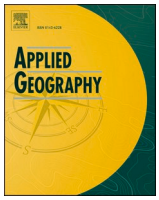
Applied Geography 124 (2020) 102329

Contents lists available at ScienceDirect

Applied Geography

journal homepage: http://www.elsevier.com/locate/apgeog



Wild alternatives: Accounting for and rethinking the relationship between wild game and food security in Appalachian food systems

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ARTICLE INFO

Keywords:
Big game
Food security
Hunting
West Virginia
Wild food

ABSTRACT

The relationship between wild food and food security among human populations is under researched, particularly in the Global North. Much of the food security research does not account for food provisioning from hunting and foraging despite the prevalence of such practices in human communities. Here we explore the significance of wild big game harvesting in one of the most economically and food insecure states in the United States, West Virginia. We analyzed harvest data of large mammal species hunted in West Virginia from 2012 to 2017 and compare these data to domesticated meat raised and commercially processed within the state. We also compare the game harvest of West Virginia to the harvests of its five neighboring states; Virginia, Pennsylvania, Ohio, Kentucky, and Maryland. Lastly, we analyzed the potential of these harvests to feed food insecure populations in each state. In West Virginia, we estimate that approximately 10 million pounds of game is harvested each year, a figure that significantly exceeds the domesticated red meat raised and processed within the state by 25% annually. The per capita big game harvest in West Virginia was significantly higher than that of all neighboring states and was enough to provide nearly 40% of the state's food insecure population with red meat for an entire year. To our knowledge, this is one of few studies in the North America that attempts to account for the amount of wild food harvested from the landscape within the context food security. We argue that food systems research may benefit from a similar accounting of wild food when addressing issues of food security and availability.

1. Introduction

Access to reliable, contaminant-free, and culturally appropriate food is a global challenge (Food and Agriculture Organization of the United Nations (FAO), 2018). Among the most vulnerable demographics of food insecure people are women, people of color, and the economically impoverished; a vulnerability that is predicted to increase with growth in both global human population and natural resource consumption rates (Coleman-Jensen et al., 2018; Food and Agriculture Organization of the United Nations (FAO), 2018).

Concurrent with addressing food access issues on a global scale, local and regional communities have a long history of mobilizing resources to meet food insecurity challenges (Breslow, 2014; Rotz, 2017; White, 2018). In the post-emancipation United States (U.S.), communities of Black people built agricultural infrastructure to provide food that was otherwise not available to them (McCutcheon, 2019; White, 2018). These practices remain important for Black communities (Reese, 2019; White, 2018) as one of the most food insecure populations in the U.S. (Food and Agriculture Organization of the United Nations (FAO), 2018). Food sovereignty and food security are also of primary concern for many Indigenous communities (Indigenous Food and Agriculture Initiative, 2015). In the U.S., the ongoing settler colonial practice of eroding Indigenous sovereignty continues to have wide ranging impacts on the ability of Indigenous people to access culturally and nutritionally appropriate foods (Davis & Todd, 2017; Indigenous Food and Agriculture Initiative, 2015; Mihesuah, 2017).

In many cases, the strategies marginalized communities use to establish and maintain food security include provisioning from wild species (Loring et al., 2013; Mihesuah, 2019; Milner-Gulland & Bennett, 2003; Ripple et al., 2016; Sherman, 2017). Whether it is hunting various forms of wild game (e.g. buffalo, deer, water fowl), fishing, or gathering wild plants and mushrooms (e.g. ramps, dandelion, morels), human populations living within nation-state boundaries often rely on non-domesticated species for survival (Harrison & Loring, 2016;

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https://doi.org/10.1016/j.apgeog.2020.102329
Received 12 November 2019; Received in revised form 19 August 2020; Accepted 8 September 2020
Available online 21 September 2020

Indigenous Food and Agriculture Initiative, 2015; McLain et al., 2012; Milner-Gulland & Bennett, 2003; Sherman, 2017).

A large proportion of research on wild food provisioning is focused on subsistence hunting in the Global South and the conflicts that arise at the intersection of wild food provisioning and the interests of the state (Milner-Gulland & Bennett, 2003; Ripple et al., 2016). In the Global North, research on wild food provisioning is especially limited, with very little work framing wild food harvesting as a strategy for meeting food security challenges (Harrison & Loring 2016; Loring et al., 2013). Nevertheless, wild food provisioning remains a prominent, albeit waning, practice in nations like the U.S. (U.S. Department of the Interior, 2017).

In the United States, 1 in 9 households are food insecure (Coleman-Jensen et al., 2018). This trend persists despite the nation's economic prosperity, technological advances, and self-purported social freedoms (2018). In rural and economically marginalized areas, the problem of food insecurity exceeds the national average (Coleman-Jensen et al., 2018). West Virginia, the only state in the U.S. entirely within the Appalachian region, ranks 11th in food insecurity and 9th in poverty (America's Health Rankings, 2018; Semega et al., 2019). While the political ecology of normative foodways in West Virginia is well researched (Wilson et al., 2016, p. 68), much of this work lacks an assessment of wild food provisioning.

Here we decided to study the role of wild food provisioning in West Virginia and the Appalachian region. Aside from being a state with relatively high food insecurity, West Virginia also has a strong cultural association and history of settler self-provisioning (Costello, 2018). To understand the prevalence of wild game in West Virginia foodways and its potential impact on food security we asked the following questions: 1) What is the extent of wild big game (hereafter referred to as "*game*") harvesting within West Virginia? 2) How does the amount of game harvested compare to the amount of domesticated red meat raised and commercially processed entirely within the state boundaries? 3) How does the amount of game harvested in West Virginia compare to the game harvests of its five neighboring states? 4) What is the capacity of the game harvest in each state to match red meat consumption rates of total state and food insecure populations? In answering these questions, we aim to establish foundational knowledge on the role of game meat in foodways that will hopefully advance food systems research.

2. Methods

2.1. Study area

West Virginia is a relatively small (24,230 sq mi; 62,756 sq km) state compared to other states in the region (United States Census Bureau, 2019a). It is also among the most rural states in the U.S., with roughly two-thirds of residents living in areas with fewer than 2500 inhabitants (United States Census Bureau, 2019a). In West Virginia, 1 in 6 households are food insecure (Coleman-Jensen et al., 2018), 18.5% of people live below the poverty line, and 24.2% of households do not earn enough in wages to cover food costs throughout a given year (Food Research & Action Center, 2018; United States Census Bureau, 2019b). Most residents in West Virginia obtain food from a combination of sources including food retail markets, government assistance programs (e.g. Supplemental Nutritional Assistance Program [SNAP]), food pantry or hot meal programs, farming their own property, and engaging in what are commonly referred to as "alternative" methods (e.g. backyard gardening, hunting, fishing, and foraging; Wilson et al., 2016, p. 68).

2.2. Data collection and processing

To begin to understand the amount of game harvested in West Virginia and neighboring states, we first collected game harvest data from the websites of each state's (Kentucky, Maryland, Ohio, Pennsylvania, Virginia, and West Virginia) Department of Natural Resources (DNR) from 2012 to 2017 (Kentucky Department of Fish & Game, 2019a; Maryland Department of Natural Resources, 2019a, 2019b; Ohio Department of Natural Resources, 2019; Pennsylvania Game Commission, 2019a; Virginia Department of Game & Inland Fisheries, 2019b; West Virginia Department of Natural Resources, 2014, 2018a). A given year's hunting season begins in the fall of one year and ends in the winter or spring of the following year. Because all of the hunting regulations for the states in our study concentrate the majority of the game species of interest in the last 4–5 months of the calendar year (typically September to December), we report the annual game harvest as single year (e.g. 2012) rather than multiple years (2012–2013). Some game harvest data was not directly accessible on state DNR websites so we used an online hunting news achieve, *Deer Friendly.com* (Deer Friendly, 2019), to access news articles on reported game harvest statistics. We cross referenced the information on *DeerFriendly.com* with accessible state DNR harvest data to verify the accuracy of the information on *DeerFriendly.com*.

For this study, we define game as inclusive of five mammal species available to hunt across the six states in our study: 1) white-tailed deer (*Odocoileus virginianus*, 2) Sika deer (*Cervus nippon*), 3) black bear (*Ursus americanus*), 4) elk (*Cervus canadensis*), and 5) wild/feral pig (*Sus scrofa*). No state had all five species available for harvest (Table 1A), either due to the absence of one or more species from the landscape (e.g. no elk present in Ohio), or because there was no specific hunting season for said species (e.g. no elk hunting season in West Virginia), and thus no data collected on their harvest. Because our research questions ultimately centered around the potential game food available, we chose to compare the entire game harvest between states rather than the white-tailed deer harvests (the only species available in every state in our study) between states. Therefore, any given state's harvest estimates include white-tailed deer and some combination of the other species available to hunt within state boundaries (Table 1A).

The amount of consumable meat harvested from an individual animal ultimately depends on the personal preferences of the harvester. At present there is no dataset in any of our study states where the variation in meat taken from a game animal is recorded. In the absence of these data, we chose to estimate a generalized butcher weight of each species by sex and age class. For white-tailed deer, sika deer, black bear, and feral pigs, we began the process of this estimation by using the reported average live weights of male, female, and yearling individuals from state DNR information (Table 1A; Kentucky Department of Fish & Game, n.d.; Maryland Department of Natural Resources, 2019c; Pennsylvania Game Commission, 2019b; Virginia Department of Game & Inland Fisheries, 2019a). Next, we calculated a generalized sex and age class butcher weight within each species based on state DNR information (Pennsylvania Game Commission, 2019b) and previous research (Goguen et al., 2018) on butcher weights of game species (Table 1B). In estimating the butcher weight of elk harvested, we used the mean reported butcher weights of elk harvested in Pennsylvania (75% of the total PA elk harvest data; Pennsylvania Game Commission, 2019a) to calculate a generalized butcher weight – again by sex and age class – for the remaining elk harvest data (25% of Pennsylvania and 100% of Kentucky elk data) where butcher weights were not recorded.

Not all of the individual animals reported as harvested were identified by sex or age and were labeled as *unknown* in our dataset (Table 1A). For these individual animals we estimated their butcher weight as the average species-specific butcher weight of female, male, and yearling (Table 1A & 1B). Harvested feral pigs were never identified by sex or age class and thus we estimated their butcher weight based on Kentucky Department of Fish & Game (2019b) information on feral pig size and a 50% of live weight meat yield.

Because the majority of livestock raised in West Virginia is transported out of the state (over 90%; West Virginia Department of Agriculture 2017) for processing, we chose to compare West Virginia game meat harvest estimates to the portion of domesticated red meat (cattle, pork, lamb and goat; United States Department of Agriculture, 2019)

Table 1
A) Estimation of live weights (pounds) of wild big game species harvested in study states – West Virginia, Virginia, Ohio, Pennsylvania, Maryland, and Kentucky – by species and sex. Also indicated are the states where each species is available for harvest through permit hunting. B) Butcher weight available by species and sex calculated as 50% of live weight (Goguen et al. 2018; Pennsylvania Game Commission 2019).

Species	Citation	Female	Male	Yearling	Unknown	State available
White-Tailed Deer	Pennsylvania Game Commission (2019b)	120	170	65	118[a]	All
Sika Deer	(Maryland Department of Natural Resources, 2019c)	70	90	N/A	N/A	MD
Black Bear	(Virginia Department of Game & Inland Fisheries, 2019a)	150	300	N/A	225[a]	KY, MD, PA, WV, VA
Elk	Weights calculated from Pennsylvania Game Commission elk harvest data	465	706	295	N/A	KY, PA
Feral Pig	(Kentucky Department of Fish & Game, 2019b)	N/A	N/A	N/A	165[b]	WV

Species	Female	Male	Yearling	Unknown
White-Tailed Deer (*Odocoileus virginianus*)	60	85	32.5	59
Sika Deer (*Cervus nippon*)	35	45	N/A	N/A
Black Bear (*Ursus americanus*)	75	150	N/A	112.5
Elk (*Cervus canadensis*)	232.5	353	147.5	N/A
Feral Pig (*Sus scrofa*)	N/A	N/A	N/A	82.5

[a] *Weight of unknown estimated as the average of female, male, and yearling weights of the species.*
[b] Sex and age of feral pigs not recorded by WVDNR, thus all were classified as "unknown".

raised and commercially processed within the state (hereafter *local domesticated meat*). We collected data on local domesticated meat from West Virginia Annual Bulletins (United States Department of Agriculture, 2019) that provide annual statistics on the production of livestock.

Finally, we collected data on food insecurity from the United States Department of Agriculture (Coleman-Jensen et al., 2018) compiled and organized by Feeding America on their interactive online map (Feeding America, 2019). We recorded the number of food insecure people in each state and the number of food insecure people in the most populated urban area – the county with the state's largest (by population) city – in each state from 2012 to 2017. Though food insecurity rates vary across urban, suburban, and rural landscapes, we chose to compare geographically similar and discrete areas across states.

2.3. Data analysis

To answer all of our research questions we needed to calculate a total and an overall average game harvest for each state from 2012 to 2017. To do this, we simply multiplied the number of individual animals harvested within each species, sex, and age class category by their corresponding butcher weights for each year, summed the year's harvest, and finally calculated the average across six years (Table 1B). To answer our second research question, we compared the six-year total, annual average, and per square kilometer average game harvest and local domesticated meat production. We used an F-test to determine if the annual averages of these two meat classes differed significantly.

To answer our third research question, we compared the six-year total, annual average, and annual per capita game harvests of each of the six states from 2012 to 2017. We calculated the annual per capita game harvest for each state by dividing the estimated game harvest for a given year by the state population for that same year (United States Census Bureau 2019b) and compared the six-year average between states. We used a One-Way Analysis of Variance test to determine if the average annual game harvests and per capita game harvests differed significantly between states. Lastly, we answered our fourth research question by calculating the percentage of an individual state's total and largest urban area food insecure population who's annual per capita red meat consumption (based on national average red meat consumption; Knight, 2019) could be supplied from that state's game harvest.

3. Results

We estimate that slightly more than 60 million pounds of game was harvested within the state of West Virginia from the start of the 2012 hunting season through the 2017 hunting season; an average amount of slightly more than 10 million pounds per year (SE = 0.65 million pounds). The peak game harvest in West Virginia occurred during the 2015 hunting season with an estimated 12.12 million pounds harvested, which followed the lowest estimated harvest (7.86 million pounds) during the previous year's hunting season (Table 2). Ninety-six percent of the West Virginia's game harvest came from white-tailed deer with an average of 130,265 (SE = 8471.14) deer harvested per year. Black bear comprised the next highest percentage of game harvest by weight and average number of individuals per year at 3.51% (SE = 0.26%) and 2896 (SE = 106.75), respectively. The number of feral pigs harvested in West Virginia averaged 66 individuals per year (SE = 9.39) and never comprised more than 0.05% of the state's game harvest by weight.

During the course of our study, the local domesticated meat produced in West Virginia was 43.3 million pounds and averaged 7.22 million pounds per year. This production peaked at 7.9 million pounds (SE = 0.19 million pounds) in 2017 and was lowest in 2014 and 2015 at 6.7 million pounds (Table 3). The game meat harvest in West Virginia was significantly higher than local domesticated meat ($P = 0.008$; $F = 12.08$; $df = 5$), with game meat averaging 2.7 million more pounds per year than local domesticated meat (Table 3). Overall, this difference totaled nearly 17 million more pounds of game meat than local domesticated meat over the course of 6 years. The annual difference in the two meat classes translated to nearly 50 more pounds of game meat per square kilometer per year than local domesticated meat (Table 3).

White-tailed deer were the only species available to hunt in all six states in our study and comprised an overall average of 98.20% (SE = 0.25%), by weight, of the game harvested. The difference in annual average game harvest between the states was significant ($P < 0.001$; $F = 164.74$; $df = 5$). Pennsylvania had the highest overall and yearly average game harvest (by weight), exceeding the next closest state, Virginia, by more than 65% or 9.55 million pounds per year on average (Fig. 1). The difference in the annual per capita game harvest was significant between states ($P < 0.001$; $F = 169.41$; $df = 5$). The per capita game harvest in West Virginia's was more than twice that of the next highest six-year average (Kentucky), and was nearly equal to the combined six-year

Table 2
Total number of animals harvested each year by species in West Virginia from 2012 – 2017 and the subsequent total estimated available meat for human consumption. See supplemental table S1 for more detailed information on the sex and age class of each species.

Year	White-Tailed Deer	Black Bear	Feral Pig	Estimate Total Weight (lbs)
2012	132,556	2753	62	10,054,356.5
2013	150,877	2692	49	11,212,609.0
2014	104,707	2581	51	7,864,323.5
2015	154,563	3201	99	12,119,557.5
2016	130,509	3012	46	10,216,607.5
2017	108,378	3158	91	8,553,887.5

Table 3
Estimated wild game harvest verses the red meat raised and commercially processed within West Virginia from 2012 – 2017. Also listed, the pounds per *square kilometer of both meat categories (West Virginia is 67,*756 km^2*). Red meat includes cattle, domesticated pigs, goats, and lamb. Wild game harvest exceeded red meat production every year by at least 500,*000 lbs.

Year	Estimate Wild Game Harvest (lbs)	Wild Game/ km^2	Commercially Processed Red Meat (lbs)	Commercially Processed Red Meat/km^2
2012	10,054,356.5	160.21	7,400,000.0	112.54
2013	11,212,609.0	178.67	7,300,000.0	111.02
2014	7,864,323.5	125.32	6,700,000.0	101.89
2015	12,119,557.5	193.12	6,700,000.0	101.89
2016	10,216,607.5	162.80	7,300,000.0	111.02
2017	8,553,887.5	136.30	7,900,000.0	120.14

averages of Maryland, Ohio, Pennsylvania, and Virginia (combined = 5.7 lbs/person vs. WV = 5.4 lbs/person; Table 4).

Food insecurity rates among the states in our study averaged 13.27% (SE = 0.33%) from 2012 to 2017. The annual average game harvest in West Virginia was capable of supplying 36.97% (SE = 2.29%) of the entire state's food insecure population with red meat for a year (Fig. 2). This was the highest rate among states and more than double that of any other state's capacity of game harvest to supply red meat to their respective food insecure population. West Virginia and Virginia were the only states where the respective game harvests were capable of meeting the per capita red meat consumed by the largest (by population) urban county (Fig. 3).

4. Discussion

4.1. Game harvest

Our results show that there is a considerable amount of game meat that comes from state landscapes on an annual basis. To our knowledge, this is the first study that quantifies the amount of wild big game meat available to human populations based on state big game harvest numbers. In West Virginia, game meat is significantly higher than local domesticated meat production. Moreover, the amount of game meat available for each resident of West Virginia is significantly higher than any of the neighboring states despite West Virginia having the second lowest game harvest of the six states.

While these findings are new to foodways research in the region, it is important to recognize some of the limitations of available game harvest data. First, our results do not account for where game meat travels within and across state boundaries. Data on non-resident hunting licenses for each state is available, however, these data do not identify the resident state of the non-West Virginia hunter, nor if said hunter was actually successful in harvesting an animal (i.e. purchasing a license does not guarantee one harvests an animal). In West Virginia, non-resident licenses to hunt, trap, and fish averaged 24.37% (SE = 1.81%; median = 23.98%) of all license sales (West Virginia Department of Natural Resources, 2019b). If this license activity directly translates to game harvested and exported from the state, then, based on our harvest estimations, approximately 14.6 million pounds of West Virginia game was consumed in other states between 2012 and 2017. Without a comprehensive study that tracks game meat distribution at the individual and household level, and across state boundaries, it is difficult to estimate how game meat harvested in the field translates to actual game meat consumption based on state residence. It is for this reason that our results represent an estimation of the amount of game meat available within state boundaries and not what was actually consumed within a given state.

Another constraint of existing game harvest data is that it almost certainly underestimates the total number of animals harvested. Because it is both impossible for any state to verify every single game animal harvested (e.g. harvest out of season, failure to register a harvested animal with state DNR), we expect our estimates of game harvest to be lower than the actual amount of game meat consumed. Regulating the number of animals harvested to minimize the effects of over harvesting is a constant issue for state wildlife management agencies. The issue of over harvesting white-tailed deer in West Virginia reportedly led to a ban of the use of fire-arms to hunt white-tailed deer in four counties in the southern coalfields of the state; a regulation that still remains today (McCoy, 2018; West Virginia Department of Natural Resources, 2019c).

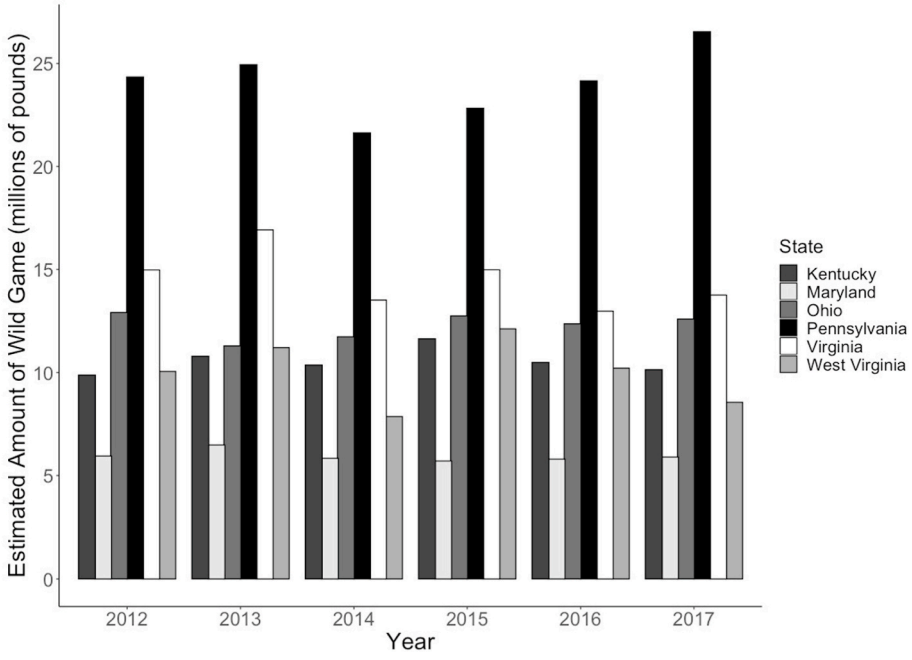

Fig. 1. Yearly estimated wild big game harvest by year from 2012 – 2017 for each state within our study. Pennsylvania remains the top wild big game producing state for all 6 years.

Table 4
Estimated wild big game harvest by state and year, yearly per capita *rate of available big game, and the six-year average* per capita *wild big game available for human consumptions from 2012 – 2017. West Virginia had the highest* per capita *big game availability in the region by at least double the next highest state.*

Year	State	Estimated Wild Game Harvest (lbs)	Human Population	Per Capita Wild Game Harvest (lbs)	6-Year Per Capita Average (±SE)
2012	Kentucky	9,879,405.0	4,386,381	2.252	2.387
2013		10,796,851.0	4,404,817	2.451	(±0.056)
2014		10,367,113.0	4,414,483	2.348	
2015		11,639,913.5	4,425,999	2.630	
2016		10,495,031.0	4,438,229	2.365	
2017		10,139,890.0	4,453,874	2.277	
2012	Maryland	5,947,930.0	5,887,072	1.010	0.997
2013		6,480,940.0	5,923,704	1.094	(±0.021)
2014		5,839,367.5	5,958,165	0.980	
2015		5,706,667.5	5,986,717	0.953	
2016		5,798,432.5	6,004,692	0.966	
2017		5,898,662.5	6,024,891	0.979	
2012	Ohio	12,915,690.0	11,548,369	1.118	1.058
2013		11,296,081.0	11,576,576	0.976	(±0.022)
2014		11,737,197.5	11,602,973	1.012	
2015		12,752,440.0	11,617,850	1.098	
2016		12,366,907.5	11,635,003	1.063	
2017		12,599,460.0	11,664,129	1.080	
2012	Pennsylvania	24,343,069.5	12,766,827	1.907	1.883
2013		24,943,918.5	12,776,621	1.952	(±0.054)
2014		21,626,947.5	12,789,101	1.691	
2015		22,826,872.5	12,785,759	1.785	
2016		24,156,412.5	12,783,538	1.890	
2017		26,536,902.5	12,790,447	2.075	
2012	Virginia	14,978,142.5	8,185,229	1.830	1.744
2013		16,920,555.0	8,253,053	2.050	(±0.076)
2014		13,513,602.5	8,312,076	1.626	
2015		14,984,307.5	8,362,907	1.792	
2016		12,979,792.5	8,410,946	1.543	
2017		13,759,220.0	8,465,207	1.625	
2012	West	10,054,356.5	1,856,764	5.415	5.430
2013	Virginia	11,212,609.0	1,853,873	6.048	(±0.348)
2014		7,864,323.5	1,849,467	4.252	
2015		12,119,557.5	1,841,996	6.580	
2016		10,216,607.5	1,830,929	5.580	
2017		8,553,887.5	1,817,048	4.708	

4.2. Game meat and food security

The capacity of the game harvests to supply food to food insecure populations in our study is considerable. Across the six states in our study, our game harvest estimates are, at minimum, enough to meet the red meat consumption needs of 10% of any state's food insecure population. Within West Virginia, the potential of the state game harvest to feed various populations is especially considerable. On an annual basis, the state's game harvest is enough to supply the combined populations of Charleston and Huntington – West Virginia's two largest cities (approximately 100,000 people) – with enough red meat for an entire year (based on national average per capita red meat consumption rates) (United States Census Bureau, 2019a). One average year of West Virginia game harvest is enough to supply the most populated county in the state, Kanahwa county, with a three-year supply of red meat. In one of the most food insecure regions in the entire country, McDowell County West Virginia, (Coleman-Jensen et al., 2018; Semega et al., 2019), an average year game harvest is enough red meat to feed the entire county for five years. These figures suggest that the potential for wild provisioning in West Virginia to feed residents needs to be better researched, both to understand what strategies and practices residents are already engaged in, and to better understand the ways current dominant food network structures might help distribute game resources to vulnerable populations. Other studies have shown the importance of wild food for food security, and the role healthy wild food environments occupy for human populations (Harrison & Loring, 2016; Loring et al., 2013; Poe et al., 2013).

Currently there is only one statewide game meat distribution program in West Virginia. The West Virginia Hunters Helping the Hungry program takes game meat donations from hunters to distribute to individuals and families in need through two local foodbanks – Facing Hunger Foodbank and Mountaineer Food Bank (West Virginia Department of Natural Resources, 2018b). While these donations are important and welcomed by those in need, they are not enough to meet the meat insecurity challenges within the state. From 2012 to 2017 the Hunters Helping the Hungry program distributed a total of 151,513 pounds of venison (deer meat; West Virginia Department of Natural Resources, 2019a), or one quarter of one percent of the 60 million pounds of game harvested during that same time.

The per capita game harvest in West Virginia is at least double the amount for other states, suggesting that game meat plays a larger role in West Virginia foodways compared to neighboring states. We have found very little research within West Virginia, its neighboring states, or within the lower 48 states of the United States where wild game is a factor for determining the food insecurity of residents, even among rural populations who would presumably have better access to wild foods. Our results suggest that West Virginia may be a good place to further research the relationship between wild game, informal food economies, and food security. Such future work should focus on the harvest and meat distribution practices of local hunters and their role in food security within the region, which, given the amount of game harvested, is likely significant.

The potential of game harvests to feed food insecure populations in highly populated urban areas also has the potential to influence racial disparities in food security (Coleman-Jensen et al., 2018). With the exception of Virginia, all of the most populated counties in our study were also within the top 5 counties with the highest percentage of Black residents (United States Census Bureau, 2019c). Very little research exists on the impact of game harvesting on historically marginalized populations, yet our work indicates that a substantial amount of food is harvested from the landscape that could, if distributed to those populations, increase food security. The limiting factor in marginalized populations accessing game food is likely related to a long history of theft and exclusion of people of color from rural landscapes via white violence (Dunbar-Ortiz, 2015; Finney, 2014; McCutcheon, 2019; Mihesuah, 2017; White, 2018). Thus, combating food insecurity may not only be an issue of building a more equitable domesticated food system infrastructure, but also involve equitable access to outdoor spaces where people of color can more easily and safely harvest wild game.

5. Conclusions

Here we have demonstrated a number of important facts about game harvesting. First, the big game harvest in our study area is substantial; averaging more than 77 million pounds per year for all six states and 10 million in West Virginia. Second, in West Virginia, the game meat harvest is significantly higher – more than 25% – than the production of local domesticated meat. Third, despite West Virginia having the second lowest game harvest, the state has significantly more game meat harvested per capita than its neighboring states by at least a factor of two. Lastly, the capacity of game harvests to meet the red meat consumption rates of each state's total population and each state's food insecure populations is substantial, especially in West Virginia. These results highlight a largely overlooked component of the food system within the region and form the necessary foundation for future inquiries into the broader dynamics of game meat economies that is missing from the foodways research.

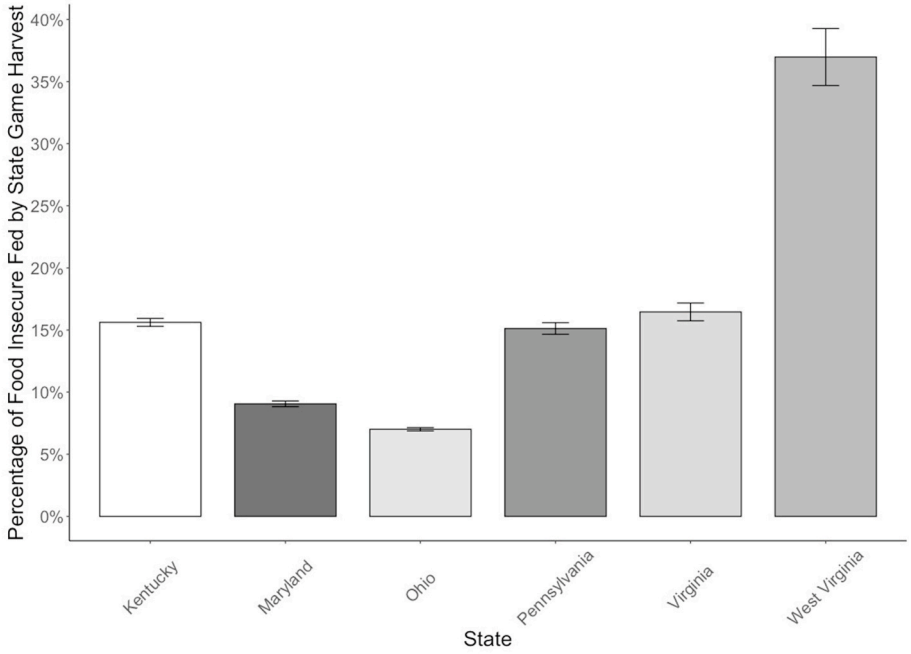

Fig. 2. Percentage of the entire state's food insecure population where 6-year average of state game harvest would meet red meat needs of said population. West Virginia's game harvest enough to meet the red meat needs of more than a third of the state's food insecure population.

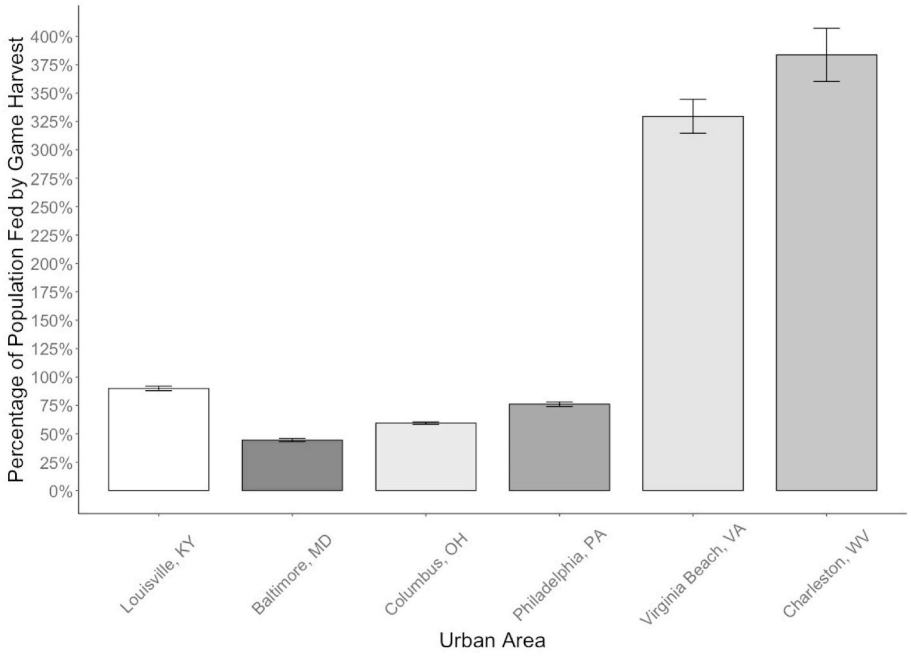

Fig. 3. Percentage of food insecure population where 6-year average of state game harvest would meet red meat needs of most populated urban areas. West Virginia and Virginia game harvest exceeds the red meat needs of those state's largest urban area by more than 3 times.

Declaration of competing interest

None.

Acknowledgments

Statement of author contributions: J.C. Hall designed the study; J.C. Hall, H. Gum, and K. Peitkoski collected, organized, and analyzed the data. J.C. Hall led writing and all authors contributed to revising and improving the manuscript. We thank Martina Angela Carretta and Thomson Gross who provided helpful feedback on the manuscript. The authors also thank the many farmers (the Stemlers, Sicklers, Stemples, Evans Knobb farm, Harvest Moutain farm, Backbone farm, DeBerry farm, Riffle farm, Ms. Judy, Mountain Line farm, and Lost Creek farm) and community members in West Virginia who have offered friendship and food that fuel our work. Lastly, we would like to thank the "Soul Glo" writing group for their support and guidance in helping the authors complete this work.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.apgeog.2020.102329.

Author statement

Statement of author contributions: J.C. Hall designed the study; J.C. Hall, H. Gum, and K. Peitkoski collected, organized, and analyzed the data. J.C. Hall led writing and all authors contributed to revising and improving the manuscript.

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