consequence of this regional identity.

Methodology

Included in the journal article are simply the data sources and results of the data processing. There was not adequate space to contextualize fully the data itself or give thorough detail to the data processing I conducted. There were several goals for the data processing. The first was to transform it into a format that could be quickly queried by its different attributes such as opponent, year played, or ticket quantity for easy subsetting. The second goal was the need to quickly perform mathematical calculations to produce carbon footprinting indices. The third was the ability for all of this data to be spatially attributed, indexed, and quickly accessible by a query. The data housing mechanism would need to both be able to store spatial data and query records based on a spatial argument. For example, if I wanted to quickly examine all ticket sales records that occur within Virginia, rather than using unreliable and non-uniform metadata like the “state” attribute, I could use a spatial query to select all records whose point geometry lies within the polygonal geometry of Virginia’s border.

There is an emphasis in all of these steps for the need for expediency. With literally millions of records from the many seasons of Tennessee football examined, the computational processing could be very cumbersome depending on the program or platform utilized. Efficiency was absolutely key. The solution was to use a PostgreSQL database with the PostGIS extension for spatial data processing. SQL databases in general and Postgres specifically are generally considered as a standard and useful method of efficient spatial

data storage and retrieval (Roth 2009). The data were delivered to me from the ticketing office in a large Microsoft Excel table. In order to move the data into a Postgres database, I first built the database from scratch on my personal Windows 10.1 machine using Linux command line commands through Git bash. After setting up various databases, schemas, and users with correct permissions and installing the PostGIS extension, I again used Git bash to access the open-source spatial processing module GDAL's "ogr2ogr" command to import all of the ticketing data into the new PSQL database.

Postgres allowed the data to be stored efficiently and then queried by its attributes. Some of these attributes such as game code, number of tickets, and raw zip code were included from the source. Due to the ease of the task in Postgres, some new attributes were created such as opponent, a cleaned zip code field, and spatial geometry-type attributes such as zip code polygon and point data. This is where the PostGIS extension was quite helpful as the raw data given to me was not spatially referenced; rather, it included only the city, state, and zip per ticket sale as input by the purchaser online at either the Tennessee ticketing website or a secondary market website such as VividSeats.com. Thus, it was incumbent upon me to georeferenced the data so it could be utilized in a GIS.

There were many instances of inconsistency in formatting ("TN" and "Tenn" in the state entry both referencing the same place, for instance) and errors in entry (such as one digit of a 5-digit zip code obviously miss-entered) in the raw data which made any sort of geocoding or georeferencing challenging. To rectify this, existing shapefiles with United States zip code polygons and points were imported into the Postgres database with GDAL's ogr2ogr. Then, SQL was used to clean the raw ticketing data's ZIP-code entries[1] to be uniformly 5-digit zip entries. Then, a Postgres left join was used to match zip codes from the

[1] ALTER TABLE schema.table ADD COLUMN zip5 varchar(5);
UPDATE schema.table SET zip5 = LPAD(zip::varchar(5), 5, '0');

ticketing table to those tables that came from the shapefiles; the point and polygonal geometries were copied over to the ticketing table through this joining. Now, with every ticket georeferenced, PostGIS was used to calculate each zip's centroid latitude and longitude which was then in turn used to calculate the Euclidian distance from Neyland Stadium in Knoxville, TN[2] for downstream processing.

The carbon dioxide equivalency values detailed in Chapter 2's article were processed based on the number of tickets sold per record and, when necessary, the distance of the ticket's point of sale to the site of the game. Each CO_2eq index was calculated as its own field column in the database, and the results of the article were calculated by summations of these values. Once again, PSQL was a good choice: each bit of data be it game-specific, geographic, or greenhouse gas emissions data were stored at its base level: the per-order unit of analysis. Because of PostgreSQL's efficiencies, I the researcher had the flexibility to aggregate up based on any research question I had on any attribute I needed using a simple "GROUP BY" SQL command, quickly make summation calculations, and import quickly into a GIS. Each of the maps produced in Chapter 2's article came from accessing data from the PSQL database directly from within ArcGIS 6.1. This was a much quicker option than trying to perform efficient data management and manipulation in an ArcGIS geodatabase via Arc tables.

A full open-source repository of the scripts I used to construct this thesis can be found online on GitHub.[3] The SQL files within are not meant to be run as a whole but rather were used within pgAdmin in pieces. Those .sql files named with "alexadmin" are the operational files that moved this research process along and made permanent changes to the PSQL tables, and those named with "alexuser" were bits of SQL I used to view and

[2] 35.955061 N, -83.924978 W
[3] https://github.com/cooperjaXC/utkthesis_coding_cooper2020

examine the results of the calculations and changes. These files reference data held solely by the author and will not work for a general audience as-is. However, with the in-text documentation and the thesis here, one could use pieces of these scripts for their own purposes.

The methodology here is important from a scientific and reproducibility standpoint. A high quality of analysis would not have been nearly as probably or possible without the flexibility and efficiency offered by the PSQL database. However, the database and GIS software used in the analysis are only tools that were useful to enhance this cultural geographic project. An attempt to be scientifically thorough in the approximation of a carbon footprint is a large part of the article that is to follow in chapter 2, and these geospatial and computational technologies helped to make that possible. However, the work fits more broadly into a critical discussion of the ideas of fandom, place-based identity, and the grounded and real results of imagined communities in the form of tourism. We absolutely need sound methodologies and advanced technological capabilities, but these are not an end in and of themselves. They are not the goal of the research process. Rather, they can and should be used as vehicles towards more robust critical, cultural, and environmental geographies.

Positionality

I am what Matt Hills calls a “scholar-fan” (2002, 19). That is, this project is foremost an academic pursuit for me. I have striven to meet the academic standards of rigor in my review of current literature, methodology, reporting of my results, and criticisms of my case study. At the same time, however, I am a self-proclaimed fan of Tennessee football, the subject of this piece of critical geography. I grew up wearing orange and white with my family of Volunteer fans, and I am a now a legacy student at the University of Tennessee. I

attended many of the games included in this dataset and cheered hard for Tennessee; thus I myself have contributed several data points in this ticketing dataset. While as a fan I feel emotionally invested in my team's success, I have tried to use my fandom as a motivator to continue my research on this topic rather than allow it to alter the results or taint the academic rigor. Be that as it may, I accept that my positionality frames from where I write. More information on my fandom and how it shapes my research may be found in the audio link in the bibliography (O'Gara & Marler 2020).

Article Disclosure Statement

At the time of publication, the author was enrolled as a graduate student at the University of Tennessee, Knoxville and was employed there as a graduate teaching assistant. Additionally, he is a self-proclaimed supporter and fan of the Tennessee Volunteers football team, the subject of this case study.

CHAPTER 2 – RESEARCH ARTICLE

Cooper, J. A. "Making orange green? A critical carbon footprinting of Tennessee football gameday tourism." *Journal of Sport & Tourism* 24 (2020). doi: 10.1080/14775085.2020.1726802

Abstract

Anthropogenic climate change is an imminent threat. In order to curb the effects of climate change, economic industries including tourism must assess their contributions to the overall phenomenon and develop creative solutions. As carbon dioxide and other greenhouse gas emissions represent a major reason why global tourism is contributing to climate change, carbon footprinting can help identify which aspects of individual tourism events are least sustainable. This case study seeks to assess the total carbon footprint of six seasons of American college football. The fan journey to the college football spectate represents a tourism experience and therefore can and should be assessed for its ecological impact. The subject of this case study is the University of Tennessee, an institution with one of the largest football stadiums in the United States. Using an extensive geographic sample of ticketing data from Tennessee's home games during the 2014-2019 seasons, a carbon footprint was estimated for each game, each contributing polluter, and each season. The total season footprint over the six years was estimated to be 232,864,549 kg CO_2eq. This study presents both a methodology for studying spectator sporting events in sport tourism and a framework by which tourism can begin to assess its contributions to the global carbon footprint. It also demonstrates grounded consequences for often trivialized ideas of fandom and place-based identity. Additionally, it highlights the need for tourism organizations and governments to consider policy and management practices that account for and reduce the impact of greenhouse gas emissions.

Keywords: Carbon footprint, sports fandom, American football, place identity

Introduction

Climate Change and Tourism

Recent reports from the United Nations (UN Human Rights Council 2019), the United States government (USGCRP 2017), and the global scientific community (Ripple et al. 2020) have reemphasized Earth's immediate and perilous challenge posed by anthropogenic global climate change. These reports communicate a clear and present need for worldwide reparative action in many sectors of human life and activity in order to curb climate change's effects and prevent a disastrous "climate apartheid scenario" (UN Human Rights Council 2019, 14). The obvious and subtle "connections between the widespread rise of authoritarian and populist leaders…and destructive trends in environmental politics and governance" (McCarthy 2019, 305) present around the world stand in direct opposition to these scientific reports and heighten the urgency for more study, understanding, and action to rollback harmful effects of climate change.

Many sectors of the global economy are introspectively assessing their own contributions to the phenomenon and are taking steps to reduce their impact by curbing emissions and finding more sustainable avenues to remain profitable. The United Nations' World Tourism Organization recognizes that tourism is contributing to climate change (UNWTO 2008). Sustainable tourism is a reaction to and an acknowledgement of the part tourism plays within the global structure of anthropogenic climate change. The Intergovernmental Panel on Climate Change (IPCC) acknowledges that meaningful mitigation efforts have "the potential for significant positive outcomes for well-being in countries at all levels of development" (Roy et al. 2018, 447). Sustainable tourism must both meet present needs and enhance future well-being (Gibson et al. 2012) at individual, national and international scales (Budeanu 2007). Sustainable tourism is about promoting an environmentally *and* socially just system of travel that is both economically profitable

and societally beneficial for years to come. This must be achieved by both individual and industrial actors.

Within sustainable tourism research, important work is being done to assess the current state of the industry's impact on global climate change. Tourism's greenhouse gas emissions, primarily from carbon dioxide (CO_2), accounted for five (UNWTO 2008) to eight percent (Lenzen et al. 2018) of all emissions globally. Many different components of tourism travel and operations contribute to these totals, and a popular research method of quantitatively assessing the quantities of these contributions is footprinting. A variety of different methods and models of footprinting have been demonstrated (Čuček et al. 2012), but because of carbon dioxide and other greenhouse gasses' prominent contributions to global climate change (Filimonau et al. 2014), this study employs a carbon footprinting model.

The case study for this paper is six seasons of American college football tourism at the University of Tennessee in Knoxville, TN. College football fandom is a strong social force in the US and is a popular tourism and travel motivator on gameday weekends in the fall. This study uses detailed, comprehensive, geographic ticketing data for six seasons of home Tennessee football games to precisely approximate a carbon footprint by considering each tourists' movement to the spectate, lodging, food consumption, waste production, and activity at the game itself. The results will demonstrate grounded consequences of social ideas like fandom and identity and highlight college football tourism's contributions to the global carbon footprint at just one of many gameday sites in the United States.

Literature Review

Environmental Footprinting

There is an established tradition of environmental footprinting in tourism research. Wackernagel and Rees (1996) introduced the idea of the ecological footprint that relies on

global hectares as a unit of measurement to assess sustainability from a land area perspective. Simply put, a footprint is any "quantitative measurement describing the appropriation of natural resources by humans" (Čuček et al. 2012, 10). Several different footprinting models including water, energy, and biodiversity footprints have been developed as attempts to quantitatively evaluate sustainability (Pandey et al. 2011, Čuček et al. 2012). These footprints are important because of their usefulness: They highlight both current areas of success in sustainability and can indicate areas where businesses, governments, or agencies can improve (Collins et al. 2018).

The carbon footprint is one such indicator that "measures the total amount of greenhouse gas emissions that are directly and indirectly generated by an activity" (Collins & Cooper 2017, 150). Because tourism is a relatively prominent contributor to global carbon emissions (Lenzen et al. 2018), it is useful to quantitatively assess tourism's direct and indirect greenhouse gas emissions and how those emissions are distributed across space and industry sectors. The findings can then aid future strategies to combat climate change in tourism. Indeed, "the [carbon footprint] has become one of the most important environmental protection indicators" of any footprinting model because of its strengths (Čuček et al. 2012, 10). A carbon footprint is measured in CO_2 equivalencies, meaning it considers other greenhouse gas emissions other than just carbon dioxide (Wicker 2018, 153). It is also a relatively flexible model in that it can be approximated at a variety of geographic scales by using a variety of research methods (Tao & Huang 2014). The national scale is often selected to create country-by-country carbon footprints (Pandey et al. 2011, see Dwyer et al. 2010 and Meng et al. 2016), but the model can be applied specifically to tourism events and phenomena. For example, Filimonau et al. (2014) approximated a carbon footprint for seasonal European travel to the French Riviera, and El Hanandeh (2013) did so for the annual pilgrimage of the Hajj.

However, because of the nuanced, multiple, and often obscured ways in which tourism totally contributes to the global carbon footprint, quantifying a local carbon footprint for tourism is a difficult task and requires several mathematical and modelling decisions by the researcher (Dwyer et al. 2010). Indeed, "the calculation of GHG emissions from tourism is complex" (Gössling 2013, 434), and no one footprinting model that attempts to account for this is perfect or without flaw (Laurent & Owsianiak 2017). In addition to calculation complications concerning the masked modes of production-induced pollution, "carbon footprints are likely to vary greatly between destinations" (Dwyer et al. 2010, 358), meaning that their estimations must be taken with caution when applied across space to different geographies (Filimonau et al. 2014). For these reasons, different carbon emissions calculators, software, or formulas can yield varying results (Padgett et al. 2008). Yet, although there are these multiple challenges inherent within carbon footprint approximation modelling, the results can still be used effectively in suitable tourism development and planning.

Event and location-based carbon footprints are often constructed by aggregating multiple emissions contributors such as, in the case of tourism studies, travelers' transportation, temporary lodging, and event-specific activities. This study seeks to estimate and aggregate greenhouse gas emissions from five tourism categories: transportation, lodging, waste management, food production and consumption, and the stadium-based gameday event itself.

Literature has found that the transport of people is the most direct contributor to emissions metrics (Robbins et al. 2007, Dwyer et al. 2010, Lenzen et al. 2018). Air travel is per person the most polluting of the typical tourism transportation options (El Hanandeh 2013), but automobiles, especially when driven long distances, are not far behind (Filimonau et al. 2014, 634; also see Collins & Potoglou 2019). All types of motorized, land-

borne modes of transport significantly contribute to larger global transportation emission totals (Chai et al. 2016), and visitor travel significantly impacts the overall sustainability and environmental impact of events (Collins & Cooper 2017, Collins & Potoglou 2019). Though the use of personal car and traveling long distances continue to be shown as significant contributors to tourism's larger emissions footprint, individual forms of transport are difficult to account for in models with a broader scope (Collins & Cooper 2017). However, the spatial detail of this study's geographic tourist dataset will allow for a precise inclusion of this valuable type of individual travel information.

Additional tourism greenhouse gas emissions come from hotel lodging (Berezan et al 2014). Filimonau et al. (2014) found hotels to be a major contributor to short-haul tourism's overall carbon footprint just behind transportation. Entire carbon footprinting studies have been devoted to assessing the direct and indirect emissions associated with lodging (see Filimonau et al. 2011, Puig et al. 2017), but the per-guest CO_2eq values found by those studies cannot easily be applied to other geographies and markets (Filimonau et al. 2014, 633). Ricaurte's (2018) work in the United States' hotel industry will be used for the present study.

Waste production and management represents a sustainability challenge as well (dos Santos Pereira et al. 2018). In the United States, facilities can emit vast levels of greenhouse gasses depending on which waste management practices are employed (Weitz et al. 2002), and these practices can vary widely from municipality to municipality (Kaplan et al. 2009). More sustainable methods of landfilling or composting can drastically reduce a processing plant's emissions (Cabaraban et al. 2008), but this value also depends on the type of solid waste received for processing (Levis et al. 2011). Waste is certainly a part of tourism's overall ecological impact (Aziz et al. 2007), but the full extent of waste management's contributions to a tourism carbon footprint remain underexplored.

Food consumption likewise is often overlooked in tourism footprinting research, though it is found to be a significant contributor to an event's overall emissions total (El Hanandeh 2013). Food is a particularly challenging aspect of the tour to footprint because of the multifaceted farm/factory-to-table journey it undergoes, and sophisticated estimation methods must be employed in a market-specific analysis to glean realistic results (Berners-Lee et al. 2012).

There are also many additional upstream development contributors to tourism's carbon footprint that may be underrepresented in this study such as the construction of the vehicles and buildings to be used for mobility and lodging, the growing and production of the foods to be consumed, and the construction of waste management infrastructure. A more encompassing set of life-cycle assessment values would help fill out a more complete footprint of tourism emissions.

Sport Tourism

Games, competitions, and spectator sports are particular events that have helped construct a vital and viable tourism industry sector. Sports tourism is a growing mode of travel with significant power to contribute to a place's tourism economy. It rose in popularity in the 1990s due to a concurrent rise in interest for high-profile worldwide sporting events and active lifestyles (Green & Chalip 1998). The study of sport initially took a more managerial perspective towards the industry but has in recent years seen more scholarship in critical social science (see Koch 2017, Wise 2017). The two motivating factors for sport-related tourism travel has remained true through to the present in the forms of spectator and active tourism: watching and playing sport (Green & Chalip 1998).

From both a tourism and a geographic perspective, there is a wide range of scale at which sports tourism operates. Sports tourism scholarship often puts certain mega, "hallmark" events under the microscope to examine the managerial challenges, economic

impact, and spectator experience at the Olympic Games, World Cup, Super Bowl, or other national and international championships (Gibson et al. 2012, see Horne 2000 and Solberg & Preuss 2007). These events' high levels of marketing often arouse a great deal of popular, media, and academic attention. At a finer scale, there exists localized, participant-based sports travel systems for community events such as youth soccer or senior games (Gibson et al. 2012). While these events require different forms of management, they all contribute to the host destination's wider economic, environmental, and social economies.

This study seeks to examine a scale situated in-between these more frequently studied ends of the spectrum. American collegiate football occurs every autumn with the power to transform the college town or even city on a temporary, often weekend basis and significantly impact the local economy (Gumprecht 2008). There lacks in the literature a serious examination of these intermediate-scale sports tourism events, including their environmental impacts. There is plenty of reason to do so under the auspices of tourism studies: The collegiate football game discussed here fits well into the established spectator sports tourism because it involves a journey. Bale (2003) depicts the journey to the spectate in his seminal work on sports geography as both a physical and an emotional journey, and Harris (2008) likens it to a pilgrimage, one of the early and important predecessors of modern tourism (Nelson 2017). These sporting events provide "liminoid space[s]" for attendees that can create and facilitate a shared identity while simultaneously and collectively creating a place that transgresses regular social norms (Zhang et al. 2018, 230; see Chang et al. 2020). Games are transformed into places of transgressive ritual, like a carnival or festival (Turner 1969, Green & Chalip 1998) where spectators gaze (Urry 2002) upon the play unfolding in front of them. Collegiate football therefore represents a tourism experience (Popp et al. 2017). It should be examined as a part of the whole global tourism economy, specifically here in terms of sustainability.

Sport Tourism and the Environment

Event (Collins & Potoglou 2019) and more specifically sports tourism (Wicker 2018) both have environmental footprints associated with them and thus impact sustainability locally and globally. Sustainability in sports tourism has been criticized in terms of both large-scale hallmark events (Schmidt 2006) and local, small-scale sporting events (Gibson et al. 2012), though the latter are usually seen on balance as less harmful. It is important to remember the idea of the "triple bottom line…framework for assessing economic, social and environmental impacts" when thinking about holistic sustainability of event tourism (Collins & Cooper 2017, 148; also see Elkington 1994). It is recognized here that the environmental costs of tourism carbon emissions are simultaneously intertwined with economic and social ones as well, and it takes both local (Gibson et al. 2012) and international (Collins & Roberts 2008) solutions to address them all.

The carbon footprint is a particularly apt model to use to assess the environmental impacts of sport tourism. In tourism and especially for events that help to create and reinforce group and place identity, there exists a tourism economy in which marketers capitalize on and, through a capitalist sale of goods, merchandise, experiences, and services, further contribute to the development of the very identity that serves to motivate continued expenditures (Harris 2008, Lee et al. 2011, Cave & Buda 2018). These expenditures are directly tied to sustainability and the carbon footprint of sports tourism; purchasing fuel and food, renting hotel rooms, and consuming disposable products all are bound up in the tourism experience, and collegiate football tourism is no exception. So, it is easy to see how Azam et al. (2018) found these expenditures, a by-product of tourism, to both boost the economy and increase CO_2 emissions.

Andrea Collins has demonstrated many times the power of footprinting in highlighting sustainability successes and problems within sport tourism. By often using the

ecological footprint, her scholarship often demonstrates effectively that sports and sport tourism are not frivolous, inconsequential pastimes (Sands 1999); rather, they are highly significant in their ability to engender civic pride but also negatively impact the environment (Collins et al. 2012). Her work in approximating ecological footprints for soccer football matches (Collins et al. 2007), mega bicycle races (Collins et al. 2012), and rugby football matches (Collins & Roberts 2008) impactfully reflects this reality. Wicker (2018), inspired by the ecological footprint-sport union, used a carbon footprinting model to assess the emissions generated by active winter sporting activities. This research is just the latest work that "has provided valuable insights into carbon footprint analysis in sport tourism" (Wicker 2018, 155; also see Chard & Mallen 2012 and Dolf & Teehan 2015). However, each of these studies employs a bottom-up survey-based footprinting methodology. While this is highly effective in evaluating emissions associated with individual tourists' travel (Wicker 2018, 154), it is less effective when working with large datasets. The current study will take a top-down approach by using big geo-data to obtain a broad, comprehensive evaluation of a sport tourism's carbon footprint while still being highly precise in considering many aspects of the gameday tourism experience, including tourist transportation.

A unique aspect of the sport tourism carbon footprint is the event's facility itself. A game at a stadium is an event, and events in their own right contribute to their larger carbon footprint as a separate measurement from tourists' transport, lodging, and food consumption and waste production (Collins & Potoglou 2019). Mega sporting events' stadiums especially have large environmental impacts through their direct energy consumption, extra waste production, and other emissions associated with event operations (Bunds et al. 2019). Hedayati et al. (2014) recognized the unique polluting potential for stadium structures and quantified a carbon footprint for one Australian-rules football match

by using a life cycle assessment (LCA) that takes into account the construction and eventual destruction of the facility. Even considering the entire LCA, this study highlighted the majority of the emissions came from electricity consumed by the stadium for the event (612). In addition to direct greenhouse gas emissions, these facilities often sit vacant for vast portions of the year and thus contribute to a static pollution of unused, unproductive, and inaccessible space absent of any attempt at "adaptive reuse" with the larger community in mind (Flaccavento 2016, 176). American college football's highest profile programs' stadiums operate in this capacity: they're among some of the largest sports stadiums in the United States, yet they're used for only seven or eight games a year.

American College Football Fandom

Yet for these few times a year in which the stadiums are used, a substantial temporary tourism economy roars to life. The fandom surrounding college football that feeds gameday tourism is intense, and nowhere is it more so than in the US South (Rooney & Pillsbury 1992, Bain-Selbo 2009). College football has a unique ability to transform landscapes and contribute to the larger placemaking processes in the US South (Bale 2003, Gumprecht 2008). Many scholars and popular authors (Barnhart 2000, Borucki 2003, Doyle 1997, Finebaum and Wojciechowski 2014, Gibbs 2010, Glier 2012, Gumprecht 2003, May 2012, McConnell 1983, Morgan & Klimasewski 2015) have connected the variety of college football played in the Southeastern Conference (SEC), including by the University of Tennessee Volunteers, to the US South through its importance in people's lives, the passion and economic expenditures it inspires, and its ability to be an important agent in geographic and regional placemaking. College football fandom is an important mode of ritual that is used to construct a narrative of regional identity (Turner 1969, Paasi 2003, Carter et al. 2019), and the stadium on gameday is the very place through tourism where that identity is fostered and (re)created (Gumprecht 2003, Harris 2008). The multi-scaled geography of

college football fandom reinforces these narratives as tourism acts as an agent in defining, bounding, and constructing the imagined fan community (Anderson 2016, Hills 2002, Nathan 2013). Gameday tourism specifically reinforces these fan communities' attachment to place through collective experience of nostalgia and emotion (Zhang et al. 2018). Through this tourism experience, fans intimately interact with the stadium space to create and recreate place that transforms the stadium, the game, and the host town into spaces infused with emotion, common identity, and nostalgia.

College Football Gameday Tourism & Attendance

Collegiate football fandom manifests itself in many ways both at and away from the stadium (Roseman & Shelley 1988, Hagood 2017) both during and outside of the season (Cooper 2020b). Gameday attendance is but one expression of fandom. However, because of its visibility on television, the popular notion of "home-field advantage" that integrates the crowd into the competition, and the economics of gameday, it is an expression that is heavily studied. This subject has been particularly pertinent with a recent widespread decline in overall football fan attendance at many institutions across the US (Abeza et al. 2018).

Groza (2010) statistically studied the impact of the college football conference realignment process on teams' gameday attendance. Importantly, he posits that the geographic "distance between universities…would be negatively associated with visitor ticket sales" (519). He reaches the conclusion that the recent conference realignments do in fact increase attendance in spite of control factors that he hypothesized might nullify this. Gameday expenditures on tickets were seen as an expression of fandom, and this stimulated a significant collection of revenue for the host university.

Falls & Natke (2014) examined factors that influence gameday attendance more directly and demonstrated the complicated and varied motivations game-goers have to

travel or to not travel. Many of the same factors examined elsewhere were found to positively influence attendance and other economic expenditures such as more on-field success, higher levels of undergraduate attendance, and more television coverage. Conversely, poor weather, a more populated municipality where the stadium is located, and a closer proximity to professional football programs were all seen to have a negative relationship with attendance. This study appropriately demonstrates the complicated and nuanced decision tourist-fans make by journeying to, investing economically in, and attending the in-person college football experience. Popp et al. (2017) examine tourist motivation in the context of college football post-season bowl games also through statistical analyses. They found slightly different results that can be explained by these games' neutral site locations. Some common factors with Falls and Natke (2014) however included a negative relationship with distance from campus and a positive relationship with on-field success. Popp et al. (2017) specifically write to a business/industry audience on how to maximize gameday attendance, citing the economic benefits for the host destination. This once again reinforces college football gameday as a tourism experience.

Geographer John Bale (2003) also discusses motivating factors for game attendance in a more qualitative and theoretical manner. He recognizes the unique ability of college football to transform landscapes and contribute to the larger placemaking processes in the US, especially the South. Bale sets the framework for this study by noting fandom's critical role in sport-geographic processes; specifically, gameday attendance, an expression of fandom, plays a critical role in gameday placemaking (2003, 117). In a specific example, he identifies fan regions around London for local Premier League teams based on ticket sales, emphasizing the role of the geographic region in motivating sport game attendance. While he does not designate it as tourism explicitly, he uses an economic expenditure tied to the tourism experience of game attendance to study the larger processes of fandom

geographically. Gumprecht (2008) and Gibbs (2010) examine gameday attendance ethnographically, and each comments on the personal economics of the fan, the larger economic impact on the host destination, and the role of travel in the college football gameday experience in the US South.

While this tourism is an important social agent, overall college football fan attendance in many places is on the decline (Abeza et al. 2018). Some have posed that television and other media are to blame (Fizel and Bennett 1989). It is after all true that gameday tourism is but one expression of fandom (Roseman & Shelley, 1989), and media is an excellent catalyst in the creation, formation, and maintenance of imagined, geographically disparate communities (Anderson 2016). Perhaps the increasing availability and quality of television sets to American college football fans precludes the need for them to express their identity by viewing the games in person (Toppmeyer 2020). Charlotte Wilder (2020) in her ethnographic journalism challenges this notion as the singular reason for the decline; rather than "a lack of emotional investment, it's a sign of shifting realities" that does include more and better television coverage but also increasing ticket costs, inconvenient kick-off times, and often uncompetitive games. This complicated tourism phenomenon of declining fan attendance nationwide is useful context when beginning to explore the ticketing data used in this study.

Methods

Data

To begin to understand fandom in intermediate-scale sport tourism and assess its contribution to the overall global tourism emissions, six seasons of home football games at the University of Tennessee, Knoxville, a member institution of the SEC, are analyzed using comprehensive, precise, anonymous, and geolocated ticket sales data. The direct goal of this

study is to quantitatively approximate the carbon footprint for Tennessee's 2014-19 football seasons by surveying this powerful ticketing dataset to assess gameday attendance and tourism in Knoxville, Tennessee. The data were processed at the per-order level where multiple tickets were often purchased in a single order. Each of these orders have an associated postal ZIP code, approximately spatially locating each ticket.

Many different types of ticket sales are included in this analysis including single-game tickets and season tickets from the university itself and tickets sold on secondary markets. Qualitative interviews with ticketing officials at the University of Tennessee and around the SEC revealed the importance of distinguishing these as conceptually separate groups of fans, but in a tourism context, their journeys to the spectate are all similar and will have comparable emissions associated with their travel. Therefore, all tickets were treated alike.

Additionally, these ticketing totals do not total up to announced attendance totals per game. The NCAA's reporting methodology and therefore reported stadium capacity includes all persons within the competition arena including players, team staff, and event workers. Those individuals are undeniably part of the tourism phenomenon that is college football, and they themselves have a carbon footprint associated with their participation in the gameday economy (Pereira et al. 2019). However, the focus of this analysis centers on the group that makes up the vast majority of the people in the stadium: the fans.

Descriptive Statistics and Initial Analysis

These data used to carbon footprint a season of football tourism in Tennessee are not static numbers; rather, they are representative of a much more complex social process of expressions, (re)creations, and performances of identity and fandom. Gameday attendance is a particular type of tourism that is still being explored. In order to better understand the context and nuance of the data here, a preliminary set of analyses were undertaken to

highlight the dynamics and dimensions by which this particular set of gameday tourism events occur.

An initial spatial and statistical examination of a sample of Tennessee ticketing data at the ZIP code unit of analysis (Table 1) supports the literature's conclusion that distance has a statistically significant negative relationship with gameday attendance.[4] That is, the farther away the ZIP code is from Neyland Stadium in Knoxville, Tennessee, the site at which The University of Tennessee plays football, the less the likelihood of someone from that ZIP code attending a game. Social factors are significant variables in spurring college football fan travel too (Menaker & Chaney 2014). Table 1 shows the results of a Poisson regression conducted with a majority sample of the total ticket sales for the 2014 Tennessee season by ZIP code with the independent variables of distance, median household income, and total number of households. The latter two variables were derived at the ZIP code level from the American Community Survey's five-year estimates for 2014 (U.S. Census Bureau 2014). The Poisson regression was used because of the data's nonlinear count nature (Zeileis et al. 2008). The two socioeconomic variables both show a significant positive relationship with ticket sales, indicating that tourists are more likely to come from more populated and more affluent areas.

Additionally, the significant, large, negative coefficient estimate for distance in this regression when controlled for these socioeconomic variables supports a distance decay pattern (Pun-Cheng 2016) and can give insight into the spatial distribution of the tourists studied here. If the literature shows transport as a major contributor to the tourism carbon footprint, perhaps the relatively more localized nature of Tennessee football tourism will render automobile emissions less of a factor. The Psuedo-R^2 value for this regression is

[4] All tables in this thesis may be found in Appendix A: Tables

higher than 0.4, meaning that the Poisson model fits this tourism case study well (McFadden 1979). We can be reasonably confident then that geography and income describe our tourist well.

However, this geography is complicated; Roseman & Shelley (1988) asserted the importance of state identity as an important factor in many states' flagship universities' fanbases. Likewise, Harris (2008) demonstrates that sports tourism in the form of gameday attendance both establishes and is marketed by place identity. The asymmetrical geography of Tennessee and its flagship university's location in the eastern part of the state along with the spatial distribution of ticket purchases (Figure 1) suggests that a geographic phenomenon stronger than simply distance decay is at work in motivating tourists to attend football games in Knoxville; perhaps this might be place-based regional identity.[5]

Approximating a Carbon Footprint

To quantitatively assess a carbon footprint of Tennessee's 2014-19 football seasons, El Hanandeh's (2013) approximation of the carbon footprint of the Hajj to Mecca was used as an inspirational framework. El Hanandeh assessed transport, food consumption, waste production, and hotel stays to estimate quantitatively the total amount of carbon produced by the Hajj annually. These measures are detailed and useful for assessing the environmental impact of gameday tourism in places away from the stadium. However, this framework does not leave room for the carbon footprint of a sporting event itself to be included in the overall approximation, an important aspect of sport tourism footprinting (Collins et al. 2007). Thus, El Hanandeh's categories plus stadium operations were aggregated to approximate a full carbon footprint.

To preface the calculations, it bears repeating that there is a great deal of authorial

[5] All figures and maps in this thesis may be found in Appendix B: Figures

speculation and bias in the generation of this model as carbon footprints estimations are notoriously controversial and issue-prone (Pandey et al. 2011). The miles used to approximate transit fuel emission figures were generated by calculating an "as the crow flies" Euclidian distance from each ZIP code centroid to Neyland Stadium with a geographic information system (GIS). A network analysis should be performed to glean more accurate driving distance values. We also know that "carbon footprints are likely to vary greatly by location" and that figures are not directly transferrable from one space to another in carbon calculating (Dwyer et al. 2010). While US data were used whenever possible, there are gaps in the current literature concerning specific, market-accurate emissions data. When this occurred, non-US, western emissions data acted as a research-based surrogate.

Also, gameday transportation is assumed to be by automobile, though in reality it is unlikely that every last fan drives to Knoxville. The EPA's carbon calculator (EPA 2019a) uses the average fuel efficiency of a vehicle in its computations when in reality, a range of automobiles that vary in age, condition, and fuel economy are used for gameday transport. There is a documented tradition among some SEC schools of driving recreational vehicles (RVs) to home and away games (Gibbs 2010, Rode 2015, see St. John 2004); these and other vehicles with low fuel efficiency would produce more emissions than for what the formula provides. The same can be said for air travel. While Knoxville, Tennessee does have an airport, it is relatively small and located well outside of the city center and stadium. While the primary form of travel is assumed to be the automobile, some fans will have used an airplane or even a yacht on the Tennessee River to travel to games. Like RVs, however, these have higher emission values than most average automobiles (El Hanandeh 2013); thus these transportation values may be a slight undercount.

For auto emissions, the EPA's formula of 4.09×10^{-4} metric tons CO_2E/mile where CO_2E includes all greenhouse gasses normalized in the metric of carbon was used (EPA

2019a, see FHWA 2018, Padgett et al. 2008). To assess vehicle occupancy, a field survey was taken at a Knoxville parking garage directly before a 2019 Tennessee football game. With a sample of n=207 vehicles with two researchers at two different garage entry points, the mean occupancy was found to be 2.7 people per car. This is comparable to Collins & Cooper's (2017) finding of 2.6 tourists per vehicle. With this mean rounded up, every 3 tickets from the same ZIP code was calculated as one automobile. This metric only takes into account travel emissions rather than a full life-cycle analysis of the car itself.

For hotel stays, only those tickets (i.e. tourists) from ZIP codes outside of a 150 mile radius were included in the calculations; anything closer was considered a day trip. Ricaurte's (2018) approximation for Knoxville, TN's hotel emissions was 23.21 $kgCO_2E$/occupied room. The American Hotel & Lodging Association (2015) estimates an average of two people per occupied hotel room in the US. Therefore, 23.21/2 = 11.605 $kgCO_2E$/guest/night. This is very similar to Filimonau et al. (2011)'s 11.65 $kgCO_2E$/guest/night finding. This hotel metric includes waste, breakfast, water usage, and laundry service.

For emissions associated with waste generation, a custom value was calculated from the US government entities Environmental Protection Agency and American Community Survey due to a lack of market-specific tourism data. In 2017, the United States was estimated to have produced a total of 1.31e+11 $kgCO_2E$ (EPA 2019b) from waste management activities. The population of the US in 2017 was approximated to be 325.7 million (U.S. Census Bureau 2017). Divided out, this comes to about 1.1 $kgCO_2E$/American/day. This value will be used in the context of this tourism study as it is US-based and is close to El Hanandeh & El-Zein's (2010) value of the 1.55 $kgCO_2E$/tourist/day. This measures the emissions generated from the collection and processing of waste and recycling.

For food consumption, Berners-Lee et al. (2012)'s estimation of 7.4 kilogram CO_2E/person/day for an average omnivorous diet in the UK was used as a proxy for US data. This is a total LCA metric including transport of food from growth/production to place of sale, cost of packaging, food store operation, and marketing of the food was calculated in this metric.

For a total footprint estimate for the games themselves, Collins' many examples of match footprinting (Collins et al. 2007, Collins & Roberts 2008) were not directly transferable due to her usage of the ecological footprint that is expressed in global hectares. In lieu of US market-based carbon emissions data, Hedayati et al. (2014)'s study of an Australian Football League stadium's total metric of 14.74 kilogram CO_2E/attendee was used. This is also an all-encompassing life-cycle assessment metric that includes stadium construction, maintenance, and gameday operations such as in-stadium energy consumption and waste production.

Results

For every ZIP code in the United States, a carbon emissions value was calculated for each of Tennessee's 7 or 8 home games per season based on the attendance counts and each of the greenhouse gas emission sectors (food, waste, hotels, car, and game/event) in the manners described above. Totals were aggregated by emission sectors (Table 2) and individual seasons (Table 3). Full data displayed by individual game may be found in Table 4. The total footprint calculated for six seasons of Tennessee football was approximately 232,864,549 kilograms of carbon equivalent emissions for an average of just under 39 million kg CO_2eq per year. The spatial distribution of this emissions total based on tourist origin can be found in Figure 2. On average, each tourist is responsible for 60.58 kg CO_2eq emissions per game.

The disaggregated results show a great variation of emissions among the tourism sectors. Automobile emissions register the highest, in line with aforementioned research suggesting that the transport of people is the most direct contributor to a carbon footprint (Lenzen et al. 2018). This holds true here; over half (57 percent) of the emissions over the study period are from automobile use. The life-cycle assessment metrics of stadium operations and food consumption, respectively, follow.

The variation of emissions values among individual games is less than by tourism sector, but there is a difference among games even when the attendance is similar. That is largely because of the total quantity of fans; each GHG index is a function of how many fans travel to each game. Therefore, the more people who attend a game, the more emissions are generated. However, the results are more nuanced that that; additional game-to-game variations come from the fact that emissions increase as distance travelled by fans increases. Table 5 shows an initial test for correlation between total emissions and driving distance to and from Knoxville (controlled for total number of tickets) at the game-level unit of analysis for the 2014-19 study period, and the significant positive result with a strong R^2 reinforces this conclusion. Figure 3 spatially displays CO_2eq per person at the ZIP code level. This map reinforces the role distance plays on increasing emissions and highlights the importance of the automobile. It is not necessarily the number of cars traveling to Knoxville but rather the distance over which they travel that is important in contributing to the overall emissions footprint.

There are interesting results to dissect from a longitudinal standpoint as well. Considering literature's recent concerns about declining college football fan attendance across the United States (Abeza et al. 2018), these ticketing totals were tabulated per game. These values are reported in Table 4. Figure 4 summarizes the ticketing data and shows that across the 2014-2019 case study period, there has been a steady downward trend in

attendance at Volunteer football games. And, as Toppmeyer (2020) notes, “Tennessee’s average…attendance has decreased in each of the past three seasons.” How is this decline affecting emissions? As just demonstrated, Table 5 shows the positive correlation between attendance and emissions. This does not completely explain emissions, however. While attendance is dropping, GHG emissions are not decreasing at the same rate and are actually fairly stable across the case study time period. In fact, when normalized by attendance, GHG emissions per ticketholder per game is actually increasing (see Figure 5). This is because emissions are correlated positively with both attendance and driving distance. Figure 6 shows a similar trend as Figure 5 and demonstrates the gradual increase in the average number of miles driven per game per tourist over the case study period. That is, fans over time are driving longer distances to get to Neyland Stadium and therefore per capita emitting more greenhouse gasses even while overall attendance is dropping. A geographic perspective of GHG emissions and highly precise geo-located data are important in the carbon footprinting process.

Discussion

Situating these results within the larger literature approximating tourism carbon footprints is difficult because a majority of emissions are usually tallied through the carbon costs of air travel (El Hanandeh 2013). So in comparison with the per-tourist per-day carbon emissions with many of the literature reviewed here, these metrics may seem low. This brings into question the transferability of the emissions rates used in these calculations. However, the sheer fact of collegiate regular-season football tourism not depending on air travel keeps this estimate relatively capped and lower perhaps than its other tourism carbon-contributing counterparts.

Nevertheless, for only one college football program, nearly 233 million kilograms of

carbon were produced in six years from gameday tourism alone. College football tourism is not unique to the University of Tennessee nor the South; rather it is a phenomenon across the United States that garners a great deal of interest, motivates millions who live there to travel annually, and produces a carbon footprint that contributes to the global tourism footprint. There are 64 "Power 5" programs at the top level of NCAA Division 1 football that play seven or eight home games a year in front of similarly large crowds. Additionally, hundreds of other, lower-level college football programs encourage fan travel and attendance. Research should continue to assess the environmental dynamics of sporting events and sport-related travel, and there is a particular value in the continued research act of carbon footprinting within sports tourism studies (Wicker 2018). And because the placed context of tourism varies considerably by market, more collegiate sport case studies will be helpful in comparing to the present one in unearthing sustainability dynamics in college football.

This is a clear indication that more universities and tourism organizations should seek to understand their carbon footprint and overall contribution to global carbon emissions. While tourism is often a boon economically (Azam et al. 2018), it too often comes at environmental costs; indeed, tourism as a value-capital accumulation process imposes a structure of violence on "both human and non-human natures" (Büscher & Fletcher 2017, 653). Making a turn to more seriously considering the ecological aspects of tourism is critical for tourism organizations and governments (Gössling and Schumacher 2010, Pandey et al. 2011). The UNWTO (2008) has proposed encouraging short-haul travel and providing market-based incentives for carbon efficiency. However, some call for more concrete mitigation measures like the implementation of a carbon tax (Lenzen et al. 2018). Local, state, and national governments should have a clear and coherent policy when it comes to tourism, and environmental issues should be considered prominently during the

legislative process (Gössling 2013). This is especially important at the local level because tourism spaces and situations vary by market, and thus geographic-specific solutions will be key to maximize sustainability (Collins & Potoglou 2019).

Specifically for this case study, the University of Tennessee should aim for two goals. First, considering Table 5 and Figure 3, it should attempt to reduce the number of miles driven by automobiles used in gameday tourism because tourist transport is a primary contributor to an event's environmental footprint (Collins & Potoglou 2019). This is especially crucial due to the increase in the average fan's traveling distance over time (Figure 5) and that's effect on the school's overall sports tourism carbon footprint.

One mitigating approach would be to focus on marketing Tennessee football to a more localized fan base. The closer the sport tourist is to the spectate, the fewer miles s/he drives and the lesser the likelihood of him/er staying in a hotel. There is value in leveraging sports tourism and fandom to engender a locally-based civic pride (Collins et al. 2012, 578), and the university employing positive fan recruitment efforts in East Tennessee could encourage this. However, the dynamics of sports fandom (Nathan 2013) and membership within the imagined fan community (see Anderson 2016, Hills 2002) are complicated and spatially dispersed (see Figure 1), so simply marketing locally will not account for long-distance fans' travels. Another approach then to reduce automobile miles but still include more far-flung fans would be for the university to sponsor bus travel from populated, long-distance urban fandom hotspots like Atlanta, Memphis, and especially Nashville. This would be one of "the most carbon-efficient travel options" (Filimonau et al. 2014, 634) as it would reduce the total number of miles per vehicle making long-distance trips to Knoxville. Additionally, the journey could be marketed as part of the tourism event itself that allows for bonding by passenger tourists over their common fandom. If seriously implemented, this option would almost certainly decrease the overall carbon footprint of Tennessee

gameday tourism along with alleviating parking infrastructure stresses in Knoxville.

A final group of local fans who could be encouraged to attend is the student ticketing population. In accordance with national trends (Wilder 2020), Table 6 shows that it is not only the general attendance population that is receding over time; Tennessee's student section is as well. Both raw student attendance and the percentage of students making up the whole crowd have declined every year for the study period. While Neyland Stadium has decreased in average attendance by 11.42 percent over this six-year span, UT student attendance has dropped by over a third at 33.55 percent over the same time span. This is significant because students are almost always local and thus come with low transportation and hotel carbon footprints. Indeed, while the overall per-capita GHG emissions value continues to increase every season, per-student GHG emissions are remaining level at much lower values (Table 6). Therefore, the student population would be an excellent local demographic for the university to target in order to boost attendance in a more environmentally sustainable way.

The second goal for which the university should strive is educating its fanbase on the very fact that there *is* a carbon footprint associated with their game attendance. Even if there currently is a "gap between environmental attitudes and tourist choices" (Budeanu 2007), there is a willingness among tourists to offset their carbon footprints (Berezan et al. 2014). However, if fans do not even know how their actions contribute to glocal, both local and global (Castree 2003, 176), environmental problems, they cannot make intentionally sustainable choices. Educating the public about how personal activity affects ecological sustainability is an important first step in encouraging better environmental habits and promoting responsible resource use and consumption (Collins et al. 2018). The university should play a critical role in this educational mission by a public awareness campaign, but governmental policy should also do more to edify its citizens on general carbon literacy. The

general public may know that automobiles emit a greenhouse gas, but do people know relatively how impactful it is or to what extent it contributes to global climate change? General societal carbon literacy would aid in educating tourists and encouraging more sustainable practices.

Conclusion

Amidst national and international recognition of the severity of climate change on a global scale, football gameday at the University of Tennessee, Knoxville contributed over 232 million kilograms CO_2eq gasses to the global carbon footprint through a host of tourism activities over six years, the majority of which came from automobile transportation. American college football fandom is a complicated social force bound up in personal, community, and place-based identity, and it is far from an innocuous, frivolous pastime; rather, it manifests in a tourism context that has tangible, grounded, and consequential effects on the environment and society. Volunteer football fandom is no different, and it is only one of many cases of college sports tourism in the United States. Each sporting event has an associated carbon footprint.

Research should continue on assessing the sustainability of sporting events, and it is imperative too that tourist-fans understand their own personal contributions to the phenomenon to encourage more sustainable individual actions and choices. Both tourism organizations and governments have a responsibility to act in light of the findings to reduce emissions and curb effects of global climate change, and the University of Tennessee and the Tennessee state government are no different. The university's "Make Orange Green" initiative has led to the enacting of a zero-waste policy at games, but clearly, as the results show, sustainable sports tourism is more nuanced than simply recycling. In light of recent international studies on global climate change and tourism's substantial contribution to this

phenomenon, more should be done to help reduce carbon emissions associated with the annual tradition of college football in Tennessee and more broadly at sporting events everywhere.

CHAPTER 3 – IMPLICATIONS AND FUTURE RESEARCH

Introduction

There are many implications of this study to note. As Chapter 1 made clear, there are several different bodies of literature and important methodologies influencing the execution of the carbon footprinting analysis, even as the producing the article in Chapter 2 did not allow for a full accounting of those issues. The execution of the project was not forcing random disparate pieces together but rather intentionally mosaicking important, carefully chosen modes of thought to inform the way in which the analysis was uniquely conducted. Considering these myriad influences, there are many different projects that could and should follow this one in different lines of academic thought and traditions. In this last chapter, I hope to demonstrate the importance of what this critical carbon footprinting is trying to accomplish by both stating a few of its implications and suggesting connected future research that would contribute more to geographic literatures of sport, fandom, identity, and sustainability.

Implications

Mixed Methods and Means of Geographic Research

One implication of this piece is the demonstration of a robust use of quantitative and computational methodologies in tandem with big data in conducting sound critical human and cultural geography. Sometimes, there is just no easy way to reconcile quantitative and qualitative methodologies in geography. Many find that they have fundamental differences of opinion, preference, and conviction over whether the nature of geographic work should be rigorously based on the scientific method and statistics or whether that approach reinforces neoliberal norms and disregards the role of culture and individuality in spacio-

human dynamics (Johnston 2003). Geographers have negotiated this "conflict over the discipline's identity" since the positivist turn away from descriptive regional geography in the mid twentieth century (Johnston 2003, 51).

There is still a place for rigorous spatial analysis in geography; indeed, "information always has a geography," and the analysis of this data can crucially help us to understand the place-making process (Poorthuis et al. 2016, 248). Big data and GIS can be used to simply understand large spatial trends both qualitatively and quantitatively (Poorthuis & Zook 2015, Poorthuis et al. 2016). Spatial analysis can examine regional economic trends (James & James 2015, Kalafsky & Graves 2018), or it can be used to understand group identity at the regional (Arthur & Williams 2019) or national (Metzger et al. 2016) levels. But it can also be leveraged for more critical social ends, like examining the experiences and expressions of traveling as a black person (Dillette et al. 2019). The means do not determine the end.

This work serves to demonstrate that new technologies and quantitative methodologies can and should contribute to forward-thinking critical human and cultural geography. Though this carbon footprinting derives much of its power from the underlying big dataset and its database-d storage and management, the resulting paper does active work that does not simply "reproduce the status quo" (Johnston 2003, 62) but rather critically investigates an under-appreciated consequence of tourism, fandom, and ultimately identity: environmental sustainability. My past work with similar datasets (see Cooper 2017) presented a positivist analysis of a regional social phenomenon without much criticism at all into the region or the phenomenon at all. For this thesis, I started with more data and more advanced technical skills, but I chose to implement it in a way this time that did not just reproduce norms and status-quos. My means did not determine my end.

Qualitative and quantitative methods in geography are leveraged to answer different

questions (Wells & Baldwin 2012). However, this does not negate the potential or the usefulness of both methods of scholarship working in tandem to fully assess, understand, and critically investigate a phenomenon of human geography. And, often times, twenty-first century technologies are apt tools that can aid researchers in answering their questions in stronger and more efficient ways.

The Study of Fandom and Sport in Geography

Another implication of this study is to emphasize the role of fandom and sports within the study of geography. Most who study these seriously must overcome some "misguided notion that sport is somehow frivolous and does not represent or offer a viable field of study" (Sands 1999, 7). Rather, social scientists who study sport acknowledge that it "plays a tremendously important role in setting boundaries between groups, contesting them, defining what is normal….and entangling the everyday lives of ordinary people with the state, the nation, and the world" (Besnier et al. 2018, 1; see Besnier & Brownell 2012). Sport is not just a cultural universal, but it is also "one of the best indicators or expressions of culture" (Sands 1999, 3), and even its "irrational aspects" can be explanations of "symbolic and emotional power" (Besnier et al. 2018, 158). Geography is a discipline well-placed to house, nurture, and foster sport scholarship because "space and place…are central to both geography and sport," and sport can be studied as a "major aspect of economic, social, and political life" (Bale 2003, 2).

The literature review in Chapter 1 touched on many of the pertinent historic and modern evolutions and dynamics of sport geography, and this work serves to continue the trend towards a more critical socio-spatial study of sport. Indeed, sports and their associated fandoms are emblematic of larger geographic processes and can have real, tangible effects and consequences for our world. Sports can inform deep psychological processes in the individual that manifest in personal and collective ways such as rabid

fandom (Pritchard et al. 2010). Of course, as this study shows, there are real and immediate consequences for the environment that manifest when that fandom induces travel to spectate at competitions (Collins & Roberts 2017), and this is a modern economic activity that is contributing to an increasingly irreversible process of climate change (McKibben 2011). Sports have also been shown to be "emblematic of geopolitical processes" (Andris 2018, 479), and this has been true for the intertwined narratives of nation and sport (Harris 2008), heritage and sport (Koch 2015), and home spaces of belonging and sport (Baker 2018).

This study has demonstrated how fandom works as an agent of placemaking, alters the cultural landscape, operates within imagined communities, and facilitates place attachments. Sports geography has a potential to operate much more broadly than simply between the sidelines. This critical look at "sports provides a window on 'the serious life'" (Brownell et al. 2017, 1) in the way it contributes to a discussion of global climate change. It has aptly reflected the idea that "sport [itself] is a spatial science" (Bale 2003, 2) in a critical environmental manner, and it shows how our societal "deep play" (Geertz 1972) and the stories we tell ourselves as communities engaged in that play have real consequences. Geographers should continue to study sports critically.

The Study of Place-Based Group Identity, Regions, and Geographic Imagined Communities of Belonging

This thesis is also working to show how constructed place-based group identities do no only act as agents in making places of belonging and attachment but also can have far-reaching tangible consequences for our world. Identity is not just a theoretical idea. And while it is imagined and constructed, it is an important part of the self-definition process for the modern individual (Taylor 1991) and it has the power to alter space and place. Identity matters.

In some instances, this is already well-established. Take for instance race. Race is an idea that is socially constructed (Fredrickson 2002), and for those marginalized on the basis of race, racial identity is a determinant part of life that undeniably has real-world effects like increased prejudice in incarceration (Alexander 2012), housing availability and eviction (Desmond 2016, Desmond & Gershenson 2017), and freedom to move across space (Alderman et al. 2019). Racial identity for some cannot be divorced from the homemaking process (see hooks 2019), and sometimes racism leads to domicide, the destruction of a place of belonging (see Bonds & Inwood 2016). Race is one socially constructed identifier, but those socially marginalized by other constructions such as gender and class also daily deal with consequences of their being Othered (Rother 2017).

It is through this intersectionality that we know that "place is linked to the formation of personal and group identity" (Castree 2003, 177). Place-based group identity is often studied in terms of the nation (Mahtani 2002, Mookerjea-Leonard 2005, Blunt & Dowling 2006). However, another important scale of place that deserves discussion is the region. This thesis has already begun in Chapter 1 to articulate the importance of studying regions despite modern geographic criticisms, and indeed, the worthwhileness of their study is a healthy disciplinary debate. However, this work supports the ideas that "understanding…regions is a justifiable, even necessary, pursuit" (Zelinsky 1980, 2). Regions are still a valuable unit of analysis for study within geography because of the power people ascribe to them during the imagination construction and maintenance processes and the material, social, and economic ramifications of membership or exclusion from these groups (Alderman 2015). The GHG emissions from Tennessee college football tourism studied here demonstrate one such result of regional construction.

Regions matter because they are geographic scales that serve as "horizons of significance" (Taylor 1991) for personal and group identity formation (Castree 2003). In an

age of globalization, it is just as imperative to examine regional scales to understand both its insular roots and interconnected routes because of their continued power to alter space and society in real, tangible consequences. Here, identity works to spur travel and induce tourism (see Carter et al. 2019), and that travel has environmental consequences not just for the region but for an entire planet in the throes of recognizing and tackling climate change. We must take seriously the role that place-based regional group identity has in creating imagined communities like Volunteer football fandom and the US South, both of which are important agents in spurring this travel and economic expenditure and hence impacting the environment. Identity in these forms may not be as apparent or as studied in its role in informing life choices as the aforementioned identities of race; class; gender; and sexuality, nor are its consequences as obvious as are those of more recognized forms of hegemonic destructive social practices (see Bonds & Inwood 2016). Fandom and regions seem innocuous enough, but this work demonstrates the necessary critical approach needed to unpack the myriad consequences of many types of place-based identity expressions.

Future Research

Continued Carbon Footprintings

This project has presented several opportunities for future research and exploration. Its multifaceted origins, methods, and results encourage a wide breadth of continued thought and exploration. First, to restate from Chapter 2, because differing market and place-based qualities, tourism spaces vary greatly, and market-specific sustainability strategies should be explored and implemented (Collins & Potoglou 2019). Carbon footprinting is a valuable part of this market-specific research. By more future cooperation and data-sharing between researchers and their university athletic administration, college sports programs will be able to address climate change and increase campus sustainability

with custom, individualized solutions. Part of future carbon footprinting that would be particularly useful would be to glean site-specific footprinting values. The current study is admittedly somewhat limited in its accuracy as it leans heavily on other research for its GHG indices. Taking this framework of a database-powered geographically precise footprinting research methodology and applying GHG emissions values gleaned from the tourism site itself would be very powerful. For example, local utility companies could be consulted for waste and stadium electricity values, and local tourism offices could be contacted for lodging and food impacts on the host community. On a related note, in future footprinting studies, a greater effort at quantifying uncertainty based on precision of data and accuracy of GHG emission rates would help add confidence in the study's results and recommendations.

Critical Readings of Campus' Sports Landscapes

Another important study in the sustainable nature of college football fandom would be to examine other pillars of the "triple bottom line" (Collins & Cooper 2017, 148): the economic and social consequences of fandom. For example, what is the economic impact of gameday tourism upon the host destination? What would a critical examination of monetary expenditures of fans on their football fandom illuminate about the values people hold and what they're willing to exchange to support their fandom and by extension their identities (see Lee et al. 2011)? Who socially is this Tennessee or SEC fandom for? How does the fandom work across class or racial lines to include or exclude? How is football in the South in conjunction with fandom deployed to prop up the mythologies of the Lost Cause and white supremacy?

Specifically addressing the social pillar of sustainability, a particularly useful study would be an analysis of college campus landscapes where gameday tourism occurs for a critical reading of the memorialization of sport-society intersections. On campuses in the US

South like Tennessee's in Knoxville, a prime candidate considering current regional and national tensions regarding race and public memory would be to examine the racial integration of SEC sports and how it is remembered in and through the landscape. Markers, signs, and memorials dotting the cultural landscape can be indicative of identity creation and negotiation (Polese 2018). Campus landscapes too are public spaces that often function as "political arenas" for the commemoration of race-related struggles and violence (Brasher et al. 2017) that contribute to the creation of a hierarchical idea of race itself (Luke & Heynen 2019). Sports are a very visible way in which publics interact with universities, and, especially in the US South, this interaction can illuminate tensions and inequalities that concern and recreate collective memory (Bever 2011). Racial integration would be a good lens through which to study southern universities' place in (re)constructing social-historical narratives surrounding race since the SEC, "perhaps mirroring social life in the South, was slow in integrating its sports teams [while today], however, black athletes are a dominant force on SEC athletic teams" (Paul et al. 1984, 297). Tennessee was the second SEC school to integrate its football team in the 1968 season, one year after Kentucky broke the SEC color barrier (Paul et al. 1984). It would be interesting not only to explore the stories which the Universities of Kentucky, Tennessee, or even Alabama (see Nathan 2015) tell about their own complicated histories of integrating their sports teams but also to see how those stories are told and retold through their campus landscapes and gameday performances.

Ticket Sales & Attendance Analyses

A part of the economic sustainability pillar that could be further explored after this project is the study of what encourages and inhibits gameday attendance and, by extension, the purchasing of football tickets. Chapter 1 reviewed some of the academic literature that has posited theories for this in different contexts (see Groza 2010, Falls & Natke 2014, and Popp et al. 2017), but use of geographically precise ticketing data could drastically enhance

the statistical power of the findings. The disciplines of sports marketing (Kim et al. 2013), tourism studies (Clifton & Handy 2003, Tucker & Deale 2018), and in particular sport tourism (Green & Chalip 1998, Daniell 2013) are consistently interested in assessing motivation for tourist travel, so this proposed research would also contribute to those bodies of knowledge.

Particular questions of attendance that this project has spurred generally stem from the precise geolocated data as geography is well suited to contribute to the questions of fan motivation. Qualitative surveys of game-going fans would be valuable to conduct in the SEC market, but this is an established method of assessing fan experience at sporting events (Robbins et al. 2007, Collins & Potoglou 2019). There are many quantitative questions that could be answered with tourism at such a fine geographic scale. Though there can be many problems using US ZIP code polygons (Sadler 2016) or indeed any formally defined administrative polygons in geospatial analysis (Poorthuis & Zook 2015), robust work can be conducted at this unit of analysis (see Hanna-Attisha et al. 2016). For instance, the US Census provides socio-economic and demographic data at the 5-digit ZIP code level. Using this, research could statistically generate a more descriptive analysis of the average fan based on ticketholders' socio-demographic origins (see Menaker & Chaney 2014). From this, we could better understand what social factors significantly influence or hinder attendance at UT football games. Table 7 shows an initial attempt at this type of analysis.

Geography itself could also be further explored. Table 1 shows an initial test for significance of distance on ticket sales at the ZIP code level. Further use of big geo-data in exploring the effect of distance decay on tourism travel should be conducted. Additionally, more sophisticated models in GIScience and geostatistics should be used to fully assess the variable of location in tourism, sport, and regional phenomena (Andris 2018, Kalafsky & Graves 2018, James & James 2019). Given also the role of US States in constructing and

bounding fan identity in the United States and especially the South (Bain-Selbo 2009, Cooper & Davis 2019), a comparative analysis should be undertaken by using the ticketing data: is distance or state of origin more predictive of fan attendance at college football games? Support of the hypothesis that the state rather than distance is a stronger predictor of attendance would contribute to the discussions of state and regional identity and the geography of fandom from a qualitative angle. It will be important too for geographers to use big data and geospatial methods for qualitative GIS uses that "[appropriate] existing GIScience for critical geographic purposes that recognize and pluralize its epistemologies instead of reworking paradigmatic assumptions" (Kamstra et al. 2019).

One final specific question that could be further explored regarding fan attendance is the issue of student fan attendance. Chapter 2 hinted that encouraging students to attend games could be a significant factor in the university's ability to boost its number of local tourists and thus reduce its overall football carbon footprint. First, however, the symptomatic drop in student attendance needs more academic exploration. Students are an important subset of the larger population of game-going fans for their contribution to the stadium culture and thus the placemaking potential of the geography of gameday. Charlotte Wilder's excellent ethnographic journalism on this issue (2020) gives a needed qualitative and anecdotal highlight to this issue that raises some potential reasons for this decline, namely: time of game, cost of both student tickets and college itself, and the competitive nature (or perceived pregame competiveness) of matchups. Using mixed methods on a localized college campus would not be much of a lift, especially for researchers who teach student-fans regularly. Surveys and statistics could answer which variables are affecting student attendance the most.

Though such a robust analysis to answer these questions is beyond the scope of this study, a few data points stand out. While Table 6 shows a drop of student tickets from the

beginning to the end of the overall study period, Figure 7 shows this steady declining trend in attendance per game. Just a casual look at the by-game figures shows greater student attendance for the first home game of every season regardless of opponent, more attendance for Tennessee's classic rivals of Florida, Alabama, and Georgia, and abysmal attendance for the biannual Vanderbilt game which occurs over students' Thanksgiving holiday break. More factors of Tennessee's current winning percentage, weather, time of game, and perceived competitiveness may also be affecting trends. Both surveys of Tennessee students and further geostatistical analyses with this dataset would be useful in answering the question of declining attendance in this Knoxville case study. The results of such a study would be useful for university administrators seeking to both rebound student ticketing sales and encourage local tourism to be more carbon-conscious in their game management.

Toponymic Analyses of Fandom & Identity

While football gameday attendance is an important expression of fandom, it is important to realize that there are many other geographic phenomena that are also indicative of fandom and identity (Cooper 2017). Indeed, it is just as valuable to explore the experiences of those fans participating in fandom away from the college football stadium (Roseman & Shelley 1988, Cooper & Davis 2019). One way geographers have studied fandom across space and in its power to alter landscape is by studying business naming patterns. There are plenty of reasons to do so under the guise of sustainability; after all, business naming is a form of economic activity. It is precisely because these practices of business naming and the toponyms themselves "participate in the commodification of place" (Alderman 2015, 51) that these studies have power. The act of "selling a place requires [using] sense of place as] the product," (Purcell & Moore 2019, 249), and that sense of place is attached to businesses to be marketed to and consumed by customers. Toponyms thus "reflect how people perceive and identify themselves" and can be read, interpreted, and

studied as “symbolic texts” that market and sell versions of imagined communities, be them fan or place-based group identities. For example, Gunderman & Harty’s (2017) study of fandom surrounding the Grateful Dead highlights the role naming can play in altering the cultural landscape, memorialize, facilitate remembrance, and maintain a fan base to compliment a discussion of this fandom within cultural geography. However, this practice has not been utilized to study the socio-spatial dynamics of sports fandom.

Geographic toponymic analyses have though been widely used in regional studies. Many of these, including the original hallmark regional toponymic study (Reed 1976), were mentioned in Chapter 1. Using business names to illuminate the vernacular region is well established (Zelinsky 1980; Good 1981; Lamme III & Oldakowski 1982 & 2007; Shortridge 1985 & 1987; Reed et al. 1990; Alderman & Beavers 1999; Barker 2005; Ambinakudige 2009; Cooper & Knotts 2010a, 2010b, 2017; Cooper et al. 2011; McEwen 2014; Alderman 2015; Liesch et al. 2015; Holtkamp & Weaver 2018). Given the importance and value of studying business toponyms in understanding both fandom (Gunderman & Harty 2017) and regional identity (Alderman 2015), business names could be used to examine the alignment of and relationship between SEC fandom and southern identity.

Given the discussion above about the implications of using new technologies as tools in critical human geography research, it is important for any geographer continuing to expand the body of literature on toponymic regional or fandom analysis in the future to use a comprehensive and complete dataset. For example, ESRI’s business analyst database sports a near-complete geocoded database of incorporated businesses in the United States (Holtkamp & Weaver 2018, 65). Reed (1976) searched phone books by hand to build his database, and following studies have relied on derivative scrapings of online phone books. A comprehensive business database would not have to rely on samples of businesses from select cities dictated by phone book; rather, the data could be more spatially precise.

Additionally, using a database would bring benefits mentioned in Chapter 1's methodology section, namely efficient and fast executions of queries. This would allow the researcher to perform a larger-scale analysis with methodological ease.

However, it is also necessary to connect this top-down mapping and measuring macro-level patterns in naming and identity with more bottom-up, micro-level, qualitative studies of name-based identity expression and meaning-making (Rose-Redwood et al. 2010). There have indeed been a few attempts to qualitatively understand the practice of naming businesses (see Bletzer 2003, Alderman 2015, Gunderman & Harty 2017), too little has been done to understand the grassroots motivations of the owners who ultimately make the decisions to market their businesses through the "symbolic capital" of naming (Alderman 2015, 36) and aligning culturally with a sports team. A sound qualitative understanding of these landscape-altering and value-expressing decisions would be useful in both the toponymic analyses of fandom and place identity. There is a vast untapped potential for the use of modern geospatial techniques, comprehensive datasets, and innovative qualitative methods in enhancing the work being done in folk geography.

Conclusions

Group identity construction is a complex, intersectional process that works in multiscalar ways. One scale at which identity can be formed that has been the subject of decades of debate in geography is the region, and the US South is a region of particular interest to scholars over time examining group identity. College football fandom is among the many "miscellaneous elements" upon which US Southern identity leans (Paasi 2003, 477). One expression of this fandom and by extension regional identity is football gameday attendance. Considering the entire "journey to spectate" (Bale 2003, 119) that is involved with such attendance, the entire fan travel experience can be framed as a tourism

phenomenon.

A dataset of six years of geo-located football ticketing data from the University of Tennessee, a prominent program in the US South, was collected and contextualized with literature from southern studies, sports geography, sport tourism, and works on fandom and belonging. Using modern database and GIS technologies, these data were evaluated categorically and spatially. In addition, due to the pressing nature of climate change and the role event tourism plays in contributing to the emissions of greenhouse gasses (Collins et al. 2007), a carbon footprinting analysis was conducted using the data. Through a quantitative analysis accounting for the geospatial precision of the ticketing data, it is estimated that from 2014-2019, 3.8 million football gameday tourists at the University of Tennessee, Knoxville contributed 232.9 million kilograms CO_2eq gasses to the global carbon.

These results demonstrate that American college football fandom is a complicated social force that it is far from an innocuous, frivolous pastime; rather, it has tangible, consequential effects on the environment and society. The same is true by extension for place-based group identity. Both should continue to be studied critically in the field of geography, and both critical quantitative and qualitative methods should be used to conduct this research. Future research to continue examinations of themes considered here include geographically precise carbon footprintings, critical readings of sport campus landscapes, mixed methods analyses on the phenomenon of and motivations for gameday tourism, and business toponymic analyses of fandom and identity. Furthermore, the University of Tennessee should work to encourage more sustainable football tourism in light of these results by encouraging more local fans to attend, providing mass transit for fans requiring long-haul transportation, and educating the public on the environmental costs of their travels to Knoxville to encourage more sustainable individual actions and choices.

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APPENDIX

Appendix A: Tables

Table 1. Generalized linear Poisson model of the relationship between ticket sales and independent variables at the ZIP-code unit of analysis.

Independent Variables	Estimate	Std. Error	*z* value	*p* value
Intercept	3.966E+00	6.35E-03	624.3	0.000***
Distance to Tennessee	-7.011E-01	1.38E-03	-509.8	0.000***
Median Family Income	1.724E-05	8.03E-08	214.6	0.000***
Total Number Households	1.135E-04	3.22E-07	352.6	0.000***

Notes: Ticket sales refer to a majority sample of 2014 single-game tickets from home Tennessee football games.
*** Significant at $p < 0.001$.
(Dispersion parameter for Poisson family taken to be 1)
Null deviance: 1098314 on 9412 degrees of freedom
Residual deviance: 523814 on 9409 degrees of freedom
45 observations deleted due to missingness
AIC: 541033
Number of Fisher Scoring iterations: 9
McFadden's Pseudo-R^2 = 0.5231

***Table 2.* Average Carbon Footprint by Emission Sector in kg CO_2eq; Tennessee Home Football Games 2014-2019**

	Hotels	Waste	Food	Stadium	Automobile
Total	11,305,858	4,235,768	28,443,454	56,656,285	132,223,184
Average per Game	262,927	98,506	661,476	1,317,588	3,074,958

***Table 3.* Carbon Footprint by Season**

Season	Total Tickets Sold	kg CO_2 eq	kg CO_2 eq per ticket
2014	647,159	36,626,989	56.597
2015	657,115	38,607,254	58.753
2016	657,799	39,412,468	59.916
2017	621,421	38,836,643	62.497
2018	605,077	37,860,748	62.572
2019*	655,139	41,520,446	63.377

*8 games (one more than the usual 7)

***Table 4*. Carbon Footprint by Game; Tennessee Football 2014-2019**

Year	Game	Opponent	Total Tickets Sold	Emissions ($kgCO_2eq$) by Sector					Total Emissions (kgCO2eq)
				Hotels	Waste	Food	Stadium	Automobile	
	1	Utah St.	96,200	235,605	106,012	711,880	1,417,988	2,815,487	5,286,972
	2	Arkansas St.	90,260	252,815	99,467	667,924	1,330,432	2,961,403	5,312,041
	3	Florida	96,433	285,158	106,269	713,604	1,421,422	3,169,209	5,695,662
2014	4	UT-Chat	86,774	203,772	95,625	642,128	1,279,049	2,260,543	4,481,116
	5	Alabama	96,078	342,835	105,878	710,977	1,416,190	3,364,186	5,940,066
	6	Kentucky	94,149	222,642	103,752	696,703	1,387,756	2,545,320	4,956,173
	7	Missouri	87,265	241,024	96,166	645,761	1,286,286	2,685,721	4,954,958
	1	Oklahoma	96,199	327,284	106,011	711,873	1,417,973	4,384,363	6,947,504
	2	W. Carolina	94,881	251,724	104,559	702,119	1,398,546	2,756,688	5,213,636
	3	Arkansas	94,654	292,794	104,309	700,440	1,395,200	3,349,479	5,842,221
2015	4	Georgia	95,548	240,073	105,294	707,055	1,408,378	2,989,201	5,450,000
	5	South Carolina	94,528	275,944	104,170	699,507	1,393,343	2,882,461	5,355,425
	6	North Texas	90,151	211,548	99,346	667,117	1,328,826	2,489,367	4,796,204
	7	Vanderbilt	91,154	240,490	100,452	674,540	1,343,610	2,643,171	5,002,263
	1	App. St.	94,077	237,531	103,673	696,170	1,386,695	2,919,480	5,343,549
	2	Ohio	95,137	311,954	104,841	704,014	1,402,319	3,351,201	5,874,329
	3	Florida	96,636	302,937	106,493	715,106	1,424,415	3,417,407	5,966,358
2016	4	Alabama	96,504	316,283	106,347	714,130	1,422,469	3,272,514	5,831,743
	5	Tenn. Tech	92,049	244,308	101,438	681,163	1,356,802	2,917,553	5,301,264
	6	Kentucky	93,458	264,281	102,991	691,589	1,377,571	3,147,391	5,583,823
	7	Missouri	89,938	267,449	99,112	665,541	1,325,686	3,153,615	5,511,402

Table 4 (continued). **Carbon Footprint by Game; Tennessee Football 2014-2019**

Year	Game	Opponent	Total Tickets Sold	Emissions ($kgCO_2eq$) by Sector					Total Emissions (kgCO2eq)
				Hotels	Waste	Food	Stadium	Automobile	
2017	1	Indiana St.	90,281	237,496	99,490	668,079	1,330,742	2,934,399	5,270,206
	2	UMass	89,595	294,082	98,734	663,003	1,320,630	3,390,446	5,766,895
	3	Georgia	96,757	248,034	106,626	716,002	1,426,198	3,205,735	5,702,595
	4	South Carolina	91,115	297,448	100,409	674,251	1,343,035	3,278,989	5,694,132
	5	Southern Miss.	85,510	245,492	94,232	632,774	1,260,417	2,917,747	5,150,663
	6	LSU	90,898	327,702	100,170	672,645	1,339,837	4,018,160	6,458,514
	7	Vanderbilt	77,265	239,899	85,146	571,761	1,138,886	2,757,948	4,793,639
2018	1	ETSU	90,776	250,784	100,035	671,742	1,338,038	3,045,454	5,406,054
	2	UTEP	81,628	256,157	89,954	604,047	1,203,197	3,143,142	5,296,497
	3	Florida	93,532	283,417	103,072	692,137	1,378,662	3,406,558	5,863,846
	4	Alabama	91,173	325,242	100,473	674,680	1,343,890	3,525,426	5,969,710
	5	Charlotte	77,825	227,945	85,763	575,905	1,147,141	2,683,156	4,719,910
	6	Kentucky	88,957	260,996	98,031	658,282	1,311,226	3,230,973	5,559,508
	7	Missouri	81,186	241,744	89,467	600,776	1,196,682	2,916,553	5,045,222
2019	1	Georgia St.	79,922	213,439	88,074	591,423	1,178,050	2,600,628	4,671,614
	2	BYU	87,481	291,715	96,404	647,359	1,289,470	3,902,108	6,227,056
	3	UT-Chat	79,143	261,171	87,216	585,658	1,166,568	3,068,016	5,168,628
	4	Georgia	86,871	236,881	95,732	642,845	1,280,479	3,150,115	5,406,052
	5	Miss. State	79,714	272,984	87,845	589,884	1,174,984	3,098,979	5,224,676
	6	South Carolina	81,613	261,461	89,938	603,936	1,202,976	2,952,829	5,111,139
	7	UAB	79,283	222,700	87,370	586,694	1,168,631	2,626,046	4,691,442
	8	Vanderbilt	81,112	240,618	89,385	600,229	1,195,591	2,894,016	5,019,839

Table 5. Multivariate linear regression model of the relationship between GHG emissions (independent variable) with the log(total round-trip driving miles) controlled for total number of tickets at the per-game unit of analysis; Tennessee football 2014-2019

Independent Variables	Estimate	Std. Error	*t* value	*p* value
Intercept	-3.94E+07	1.27E+06	-30.97	0.000***
Tickets	3.16E+01	2.10E+00	15.01	0.000***
log(Total Miles)	2.69E+06	8.38E+04	32.15	0.000***

*** Significant at $p < 0.001$.

Residual standard error: 80480 on 40 degrees of freedom

Multiple R^2= 0.9757 Adjusted R^2= 0.9744

F-statistic: 801.7 on 2 and 40 DF p < 2.2e-16***

Table 6. Carbon Footprints by Season

Year	Total Tickets Sold	Total $kgCO_2eq$ in millions	$kgCO_2eq$ per Ticket	Student Tickets Sold	Percent Student Attendance	Average Students per Game	Student $kgCO_2eq$ in millions	$kgCO_2eq$ per student
2014	647,159	36.6	56.60	69,747	10.78%	9,964	1.7	24.96
2015	657,115	38.6	58.75	60,256	9.17%	8,608	1.5	25.36
2016	657,799	39.4	59.92	62,839	9.55%	8,977	1.9	25.15
2017	621,421	38.8	62.50	52,191	8.40%	7,456	1.3	25.72
2018	605,077	37.9	62.57	53,339	8.82%	7,620	1.4	25.80
2019*	655,139	41.5	63.38	52,965	8.08%	6,621	1.4	25.85

*8 games (one more than the usual 7)

Table 7. PMC Correlation t-test for relationship between GHG Emissions and median family income at the ZIP-code unit of analysis, 2014

Estimate	n-1 (d.f.)	*t* value	*p* value
0.039027	9411	3.7889	0.0002***

Notes: Model uses a majority sample of 2014 single-game tickets from home Tennessee football games.

*** Significant at $p < 0.001$.

95% confidence interval: 0.0188 - 0.0592

Appendix B: Figures

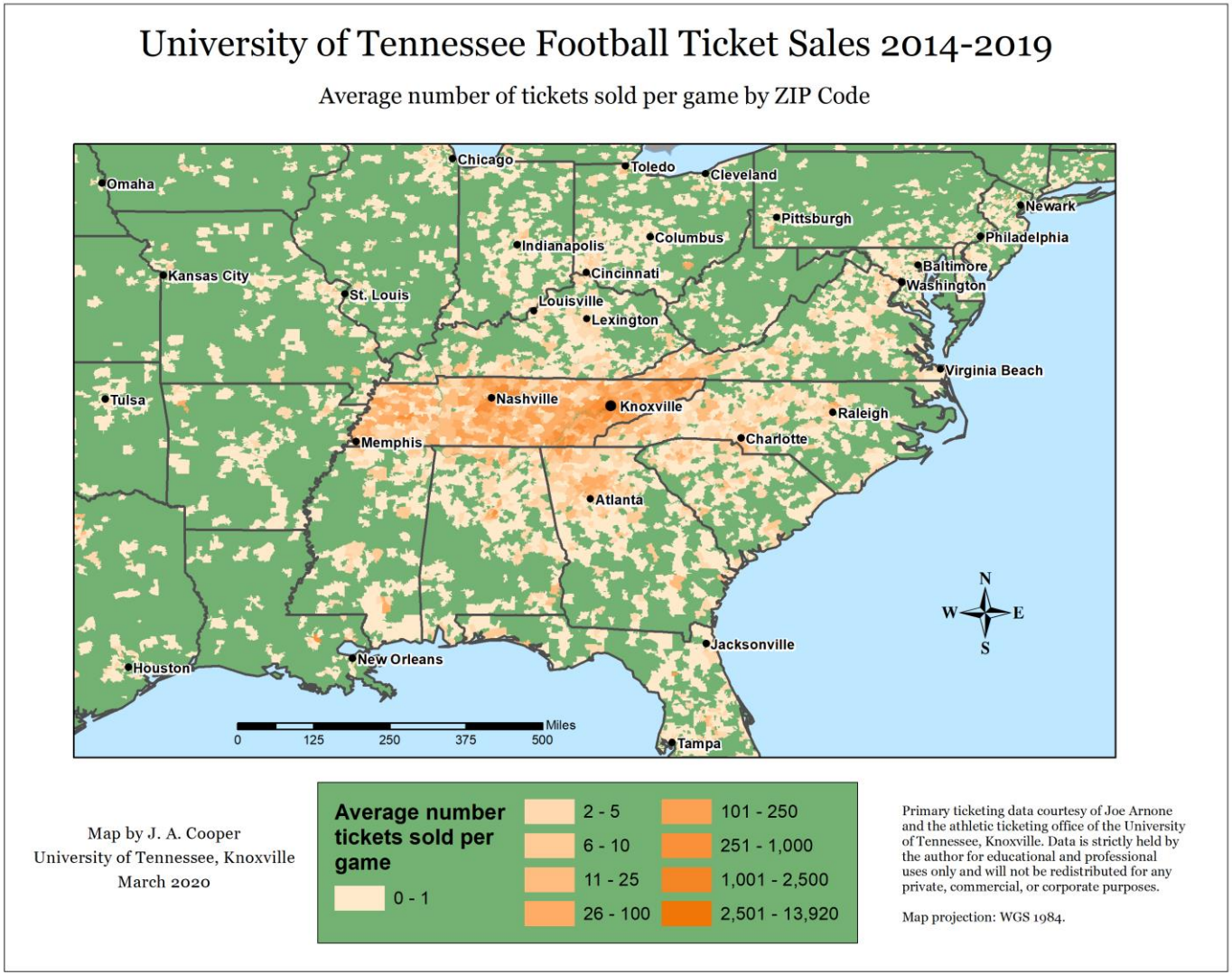

Figure 1. Average tickets sold per game by ZIP code.

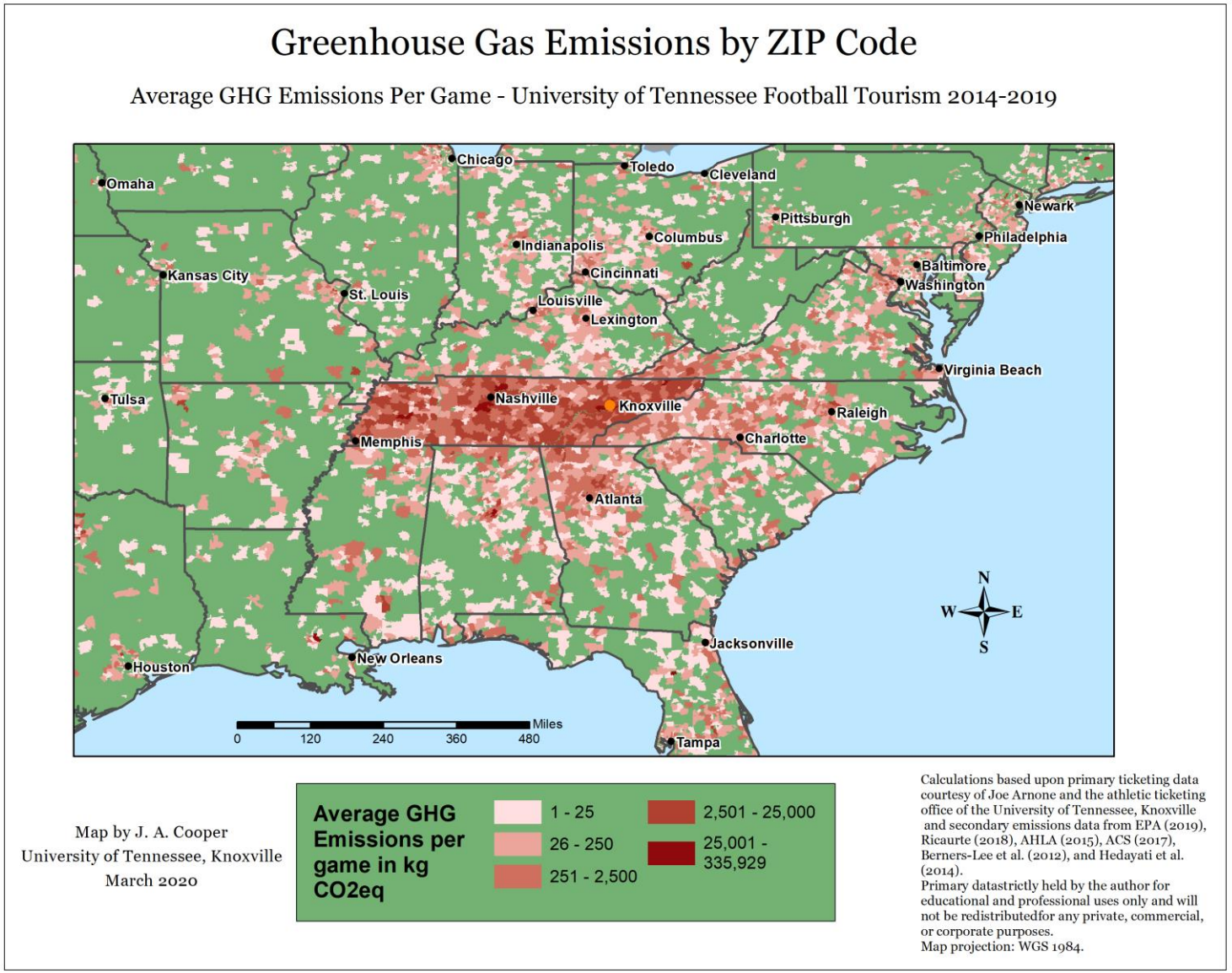

Figure 2. Annual greenhouse gas emissions per game by ZIP code.

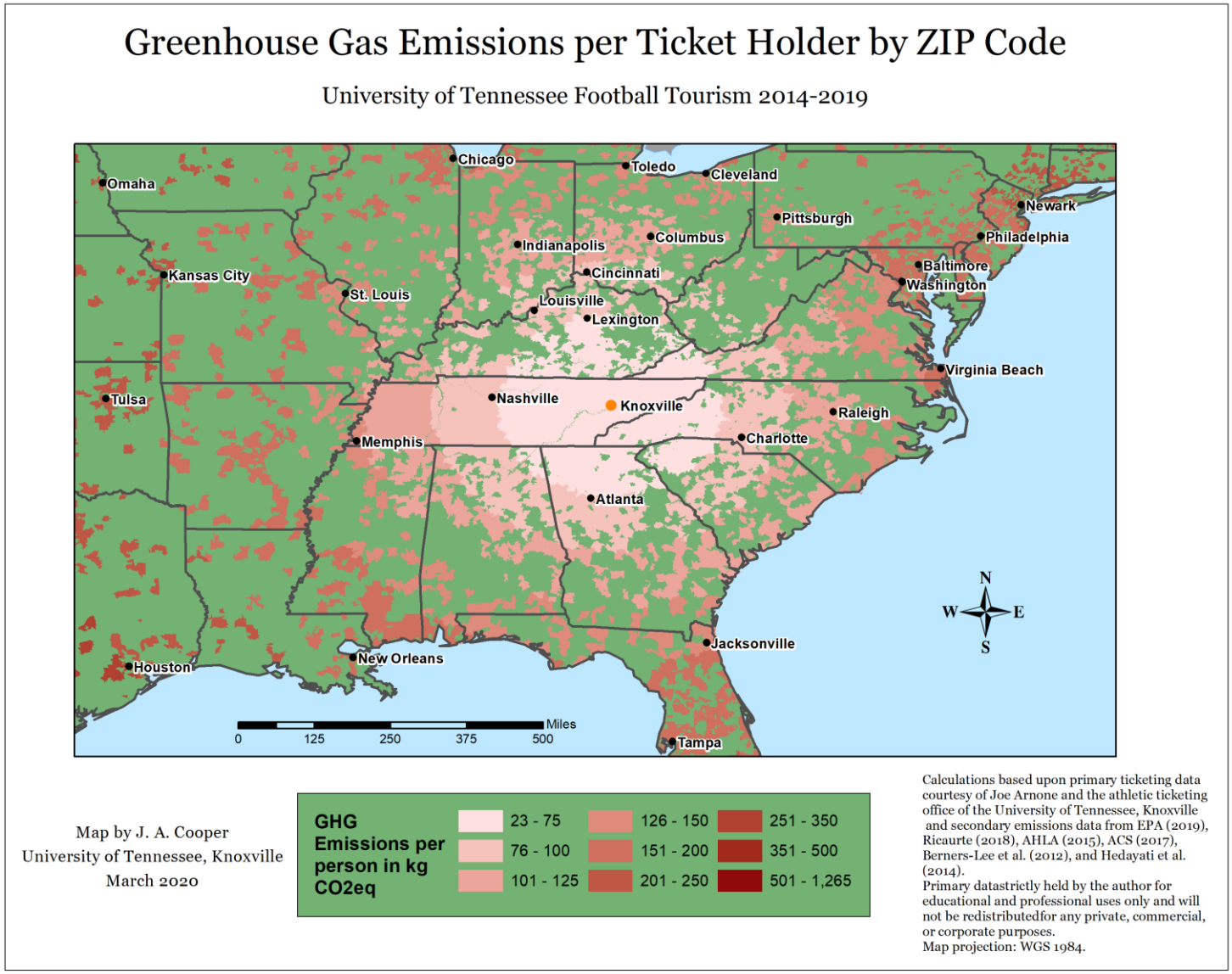

Figure 3. Average greenhouse gas emissions per capita by ZIP code.

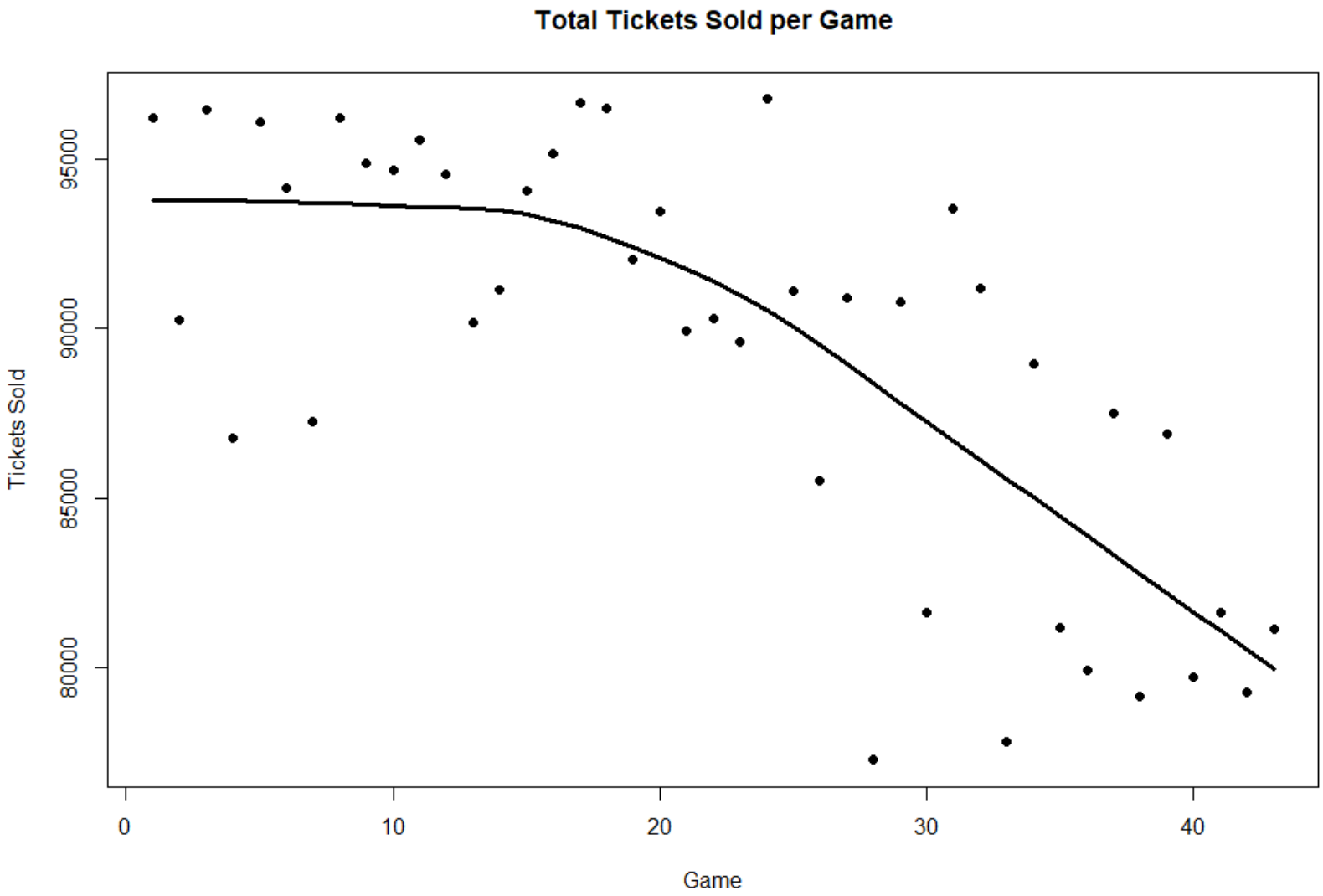

Figure 4. Total Tickets Sold per Game, 2014 - 2019

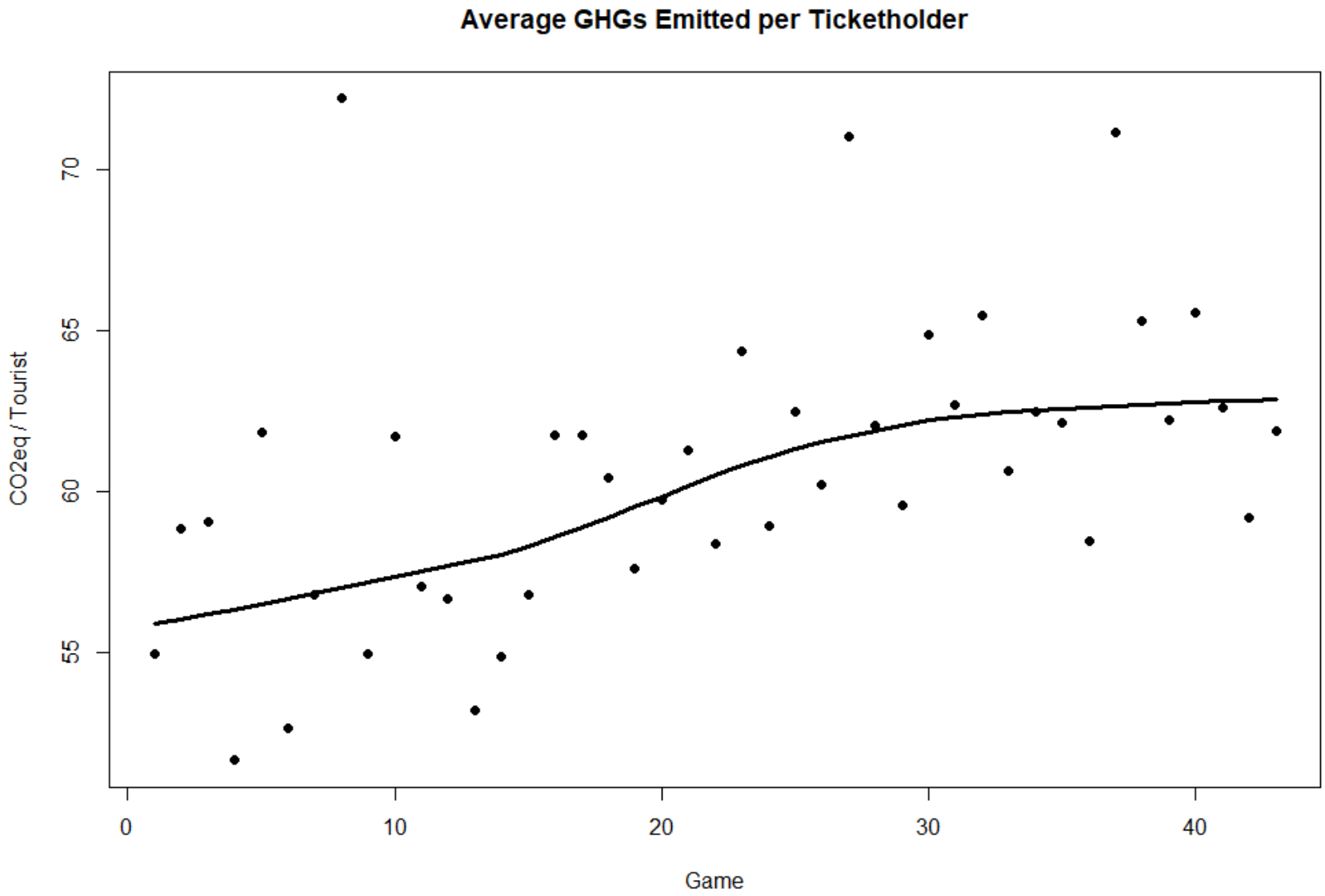

Figure 5. Average Greenhouse Gas Emissions per Ticketholder, 2014 - 2019

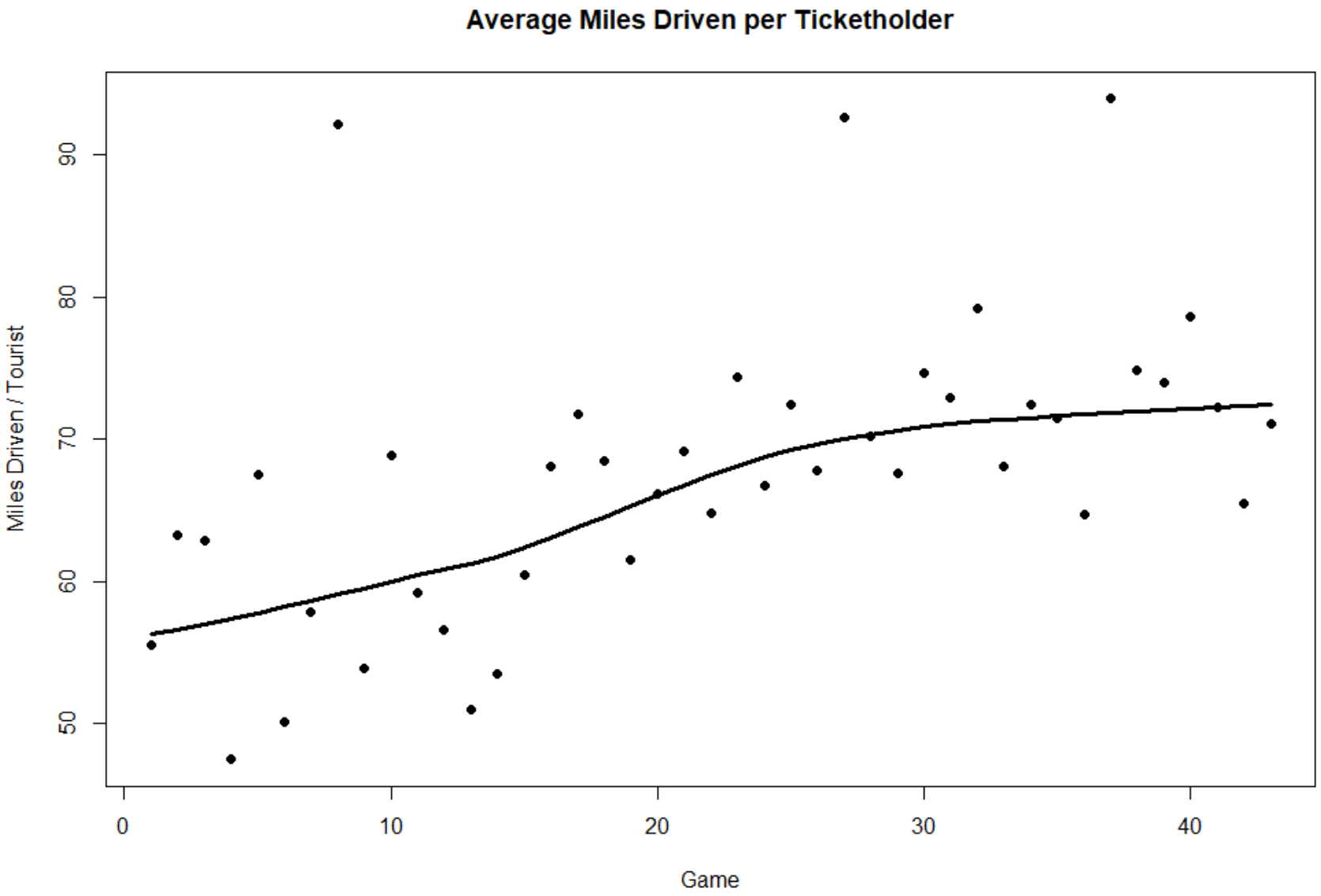

Figure 6. Average Round-Trip Miles Driven per Ticketholder, 2014 - 2019

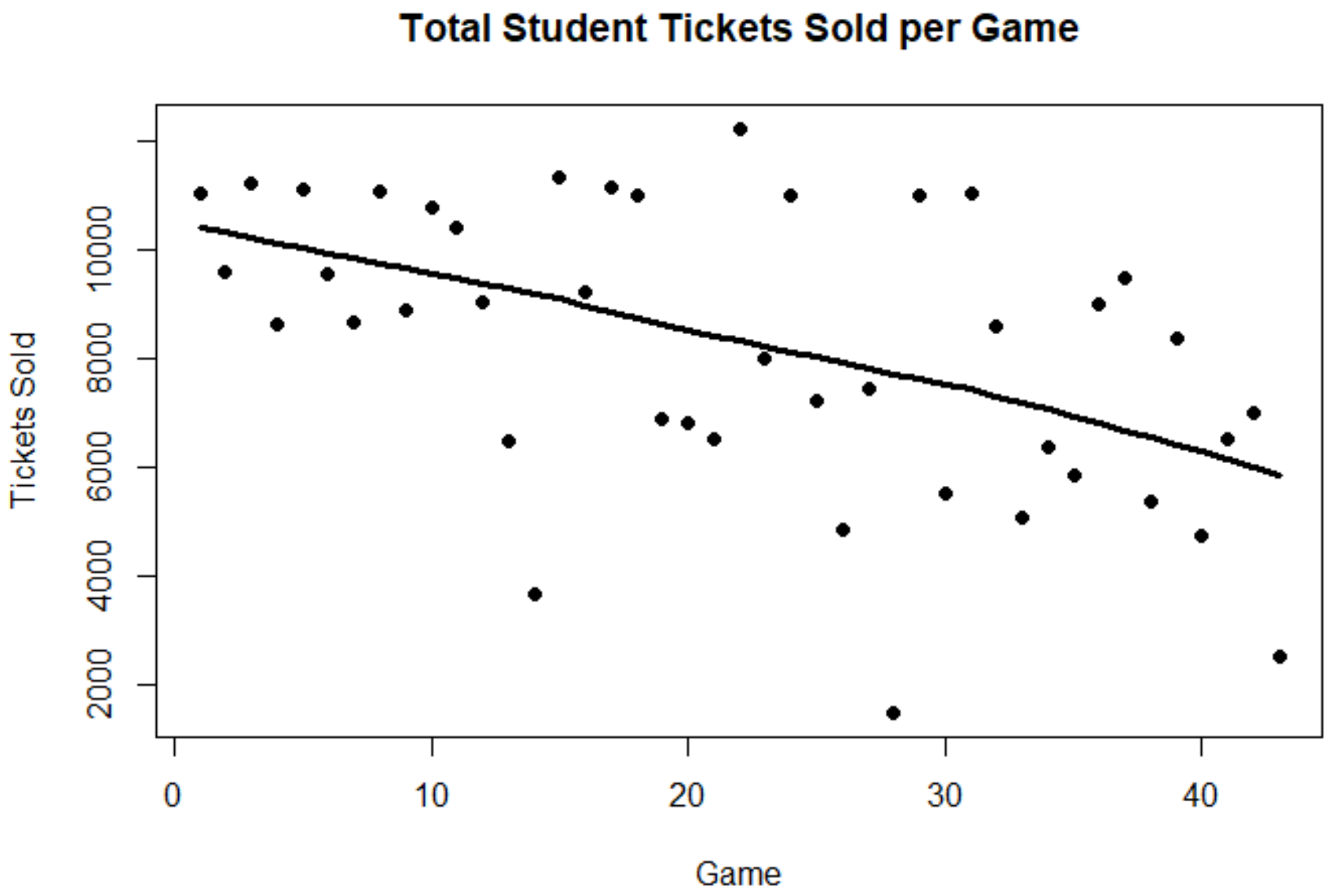

Figure 7. Total Student Tickets Sold per Game, 2014 – 2019

VITA

J. A. Cooper is a human geographer interested in fusing quantitative computational GIS methodologies with critical cultural studies. He is also interested in place-based group identity, sustainability, and sports geography. Cooper was born in Huntsville, Alabama, grew up in Christiansburg, Virginia, and graduated summa cum laude from Emory & Henry College in Virginia in 2017 with honors in geography. He has worked in conservation GIS at Virginia's New River Land Trust and in computational approaches to demographic geography at Oak Ridge National Laboratory in Tennessee.