2018

INDIANA WHITE-TAILED DEER REPORT

DNR
Indiana Department of Natural Resources

2018 Indiana White-tailed Deer Report

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Federal Aid in Wildlife Restoration Program

This program supports state fish and wildlife agencies to conserve, protect, and enhance fish, wildlife, their habitats, and the hunting, sport fishing and recreational boating opportunities they provide. This program was initiated in 1937 as the Federal Aid in Wildlife Act and created a system where by taxes are paid on firearms, ammunition and archery equipment by the public who hunts. Today this excise tax generates over a hundred million dollars each year that are dedicated to state wildlife restoration and management projects across the United States.

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Cover Photo: Jason Yoder

“No matter how intently one studies the hundred little dramas of the woods and meadows, one can never learn all the salient facts about any one of them.” — Aldo Leopold

CHAPTER 1. OVERVIEW

The 2018 Indiana White-tailed Deer Report is a comprehensive report of the state's deer herd. The report includes deer hunting season results, use of depredation permits, deer-vehicle collision reports, disease monitoring efforts, survey results, and internal and external deer research projects.

2018-2019 DEER HUNTING SEASON

The 2018 deer hunting season was composed of four statewide seasons: Youth (Sept. 29-30), Archery (Oct. 1 to Jan. 6), Firearms (Nov. 17 to Dec. 2), and Muzzleloader (Dec. 8-23). In addition to the four statewide seasons, a Special Antlerless Firearms season was available from Dec. 26 to Jan. 6 in 24 counties, with additional date restrictions for counties with "A" designated quotas. Most resident deer licenses could be purchased for $24, nonresident licenses for $150. A deer license bundle was available for purchase at $65 for residents and $295 for nonresidents. The deer license bundle, which is valid in all deer seasons, except in the Deer Reduction Zone season, allowed hunters the opportunity to take up to three deer while attempting to satisfy statewide bag limits for Archery, Firearms, Muzzleloader, and Special Antlerless Firearms seasons. The three deer could be either two antlerless and one antlered, or three antlerless deer. A hunter could take only one antlered deer during all statewide seasons combined (Archery, Firearms, Muzzleloader, and Youth seasons). Resident landowners and lessees who owned and worked Indiana farmland were exempt from needing deer licenses when hunting on their land. Hunters were required to register all harvested deer through the online CheckIN Game system within 48 hours of the kill.

Licensed youth, age 17 or younger, were eligible to participate in a youth-only season if accompanied by an adult at least 18 years old. Youth could take multiple deer (one antlered deer and the number of bonus antlerless deer per county quota) during this special season.

The statewide archery bag limit was two deer. Hunters could take one deer per license, for a total of either two antlerless or one antlered and one antlerless deer. Hunters were allowed to use crossbows throughout the entire archery season when in possession of a crossbow license. Any deer taken with a crossbow counted toward the hunter's two-deer archery bag limit.

The bag limit during Firearms season was one antlered deer. The bag limit for Muzzleloader season was one deer of either sex (antlered deer were only allowed for hunters who had yet to satisfy their one antlered bag limit across all statewide seasons). A single firearms license was required to hunt with any combination of shotgun, muzzleloader, rifle, or handgun during Firearms season. For the second year in a row, hunters could use high-powered rifles as an equipment option during Firearms season. A muzzleloader license (separate from the firearms license) was required to hunt during Muzzleloader season.

Hunters could harvest additional deer beyond the statewide bag limits in designated Deer Reduction Zones. Beginning with an antlerless deer, hunters were allowed to harvest up to 10 additional deer under the Deer Reduction Zone bag limit, for a total of either 10 antlerless or one antlered ("earn-a-buck") and nine antlerless deer. Harvest of these additional deer required the possession of a Deer Reduction Zone license for each deer harvested. An antlered deer harvested under the Deer Reduction Zone license did not count toward a hunter's statewide bag limit of one antlered deer. However, deer harvested in designated Deer Reduction Zones with other license types (e.g., archery, bonus antlerless, and license bundle) counted toward statewide bag limits. The Deer Reduction Zone season opened Sept. 15, two weeks prior to the beginning of Archery season, and continued through Jan. 31.

There were multiple reserve draw hunts open to hunters with a valid deer hunting license. In 2018, the reserve draw locations change annually and included, among others, Muscatatuck National Wildlife Refuge, Big Oaks National Wildlife Refuge and Camp Atterbury Joint Maneuver Training Center. For a complete list of reserve draw deer hunts, please visit the Indiana DNR website on.IN.gov/reservedhunt.

Deer Control Permits and Deer-Vehicle Collisions

Deer control permits were issued to Indiana residents experiencing an economic loss of $500 or more as a result of property damage caused by deer or where there was an identified disease risk to humans or domestic livestock. Each depredation permit specified the number of deer a landowner was authorized to take under the permit. Permits were only valid on the permit holder's property, and the permit holder was allowed to designate assistants to remove deer in place of themselves. Depredation permits for deer are typically only issued outside of the deer hunting season.

Vehicle collisions involving deer and resulting in property damage of at least $750 or injury to any person were reported to the Indiana State Police and Indiana Department of Transportation by local and State law enforcement agencies. Information collected included location of collision (e.g., county, coordinates, intersection, etc.) and road type (e.g., county road, state road, interstate, etc.). The number of deer-vehicle collisions and the number of deer taken with depredation permits are factors that influence the bonus antlerless quotas for the hunting season. Numerous deer-vehicle collisions and abundant damage due to deer in a county may indicate too many deer in that county. Thus, the bonus antlerless quotas may be adjusted to minimize the impacts deer have on roadways and properties.

Deer Health

DNR monitors deer health for major outbreaks of diseases such as epzootic hemorrhagic disease (EHD), bovine tuberculosis (bTB), and chronic wasting disease (CWD). There was only the occasional report of a deer with clinical signs consistent with EHD, and no deer tested positive. We continued to monitor deer in Franklin County for bTB, and none tested positive for that disease. A total of 756 hunter-harvested deer, 180 road-killed deer, 26 targeted deer, and seven found-dead deer were tested for CWD statewide in 2018. Our ability to detect the disease in the targeted surveillance areas

Fish and Wildlife deer check station 52 Pik-Up, staff check the deer for Bovine Tuberculosis. Photo by John Maxwell.

ranged from 3.26% to 1.63% in the northwest targeted area and 1.3% in Steuben County in the northeast (**Table** 6-2). To date, no wild deer from Indiana have tested positive for CWD.

Surveys and Citizen Science

Surveys of hunters, landowners, and the public are tools Indiana DNR uses to manage the state's deer herd. Prior to 2017, paper surveys were mailed to a subset of Indiana hunters and landowners every three or four years, asking questions about harvest, deer damage, and opinions on the size and management of deer in Indiana. In 2018, hunters had the opportunity to complete an online survey immediately after checking in their deer, and to participate in the Deer Management Survey to share their opinions of Indiana deer management. These surveys gathered specific information about the deer that were harvested (sex, age, approximate size, etc.), the hunting experience associated with those deer (number of does or bucks seen and happiness with the hunt), how hunters feel about the state's deer population, and how they would like deer to be managed. Indiana DNR also solicited hunter and public participation in citizen science projects to collect valuable data on fawn:doe and buck:doe ratios to better understand the recruitment rates of populations at the county and regional levels.

CHAPTER 2.
CHANGES TO DEER MANAGEMENT

Deer Management Units

In 2018, Indiana DNR began analyzing deer data on a regional scale, based on Deer Management Units (DMUs). DMUs are defined groupings of Indiana counties that were developed as part of a collaborative research project between Purdue University and Indiana DNR. Counties were grouped based on similar characteristics such as habitat, hunter density, and urban development. The research project and the statistical process are described in Chapter 10 of this report. The project originally defined Regional Management Units (RMUs) that Purdue University is using to conduct research on deer populations and deer management. However, Indiana DNR adapted the RMUs into the DMUs referenced throughout this report to make them better suited for management applications (**Figure** 2-1). The DMUs are only used for statistical analyses to inform deer management. They do not alter any county-level hunting regulations.

Historically, the county has been the base unit for deer management in Indiana. However, Indiana DNR is often unable to collect enough data at the county level to accurately interpret deer data trends. Therefore, the DMUs provide a larger quantity of data for analysis and interpretation. This allows us to evaluate deer harvest, provide harvest recommendations, and report survey data on a broader scale. For example, Indiana DNR uses data from Snapshot Indiana, a citizen science trail camera project (see Chapter 8), to estimate annual deer recruitment (i.e., fawn:doe ratio in the fall prior to the hunting season). On average, there are only one or two cameras set up in each county. That is not enough cameras to provide sufficient data to evaluate recruitment for individual counties. The data can be used to estimate recruitment statewide; however, recruitment varies based on the quality of fawning habitat, which differs across the state. Using the DMU groupings, Indiana DNR is able to pool camera data from multiple counties with similar habitat. Having more data results in improved quality of analysis, which better informs management decisions.

The DMUs are also not rigid groupings. They may change slightly over time, as we develop better datasets and reassess counties that may have been only a slightly better fit for inclusion in one DMU over another. However, we expect these changes to be relatively minor, and changes will only be made to improve the data quality from counties that are grouped together. DMUs 1 through 9 are grouped based on similar characteristics among counties. DMU 10 is the Urban Deer Management Unit and includes Marion County and other highly urbanized areas, most of which are designated Deer Reduction Zones. Because the Urban Deer Management Unit is based on a sub-county level, some data, such as the deer harvest data, cannot be reported for this unit. Only certain datasets that are reported at the sub-county level by a 16-sq. mi. grid system can be described for the Urban Deer Management Unit.

Throughout the 2018 Indiana White-tailed Deer Report, we report data at the county level, the regional DMU level, and statewide. As in years past, data for individual counties can be found in the County Data Sheets at the end of the report. Similarly, data for each DMU can be found in the DMU Data Sheets, also at the end of the report.

Changes to the County Data Sheets

County data sheets were first included in the 2016 Indiana White-tailed Deer Report, and consisted primarily of harvest data, take from deer control permits, and deer-vehicle collision trends. In 2017, they were expanded to include hunter and farmer opinion data from past and current surveys. As Indiana DNR has developed a more robust data collection system for citizen input, we have developed additional indices and trends that can be analyzed at the county level. Likewise, we are expanding the amount of biological data that can be used to evaluate the deer population, mortality, and harvest trends.

In the 2018 Indiana White-tailed Deer Report, we have expanded these county data sheets once again. There are now a total of four pages of data dedicated to each county. The first and second pages include the biological and harvest data, while the third and fourth pages are typically the opinion data from both hunters and non-hunters. The data are used by deer scientists, wildlife biologists, and program administrators to assess the harvest and mortality of deer, examine trends in the population, and assess public desire for the direction of the deer population.

Over time, Indiana DNR will continue to assess the deer population using improved datasets and the latest statistical methods available. As we expand the types of data collected, we will continue to update the DMU and County Data Sheets with new analyses.

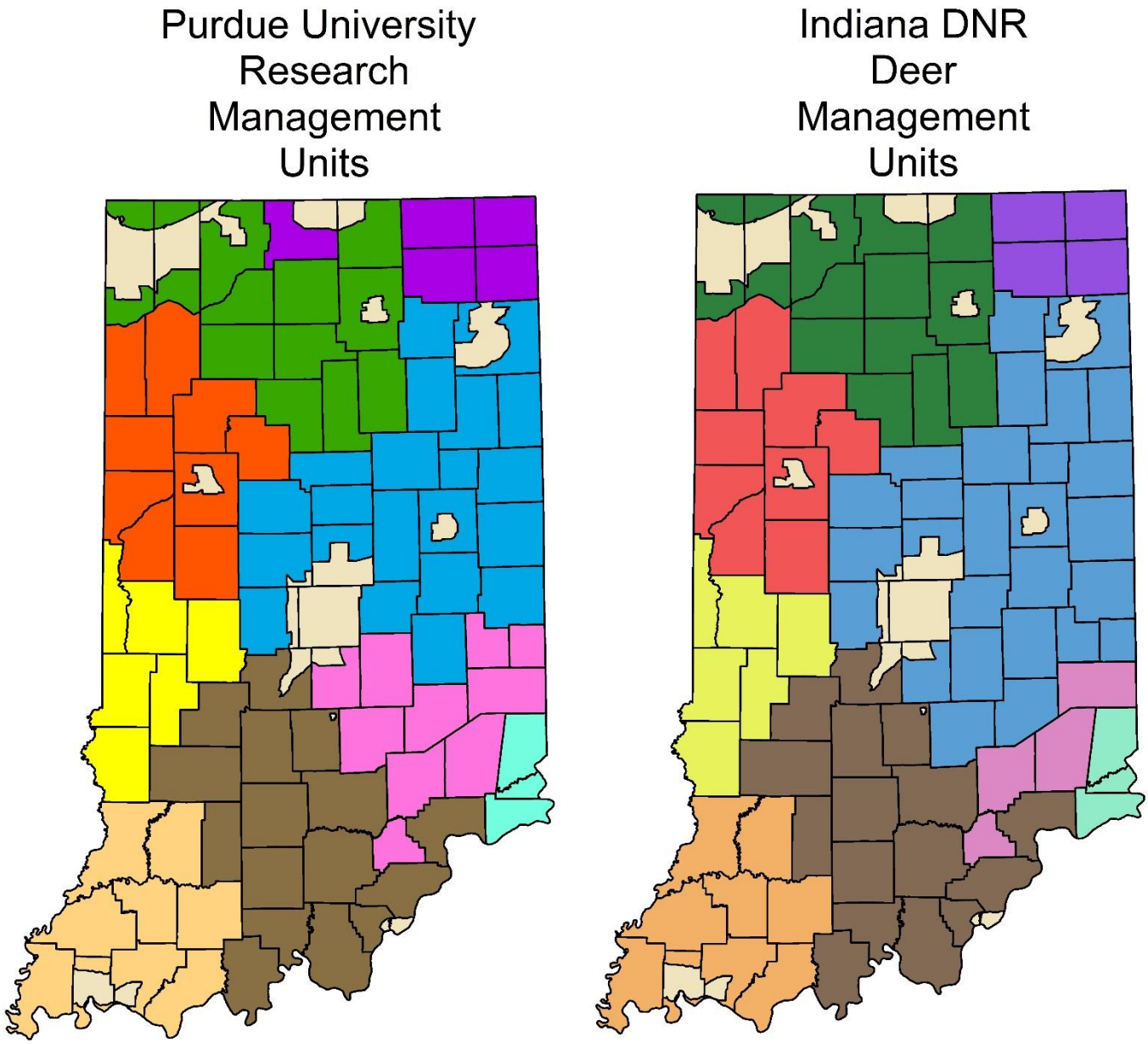


Figure 2-1: The Research Management Units (RMUs), developed through a collaborative research project by Purdue University and Indiana DNR (left), and the Deer Management Units (DMUs) that Indiana DNR adapted from the RMUs for deer management in Indiana (right).

CHAPTER 3.
2018-2019 DEER HUNTING SEASON

Joe Caudell, Olivia Vaught, Patrick Mayer, and Kyle Smith, *Indiana Department of Natural Resources*

Errors in Reporting

The online check-in system, CheckIN Game, was initiated in 2012 as an option for hunters and was made the primary game-checking system in 2015. Hunters who check in their game online occasionally make errors in reporting their harvest. Errors include checking in deer with the wrong sex indicated, incorrect licenses, or multiple entries of the same deer. Indiana DNR is constantly working throughout the deer season to correct these errors so that harvest numbers are as accurate as possible. In many cases, this involves contacting hunters by telephone or email to determine what type of error has been made before a correction can be issued.

For this reason, these data in this document should be considered to have a certain amount of reporting error. Hunters or others who use these data should expect that the numbers reported in future Indiana White-tailed Deer Reports may change slightly based on corrections of errors. This is also true for the Deer Counter on the DNR Deer webpage (deer.dnr.IN.gov). Some hunters have observed the reported total harvest decreasing as the corrections to the data were made and have contacted the DNR to ask why this was happening.

Two error rates were calculated for this issue: an unreconciled error rate and a total error rate, which includes both reconciled errors and unreconciled errors (Table 3-1). Typically, the numbers reported in this document will only fluctuate by the unreconciled error rate as the reconciled errors have already been voided and are not included in the data. However, occasionally a statistic might have been calculated without removing the voided transactions. Because error rates are relatively low, they have no effect on management decisions.

Harvest totals for the 2018 deer hunting season are current as of Feb. 7, 2019. Additionally, harvest totals for the 2016 and 2017 seasons have been updated since previously reported. In this report, the updated totals are used in analyses and comparisons between years.

Table 3-1. Error rates of hunter-reported deer harvests for the 2015, 2016, 2017, and 2018 hunting seasons. Total error includes reconciled and unreconciled errors.

	2015-2016	2016-2017	2017-2018	2018-2019
% total error	0.95%	0.73%	1.44%	0.61%
% unreconciled error	0.30%	0.38%	0.48%	0.17%

Harvest by Season

Harvest summary reports prior to 2016 did not include harvest numbers from Indiana State Park Reduction Hunts because those deer were checked in at the properties and reported separately by the Division of State Parks. Now that the deer check-in process is online for all hunters and hunts, deer harvested during State Park Reduction Hunts are included in the check-in database and can be reported with the statewide totals.

Shed bucks are checked in as antlerless deer in the CheckIN Game system and do not count against a hunter's buck limit. However, for the purpose of analyzing the harvest data, antlered bucks and shed bucks are grouped as antlered deer, while does and button bucks are grouped as antlerless deer, unless specified.

A total of 111,251 harvested deer were reported in Indiana during the 2018 season (**Figure**s 3-1 and 3-2). This harvest was 2.1% lower than the 113,590 deer taken during the 2017 season. The antlered deer harvest of 47,256 was 4.8% higher than the 45,088 reported in 2017. The antlerless harvest of 63,995 was 6.6% lower than the 68,502 harvested in 2017. In 2018, the reported harvest for total deer ranks 18th highest all-time, while the total antlerless deer harvest ranks as the 17th highest all-time in Indiana history. The antlered harvest ranks 15th highest since reporting began in 1951. Approximately 3.8 million deer have been reported harvested during the past 66 deer-hunting seasons in Indiana.

The hunting season began with the Deer Reduction Zone on Sept. 15, followed by a youth-only weekend (Sept. 29-30). The number of deer harvested with archery equipment during the Deer Reduction Zone season were incorporated into the Archery season totals, while deer harvested with firearms during the Deer Reduction Zone season were incorporated into the Firearms season totals.

The Youth season was created in 2006 and allowed youth 15 years old and younger to harvest one antlerless deer. It was changed in 2009 to include all youth 17 years old and younger. Youth hunters may harvest an antlered deer, which counts toward the statewide bag limit of one antlered deer and the number of antlerless deer determined by bonus antlerless quotas in each county. A total of 1,674 deer were reportedly harvested in 2018 during this season, an increase of 12.6% from the 1,463 deer harvested in 2017. This season resulted in 1.5% of the total harvest (Table 3-2). More than 30% of the Youth season harvest were antlered bucks (**Figure** 3-3).

There were 31,554 deer harvested during Archery season, which represented 28.4% of the overall harvest and was similar (0.6% less than) to the 31,738 deer harvested in 2017 (Table 3-2). Antlerless deer (n=18,441) made up 59.5% of the total Archery season harvest (**Figure** 3-3).

The Firearms season harvest was similar (0.1% less than) to the 67,236 deer harvested in 2017 and represented 60.3% of the total harvest (Table 3-2). The antlerless harvest of 35,813 was 5.4% less than the 2017 antlerless harvest. The 2018 antlered harvest was 6.7% greater than the number of antlered deer harvested in 2017. The antlered harvest exceeded the antlerless harvest on only the first three days of the season. The antlerless deer harvest outnumbered antlered deer during the other 13 days of the season (Table 3-3). Opening weekend contributed 27.0% of the statewide total harvest for all 2018 seasons, which was 53.1% more than in 2017. Antlerless deer accounted for 53.4% of the total Firearms season harvest. (**Figure** 3-3).

At 8,165 deer, the Muzzleloader season harvest accounted for 7.3% of the total 2018 harvest, an 8.0% decrease from the Muzzleloader season harvest of 2017 (Table 3-2). In 2018 the proportion of antlered versus antlerless deer remained the same as 2017. As in years past, a large percentage of the deer harvested during the Muzzleloader season were antlerless (72.5%, **Figure** 3-3)

The Special Antlerless Firearms season was available in counties with a bonus antlerless county designation of four or more. A total of 24 counties met this criterion in 2018. Fifty-one counties participated in 2017. The reported harvest during this season was 2,720, with 98.8% of the harvest reported as antlerless does and button bucks (**Figure** 3-3). No shed bucks were reported harvested during the Special Antlerless Firearms season in 2018.

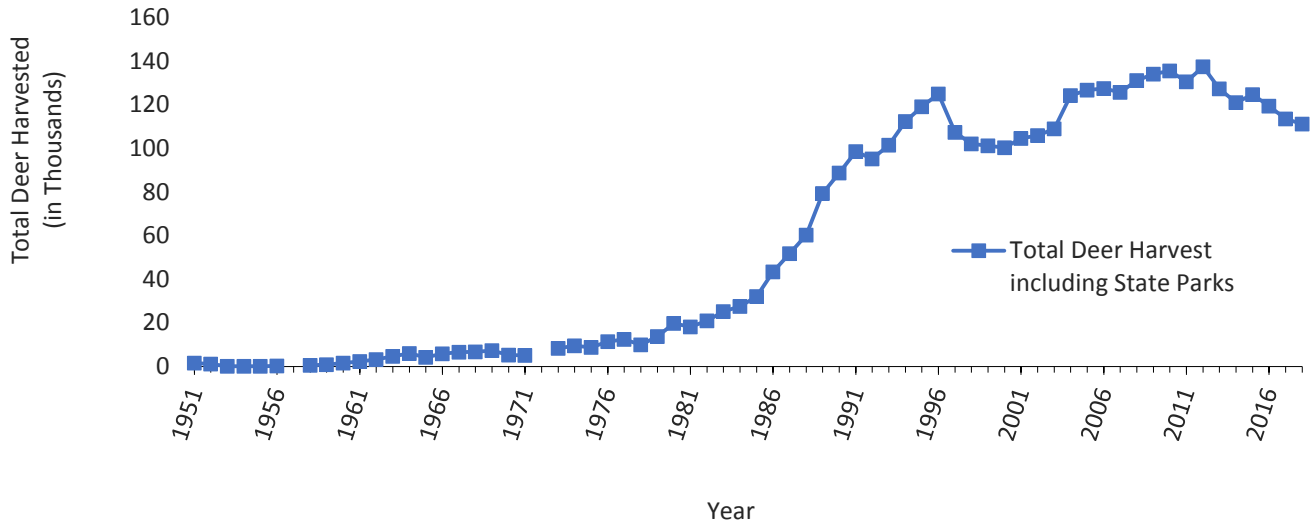


Figure 3-1. The total number of deer harvested in each Indiana deer season, 1951-2018. Totals include deer harvested in State Park Reduction Hunts, 1993-2018. Reporting error rates: ±0.61% (2018), ±1.44% (2017), ±0.73% (2016), and ±0.95% (2015).

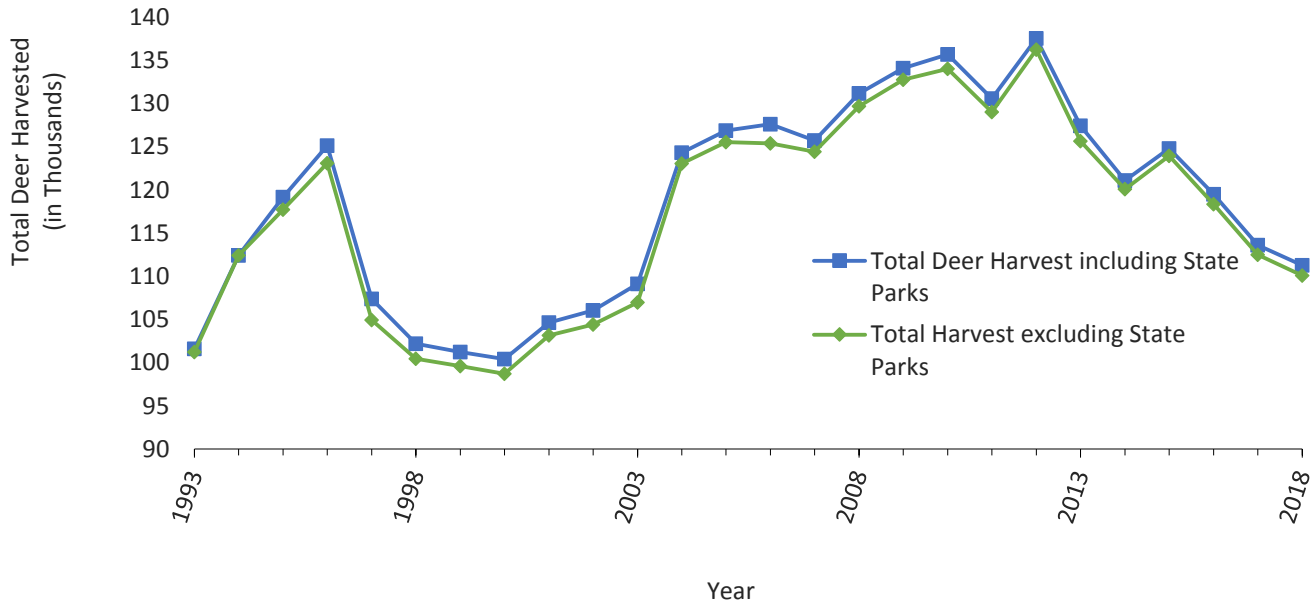


Figure 3-2. A comparison of the total number of deer harvested in each Indiana deer season, including and excluding deer harvested during State Park Reduction Hunts, 1993-2018. Reporting error rates: ±0.61% (2018), ±1.44% (2017), ±0.73% (2016), and ±0.95% (2015).

Table 3-2. Number of deer harvested per season during the 2018 Indiana deer hunting season. Values in parentheses represent percent of total harvest for each season. Values may not total 100 due to rounding. Reporting error rates: ±0.61% (2018).

	Number of deer harvested (% of total harvest)		
Season (Dates)	Antlered#	Antlerless##	Total
Youth Deer*(29 – 30 Sept)	512 (0.5%)	1,135 (1.0%)	1,647 (1.5%)
Archery* (1 Oct – 6 Jan)	13,113 (11.8%)	18,441 (16.6%)	31,554 (28.4%)
Firearms* (17 Nov - 2 Dec)	31,352 (28.2%)	35,813 (32.2%)	67,165 (60.4%)
Muzzleloader (8 – 23 Dec)	2,247 (2.0%)	5,918 (5.3%)	8,165 (7.3%)
Special Antlerless Firearms** (26 Dec – 6 Jan)	32 (0.03%)	2,688 (2.4%)	2,720 (2.4%)
Totals	47,256 (42.5%)	63,995 (57.5%)	111,251

*Includes Deer Reduction Zone harvests
**In 24 counties
#Includes shed buck harvest
##Includes button buck harvest

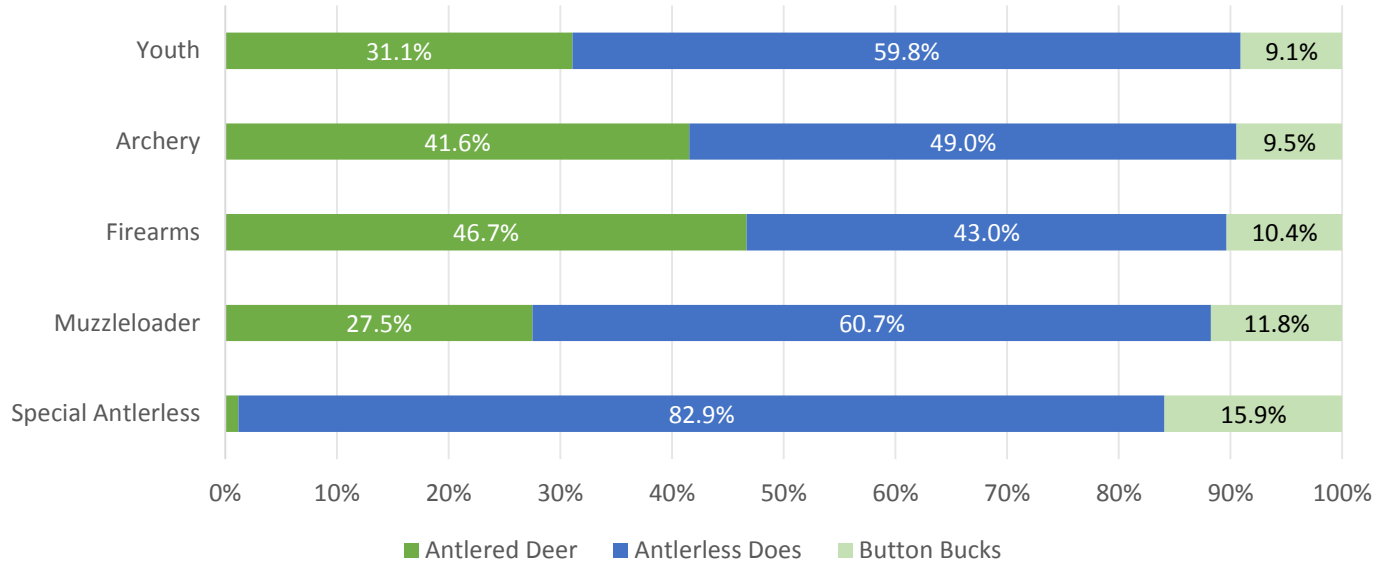


Figure 3-3. Composition of individual season harvests during the 2018 Indiana deer season. Reporting error rates: ±0.61% (2018).

Table 3-3. Number of deer harvested on each day of the 2018 Indiana Firearms season (includes deer taken by bow and arrow, crossbow, shotgun, handgun, rifle, and muzzleloader). Values may not total 100 due to rounding. Reporting error rates: ±0.61% (2018).

		Antlered		Antlerless		Total		
Date	Day	Deer	% of Daily Total	Deer	% of Daily Total	Deer	% of Season Total	% of Total 2018 Harvest
17 November	Sat	11,440	56.9%	8,650	43.1%	20,090	31.4%	18.1%
18 November	Sun	5,198	52.3%	4,745	47.7%	9,943	15.5%	8.9%
19 November	Mon	1,742	50.7%	1,691	49.3%	3,433	5.4%	3.1%
20 November	Tue	1,452	49.8%	1,462	50.2%	2,914	4.5%	2.6%
21 November	Wed	1,638	47.0%	1,846	53.0%	3,484	5.4%	3.1%
22 November	Thu	1,783	43.6%	2,302	56.4%	4,085	6.4%	3.7%
23 November	Fri	1,888	39.7%	2,873	60.3%	4,761	7.4%	4.3%
24 November	Sat	1,094	39.0%	1,709	61.0%	2,803	4.4%	2.5%
25 November	Sun	1,077	38.1%	1,749	61.9%	2,826	4.4%	2.5%
26 November	Mon	324	34.7%	609	65.3%	933	1.5%	0.8%
27 November	Tue	390	34.5%	742	65.5%	1,132	1.8%	1.0%
28 November	Wed	403	32.2%	850	67.8%	1,253	2.0%	1.1%
29 November	Thu	419	32.3%	878	67.7%	1,297	2.0%	1.2%
30 November	Fri	460	33.7%	903	66.3%	1,363	2.1%	1.2%
1 December	Sat	373	30.4%	855	69.6%	1,228	1.9%	1.1%
2 December	Sun	841	33.3%	1,681	66.7%	2,522	3.9%	2.3%
Total		30,522		33,545		64,067	100.0%	57.6%

Harvest by County

The number of deer harvested in individual counties ranged from 100 in Benton County to 2,648 in Harrison County (Table 3-4). Harvest exceeded 1,000 deer in 54 counties and 2,000 deer in 11 counties. The antlered buck harvest exceeded 1,000 in two counties (Steuben and Harrison), while the antlerless harvest exceeded 1,000 deer in 23 counties compared with 29 the previous year. Antlerless deer accounted for at least 50% of the total harvest in 86 of the state's 92 counties in 2018. The 10 counties with the highest harvests were, in descending order, Harrison, Noble, Franklin, Steuben, Dearborn, Parke, Greene, Washington, Lawrence, and LaGrange. The 10 counties with the lowest harvests, beginning with the lowest, were Benton, Tipton, Hancock, Clinton, Howard, Rush, Blackford, Boone, Marion, and Shelby.

Table 3-4. Deer harvest by county during the 2018 Indiana deer hunting season. Reporting error rates: ±0.61% (2018).

County	Antlered	Antlerless	Total	County	Antlered	Antlerless	Total
Adams	222	297	519	Lawrence	891	1,240	2,131
Allen	632	923	1,555	Madison	245	285	530
Bartholomew	403	638	1041	Marion	128	307	435
Benton	74	26	100	Marshall	800	943	1,743
Blackford	160	234	394	Martin	652	940	1,592
Boone	169	227	396	Miami	444	620	1,064
Brown	530	924	1,454	Monroe	520	750	1,270
Carroll	378	436	814	Montgomery	378	425	803
Cass	491	552	1,043	Morgan	517	722	1,239
Clark	605	909	1,514	Newton	381	403	784
Clay	542	623	1,165	Noble	988	1,478	2,466
Clinton	168	146	314	Ohio	251	288	539
Crawford	760	1,118	1,878	Orange	815	1,115	1,930
Daviess	415	501	916	Owen	773	1,086	1,859
Dearborn	857	1,456	2,313	Parke	930	1,375	2,305
Decatur	291	441	732	Perry	720	1,025	1,745
Dekalb	871	1,064	1,935	Pike	667	805	1,472
Delaware	297	351	648	Porter	508	850	1,358
Dubois	706	1,019	1,725	Posey	513	540	1,053
Elkhart	544	780	1,324	Pulaski	710	990	1,700
Fayette	358	540	898	Putnam	905	988	1,893
Floyd	276	381	657	Randolph	266	332	598
Fountain	461	559	1,020	Ripley	666	1,163	1,829
Franklin	904	1,530	2,434	Rush	175	184	359
Fulton	556	680	1,236	Saint Joseph	445	755	1,200
Gibson	526	688	1,214	Scott	348	478	826
Grant	337	426	763	Shelby	208	229	437
Greene	914	1,330	2,244	Spencer	487	612	1,099
Hamilton	196	311	507	Starke	515	803	1,318
Hancock	150	141	291	Steuben	1,095	1,300	2,395
Harrison	1,037	1,611	2,648	Sullivan	926	1,022	1,948
Hendricks	314	314	628	Switzerland	774	1,058	1,832
Henry	268	332	600	Tippecanoe	388	475	863
Howard	156	186	342	Tipton	72	39	111
Huntington	409	368	777	Union	256	372	628
Jackson	648	842	1,490	Vanderburgh	233	452	685
Jasper	505	636	1,141	Vermillion	466	605	1,071
Jay	354	510	864	Vigo	694	755	1,449
Jefferson	775	1,109	1,884	Wabash	557	617	1,174
Jennings	697	1,092	1,789	Warren	427	455	882
Johnson	231	339	570	Warrick	644	700	1,344
Knox	426	443	869	Washington	877	1,333	2,210
Kosciusko	843	1,196	2,039	Wayne	482	644	1,126
Lagrange	824	1,260	2,084	Wells	220	233	453
Lake	461	852	1,313	White	367	417	784
LaPorte	729	1,004	1,733	Whitley	462	442	904

Harvest per Hunter

The majority of hunters (71.3%, n=56,242) in Indiana harvested one deer during the 2018 deer season (Table 3-5). Only 0.8% (n=642) of hunters statewide harvested more than four deer in 2018, which is 28% less than the percentage (1.1%, n=891) that harvested more than four deer in 2017.

Table 3-5. Number of deer harvested by individual hunters during the 2017 and 2018 Indiana deer seasons. Reporting error rates: ±0.61% (2018) and ±1.44% (2017).

	2017		2018	
Number of Deer	Hunters	% of Total	Hunters	% of Total
1	55,886	70.5%	56,242	71.3%
2	16,322	20.6%	16,095	20.4%
3	4,903	6.2%	4,687	5.9%
4	1,299	1.6%	1,266	1.6%
5	519	0.7%	381	0.5%
6	193	0.2%	140	0.2%
7	88	0.1%	68	0.1%
8	53	0.1%	33	0.0%
9	23	0.0%	6	0.0%
10	10	0.0%	7	0.0%
11	3	0.0%	5	0.0%
12	1	0.0%	0	0.0%
13	1	0.0%	0	0.0%
14	0	0.0%	1	0.0%
15	1	0.0%	0	0.0%
16	0	0.0%	1	0.0%

Harvest by Equipment Type

Six types of equipment were legal for hunting deer during 2018 (**Figure** 3-4): archery (traditional and compound bows), crossbows, handguns, muzzleloaders, rifles, and shotguns. Harvest decreased from 2017 for bow and arrow (-5.8%), handgun (-1.0%), muzzleloader (-6.8%), and shotgun (-11.9%) (Table 3-6). Only rifle harvest and crossbow harvest increased (2.8% and 5.7%, respectively) from 2017, indicating a growing popularity of these equipment types.

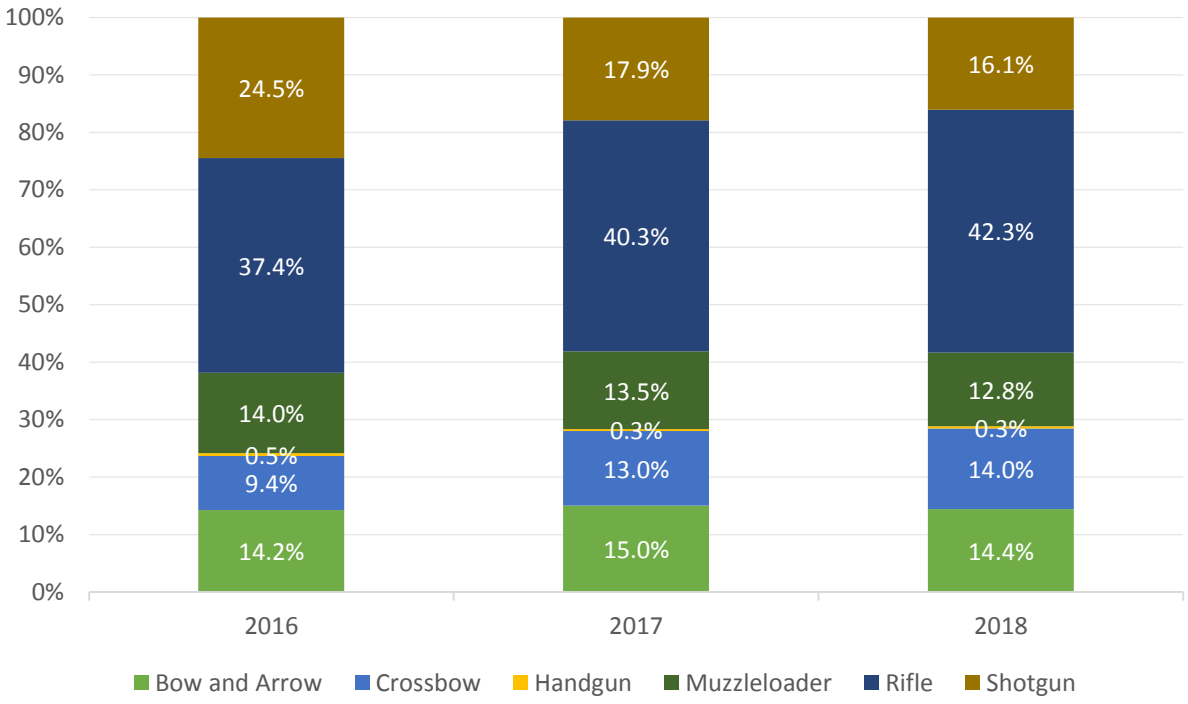


Figure 3-4. Percent harvest by equipment type 2016-2018. Reporting error rates: ±0.61% (2018), ±1.44% (2017), and ±0.73% (2016).

Table 3-6. Number of deer harvested by type of legal hunting equipment across seasons in 2018. Values within this table do not exactly equal those tallied by season (Table 3-2) due to the fact that multiple equipment types can be used during the Firearms season. Approximate percent of total harvest shown in parentheses. Reporting error rates: ±0.61% (2018), ±1.44% (2017), ±0.73% (2016), and ±0.95% (2015).

	Number of deer harvested (% of total harvest)					
Equipment	2013	2014	2015±	2016±	2017±	2018±
Bow and Arrow	24,288 (19.3%)	22,375 (18.6%)	20,320 (16.3%)	17,014 (14.2%)	17,066 (15.0%)	16,069 (14.4%)
Crossbow	10,171 (8.1%)	11,723 (9.8%)	11,844 (9.5%)	11,270 (9.4%)	14,774 (13.0%)	15,623 (14.0%)
Handgun	937 (0.7%)	844 (0.7%)	917 (0.7%)	604 (0.5%)	392 (0.3%)	388 (0.3%)
Muzzleloader	24,935 (19.8%)	23,657 (19.7%)	24,770 (19.8%)	16,689 (14.0%)	15,325 (13.5%)	14,278 (12.8%)
Rifle	18,846 (15.0%)	19,527 (16.3%)	23,306 (18.7%)	44,675 (37.4%)	45,730 (40.3%)	47,015 (42.3%)
Shotgun	46,458 (37.0%)	41,947 (34.9%)	43,612 (35.0%)	29,217 (24.5%)	20,303 (17.9%)	17,878 (16.1%)
Total	125,635	120,073	124,769	119,469	113,590	111,251

±Totals include State Park Reduction Hunts

Harvest Age and Sex Structure

The age and sex structure of the 2018 deer harvest was 42.5% adult males, 47.2% adult females, and 10.3% male fawns (button bucks) (Table 3-7). Antlerless deer (does and button bucks) represent the highest proportion of the total deer harvest at 57.5% but dropping from an all-time high of 66% in 2012.

During the opening weekend of Firearms season, DNR biologists have traditionally manned check stations throughout the state to collect age-structure data and tissue samples for disease testing. Prior to the 2012 deer season, all deer had to be brought to a check station; therefore, age data collected during the opening weekend of Firearms season provided an unbiased method for determining the age structure of the harvest. All hunters had to check in deer online during the 2018 season; therefore, age estimates of adult deer, such as the proportion of yearling bucks in the harvest, became unreliable. Evaluation of the online check-in data for the opening weekend of Firearms season historically showed that hunters were more likely to report antlered bucks at check stations than online but were more likely to report button bucks online than at check stations, thus biasing estimates toward an older age structure than the actual harvest. Therefore, age class estimates of adult deer are unavailable until a valid, scientific method for correcting this bias is obtained.

Table 3-7. Sex and age structure of the Indiana deer harvest 1987-2018, as determined from check stations and online registrations. Number in parentheses is the percent of the total harvest for that age/sex class per year. Values may not total 100 due to rounding. Reporting error rates: ±0.61% (2018), ±1.44% (2017), ±0.73% (2016), and ±0.95% (2015).

	Adults		Fawns		Total
Year	Males (%)	Females (%)	Males (%)	Females (%)	
1987	29,530 (57)	11,139 (21)	6,164 (12)	4,945 (10)	51,778
1988	34,358 (57)	13,170 (22)	7,050 (12)	5,656 (10)	60,234
1989	40,503 (51)	19,464 (24)	10,737 (14)	8,614 (11)	79,318
1990	43,080 (48)	23,680 (27)	12,373 (14)	9,630 (11)	88,763
1991	41,593 (42)	31,211 (32)	14,626 (15)	11,253 (11)	98,683
1992	43,508 (46)	25,387 (27)	14,262 (15)	12,157 (13)*	95,314
1993	44,424 (44)	27,704 (27)	14,751 (15)	14,335 (14)*	101,214
1994	50,812 (45)	32,466 (29)	15,487 (14)	13,651 (12)*	112,416
1995	47,098 (40)	40,946 (35)	16,398 (14)	13,287 (11)*	117,729
1996	47,315 (38)	39,913 (32)	17,307 (14)	18,551 (15)*	123,086
1997	42,537 (41)	35,163 (34)	14,039 (13)	13,198 (12)*	104,937
1998	44,955 (45)	30,711 (31)	12,257 (12)	12,538 (12)*	100,461
1999	46,371 (46)	30,474 (31)	11,645 (12)	11,129 (11)*	99,618
2000	44,621 (45)	31,986 (32)	11,072 (11)	11,046 (11)*	98,725
2001	48,357 (47)	31,806 (31)	11,230 (11)	11,770 (11)*	103,163
2002	47,177 (45)	35,357 (34)	11,291 (11)	10,603 (10)*	104,428
2003	49,533 (46)	36,303 (34)	10,262 (10)	10,887 (10)*	106,986
2004	54,743 (44)	41,749 (34)	12,501 (10)	14,065 (11)*	123,058
2005	52,488 (42)	44,286 (35)	13,030 (10)	15,722 (13)*	125,526
2006	49,097 (39)	45,257 (36)	13,688 (11)	17,339 (14)*	125,381
2007	49,375 (40)	44,514 (36)	13,313 (11)	17,225 (14)*	124,427
2008	50,845 (39)	46,666 (36)	13,083 (11)	19,154 (15)*	129,748
2009	52,878 (40)	48,222 (36)	13,040 (10)	18,291 (14)*	132,431
2010	53,007 (40)	49,911 (37)	13,367 (10)	17,719 (13)*	134,004
2011	50,717 (39)	45,931 (36)	13,058 (10)	19,312 (15)*	129,018
2012	45,936# (34)	54,983 (40)	15,911 (12)	19,418 (14)*	136,248
2013	46,240# (37)	46,229 (37)	14,100 (11)	19,066 (15)*	125,635
2014	45,686# (38)	46,760 (39)	12,694 (11)	14,933 (12)*	120,073
2015±	51,176# (41)	60,828 (49)	12,765 (10)	€	124,769
2016±	51,773# (43)	55,922 (47)	11,774 (10)	€	119,469
2017±	45,088# (40)	56,335 (50)	12,167 (10)	€	113,590
2018±	47,256# (42)	52,513 (47)	11,482 (10)	€	111,251

* Number of adult and fawn females is projected from the % fawns of all females aged at the biological check stations (not from the ratio of fawn doe to fawn bucks in the total deer harvest).

Includes shed antlered bucks

± Includes State Park Reduction Hunts

€ Due to the lack of biological check station and the implementation of 100% online check in of all harvested deer in 2015, female fawn numbers are not available.

Public Lands Harvest

A total of 6,778 (a 2.3% increase from 2017) deer were harvested on 122 public lands in Indiana during the 2018-2019 season which resulted in 6.1% of the total deer harvest. Public lands included state fish and wildlife areas, state nature preserves, state parks, state forests, national wildlife refuges, national forests, conservation areas, and military lands (Tables 3-8, 3-9, 3-10, and 3-11). Almost 22% of the deer harvested on public lands were taken from across 25 Fish and Wildlife Area (FWA) properties. Pigeon River FWA had the largest harvest of 244 deer. Hoosier National Forest accounted for 15.8% of the public lands harvest, while Big Oaks National Wildlife Refuge accounted for 6.1%. Together, state park (17.2%) and state forest (14.4%) lands contributed to 31.6% of the public lands harvest.

The percent of antlered (43.4%) and antlerless (56.6 %) deer harvested on public lands was similar to the composition of the total harvest (42.4% antlered, 57.5% antlerless). Button bucks accounted for 11.7% of the antlerless harvest on public lands.

Table 3-8. Deer harvested during the 2018-2019 deer hunting season on public lands managed by Indiana DNR Division of Fish & Wildlife. Reporting error rates: ±0.61% (2018).

Property	Antlered	Button Buck	Antlerless	Total	Property	Antlered	Button Buck	Antlerless	Total
FISH &WILDLIFE AREA	**707**	**152**	**619**	**1,478**	**WILDLIFE CONSERVATION AREA**	**35**	**15**	**45**	**95**
Atterbury	19	5	13	37	Aukiki	2	0	3	5
Blue Grass	2	4	3	9	Barnes-Seng	0	0	1	1
Chinook	10	0	10	20	Bittern Bog	0	0	1	1
Crosley	24	7	10	41	Cedar Swamp	6	3	6	15
Deer Creek	13	3	10	26	Durham Lake	5	1	0	6
Fairbanks Landing	57	6	33	96	Fish Lake	0	1	2	3
Glendale	25	4	29	58	Galena	4	0	1	5
Goose Pond	12	3	10	25	Lake Maxinkuckee	1	0	0	1
Hillenbrand	15	3	20	38	Little Pigeon Crk	2	2	2	6
Hovey Lake	20	1	23	44	Mallard Roost	3	1	4	8
J.E. Roush	35	8	27	70	Marsh Lake	1	4	9	14
Jasper-Pulaski	58	12	43	113	Maxincukee	0	0	5	5
Kankakee	15	3	14	32	Mendenhall	0	0	1	1
Kankakee Sands (TNC)	8	0	5	13	Menominee	7	1	8	16
Kingsbury	61	14	54	129	Province Pond	2	0	0	2
Lasalle	30	4	36	70	Swamper Bend	0	1	1	2
Pigeon River	94	38	112	244	Tern Bar Slough	1	0	1	2
Splinter Ridge	14	2	12	28	Turkey Foot	0	1	0	1
Stucker Fork	1	0	2	3	Whirledge	1	0	0	1
Sugar Ridge	37	4	15	56	**WILDLIFE MANAGEMENT AREA**	**8**	**4**	**3**	**15**
Tri-County	18	5	23	46	Oak Grove	1	0	0	1
Wabashiki	20	0	6	26	Randolph County	3	1	1	5
Wilbur Wright	5	1	3	9	White River Bend	4	3	2	9
Willow Slough	66	11	64	141	**GAMEBIRD AREA**	**14**	**1**	**5**	**20**
Winamac	48	14	42	104	Brouillette	1	0	0	1
CONSERVATION AREA	**46**	**10**	**47**	**103**	Hufford Trust	6	0	4	10
Austin Bottoms	26	7	28	61	Iroquois	2	0	0	2
Sugar Creek	13	1	13	27	McGinnis-Lauerman	0	0	1	1
Wabash River	7	2	6	15	Metro-60	0	1	0	1
GAMEBIRD HABITAT AREA	**1**	**0**	**0**	**2**	Pine Creek	1	0	0	1
Reynolds Creek	1	0	1	2	Prudential	2	0	0	2
PUBLIC FISHING AREAS	**2**	**1**	**0**	**3**	Sandy Ridge	2	0	0	2
Driftwood	1	0	0	1	**RESOURCE AREA**	**2**	**0**	**0**	**2**
Green Valley	1	1	0	2	Deniston	2	0	0	2

Table 3-9. Deer harvested during the 2018-2019 deer hunting season on public lands managed by Indiana DNR Division of State Parks. Deer harvested in state parks were taken during special state park draw hunts. Reporting error rates: ±0.61% (2018).

Property	Antlered	Button Buck	Antlerless	Total
STATE PARKS	**458**	**159**	**557**	**1,174**
Brown County	72	20	62	154
Chain O'Lakes	32	22	63	117
Charlestown	0	0	1	1
Clifty Falls	9	6	11	26
Fort Harrison	20	3	19	42
Harmonie	43	13	38	94
Indiana Dunes	15	3	16	34
Lincoln	14	6	11	31
Ouabache	13	8	24	45
Pokagon	0	0	1	1
Potato Creek	33	13	66	112
Prophetstown	15	3	14	32
Shades	33	8	31	72
Shakamak	15	7	19	41
Spring Mill	3	0	1	4
Summit Lake	14	4	25	43
Tippecanoe River	35	7	46	88
Turkey Run	23	5	20	48
Versailles	46	19	47	112
Whitewater Memorial	23	12	42	77
NATURAL AREA	**8**	**2**	**9**	**19**
Cave River Valley	8	2	9	19
STATE RECREATION AREAS	**50**	**12**	**58**	**120**
Deam Lake	9	4	8	21
Interlake	18	2	22	42
Lieber (Cagles Mill Lake)	12	4	17	33
Raccoon Lake	2	0	2	4
Starve Hollow	6	2	3	11
Trine	3	0	6	9
STATE RESERVOIRS	**266**	**98**	**318**	**682**
Brookville Lake	57	41	107	205
Hardy Lake	8	1	11	20
Mississinewa Lake	53	20	62	135
Monroe Lake	20	6	23	49
Patoka Lake	88	22	87	197
Salamonie Lake	40	8	28	76

Table 3-10. Deer harvested during the 2018-2019 deer hunting season on public lands managed by Indiana DNR Division of Forestry and the Division of Nature Preserves. Reporting error rates: ±0.61% (2018).

Property	Antlered	Button Buck	Antlerless	Total
STATE FORESTS	**407**	**122**	**457**	**986**
Clark	46	13	40	99
Ferdinand	11	3	16	30
Frances Slocum	6	0	1	7
Greene-Sullivan	41	6	25	72
Harrison-Crawford	90	23	101	214
Jackson-Washington	28	11	35	74
Martin	32	4	35	71
Morgan-Monroe	65	17	62	144
Owen-Putnam	15	9	23	47
Pike	18	3	18	39
Salamonie River	6	3	16	25
Selmier	1	1	5	7
Yellowwood	48	29	80	157
NATURE PRESERVES	**22**	**2**	**27**	**51**
Beaver Lake	2	0	1	3
Bob Kern	0	0	1	1
Conrad Savanna	3	1	1	5
Judy Burton	2	0	2	4
Round Lake Wetland	0	0	2	2
Section Six Southern Flatwoods	4	1	4	9
Twin Swamps	8	0	11	19
Wabash Lowlands	3	0	5	8

Table 3-11. Deer harvested during the 2018-2019 deer hunting season on public lands managed by federal agencies. Special draw hunts were held on the military lands and national wildlife refuge properties. Reporting error rates: ±0.61% (2018).

Property	Antlered	Button Buck	Antlerless	Total
MILITARY LANDS	**204**	**30**	**227**	**461**
Camp Atterbury	79	20	148	247
Crane	125	10	79	214
NATIONAL FOREST	**469**	**130**	**469**	**1,068**
Hoosier	469	130	469	1,068
NATIONAL WILDLIFE REFUGE	**243**	**58**	**197**	**498**
Big Oaks	203	48	160	411
Muscatatuck	23	5	15	43
Patoka River	17	5	22	44

Deer Reduction Zones Harvest

Indiana Deer Reduction Zones (DRZs) are designated to target areas within the state that have high deer populations coupled with high human density, where the cultural carrying capacity has been exceeded due to concerns over local ecology, deer-vehicle collisions, or the amount of damage to personal property. DRZs aim to reduce deer-human conflict in these areas rather than to eliminate the deer population.

Hunters may harvest up to 10 deer in the DRZs, 10 antlerless deer or nine antlerless deer and one antlered deer after first harvesting an antlerless deer (earn-a-buck). For the 2018 season, traditional DRZs were added in Brown and Warrick counties. New this year, DRZ corridors were also added in Brown, Dearborn, Dekalb, Fulton, LaGrange, Madison, Monroe, Steuben, and Wabash counties. DRZ corridors are designated areas along sections of major roadways that have high rates of deer-vehicle collisions. The DRZ corridor extends ½ mile on either side of the centerline of the specified road and includes the entirety of any parcel of land that is intersected by the DRZ corridor. An interactive map of the 2018 DRZs along with information and a video about how DRZs are determined can be found online at wildlife.IN.gov/8534.htm. The DRZ interactive map received 36,301 views in 2018, the third-highest rate behind the Where to Hunt (71,391 views; wildlife.IN.gov/5427.htm) and Where to Fish (67,294 views; wildlife.IN.gov/3591.htm) interactive maps.

Approximately 3,946 deer were harvested in DRZs in 2018 (Table 3-12), a 28.5% increase from 2017. These deer were harvested within a DRZ county using a valid license type for DRZs (DRZ license, lifetime license, youth license, or landowner or military exemptions) and were marked that they applied to the "zone bag limit" in the CheckIN Game system. Deer harvested on any other license type within the boundaries of a DRZ counted toward the statewide bag limit.

In 2018, antlerless deer made up 82.2% of the DRZ harvest. The percentage of the statewide antlerless harvest that was taken in a DRZ increased by 35.8% in 2018 (5.0%) compared to 2017 (3.7%). A total of 697 antlered deer were taken in DRZs in 2018, which accounted for 1.5% of the statewide antlered harvest. Deer taken within a DRZ accounted for between 1.0% and 60.2% of each DRZ county's total harvest (Table 3-13).

Table 3-12. The number of antlered and antlerless deer harvested within a Deer Reduction Zone (DRZ), defined as deer harvested within a DRZ county using a valid license type (DRZ license, lifetime license, youth license, or landowner or military exemptions) and indicated as counting toward the zone bag limit in the CheckIN Game system, 2016-2018. Also reported, the percent of the statewide total harvest, statewide antlered harvest, and statewide antlerless harvest that were reported as harvested in a DRZ. Reporting error rates: ±0.61% (2018), ±1.44% (2017), and ±0.73% (2016).

	2016			2017			2018		
County	Antlered	Antlerless	Total	Antlered	Antlerless	Total	Antlered	Antlerless	Total
Allen	75	343	418	99	359	458	74	339	413
Boone	9	33	42	5	28	33	8	26	34
Brown	--	--	--	--	--	--	11	59	70
Dearborn	--	--	--	--	--	--	20	101	121
Dekalb	--	--	--	--	--	--	18	54	72
Delaware	--	--	--	5	25	30	5	19	24
Elkhart	--	--	--	10	29	39	13	57	70
Fulton	--	--	--	--	--	--	3	9	12
Hamilton	33	139	172	29	112	141	43	145	188
Hendricks	18	41	59	17	49	66	17	47	64
Johnson	4	13	17	3	32	35	4	31	35
Kosciusko	--	--	--	12	76	88	13	95	108
LaGrange	--	--	--	--	--	--	20	105	125
Lake	93	435	528	87	473	560	102	511	613
LaPorte	--	--	--	19	161	180	34	174	208
Madison	--	--	--	--	--	--	1	10	11
Marion	37	202	239	45	217	262	43	215	258
Monroe	--	--	--	--	--	--	3	18	21
Morgan	--	--	--	9	63	72	17	96	113
Porter	106	523	629	83	491	574	113	478	591
Saint Joseph	--	--	--	6	62	68	12	90	102
Steuben	--	--	--	--	--	--	23	155	178
Tippecanoe	6	15	21	12	46	58	7	50	57
Vanderburgh	75	288	363	70	338	408	77	270	347
Wabash	--	--	--	--	--	--	6	12	18
Warrick	--	--	--	--	--	--	10	49	59
Total	456	2,032	2,488	511	2,561	3,072	697	3,215	3,912
Percent of Statewide Harvest Totals	0.9	3	2.1	1.1	3.7	2.7	1.5	5.0	3.5

Table 3-13. Proportion of each Deer Reduction Zone county's total deer harvest that was counted as deer harvested in the DRZ, 2018-2019. DRZ deer were defined as deer harvested within a DRZ county using a valid license type (DRZ license, lifetime license, youth license, or landowner or military exemptions) and indicated as counting toward the zone bag limit in the CheckIN Game system. Reporting error rates: ±0.61% (2018).

County	DRZ Harvest	Total County Harvest	% DRZ
Allen	414	1,555	26.6%
Boone	36	396	9.1%
Brown	72	1,454	5.0%
Dearborn	122	2,313	5.3%
Dekalb	73	1,935	3.8%
Delaware	25	648	3.9%
Elkhart	71	1,324	5.4%
Fulton	12	1,236	1.0%
Hamilton	189	507	37.3%
Hendricks	64	628	10.2%
Johnson	35	570	6.1%
Kosciusko	109	2,039	5.3%
LaGrange	125	2,084	6.0%
Lake	619	1,313	47.1%
LaPorte	208	1,733	12.0%
Madison	11	530	2.1%
Marion	262	435	60.2%
Monroe	21	1,270	1.7%
Morgan	114	1,239	9.2%
Porter	595	1,358	43.8%
Saint Joseph	102	1,200	8.5%
Steuben	180	2,395	7.5%
Tippecanoe	60	863	7.0%
Vanderburgh	349	685	50.9%
Wabash	19	1,174	1.6%
Warrick	59	1,344	4.4%

Community hunting access program hunter, Eric Silkwood at Oliver Woods near Keystone at the Crossing.
Photo by John Mawell

Community Hunting Access Program (CHAP)

The Division of Fish & Wildlife created the Community Hunting Access Program (CHAP) in 2017 to assist communities with using hunting as an effective deer management tool. This innovative program provides financial assistance to community partners who hired coordinators to manage and oversee recreational deer hunting. Their efforts provide a practical and economical method for reducing deer numbers in order to balance ecological and societal needs. CHAP allows for community partners oversite and flexibility to determine when and where managed hunts occur. In 2018, five applications were funded. However, two applicants subsequently withdrew, leaving three communities conducting CHAP hunts. In order to receive the agreed-upon funding, each community, with an approved CHAP agreement, is required to submit a final report, in writing, within 30 days after the completion of the last hunt each year of the two-year agreement. The three communities that successfully conducted CHAP hunts in 2018 were awarded $47,812.50 cumulatively. These three communities made available 1,303 acres for hunter access, allocating 730 hunting opportunities and harvesting 75 deer. The actual cost per acre for allowing hunter access was $36.69. Further community interest has been generated, and it is anticipated that the program will expand with additional community participation in 2019. Additional information regarding the CHAP program is available at wildlife.IN.gov/9420.htm.

Harvest by License Status

Resident hunters harvested 95% of the total deer harvested in Indiana in 2018 while non-residents harvested 5% of the total (**Table 3-14**). Of resident Indiana hunters, annual license holders (license types purchased every year) harvested 64.8% of the total deer. Lifetime license holders harvested 18.7% and landowner-exempt hunters (landowners and lessees who hunted on their own land without a license) harvested 11.5% of deer in 2018. A large proportion of hunters harvested deer using a deer bundle license (38.5% of resident hunters, 2.2% non-resident hunters).

Table 3-14. Number of deer harvested by resident and non-resident license types during the 2018 deer hunting season. Reporting error rates: ±0.61% (2018).

License Type	Resident Harvest	Non-Resident Harvest	Total
Bonus Antlerless	3,957 (3.6%)	133 (0.1%)	4,090
Deer Archery	2,471 (2.2%)	459 (0.4%)	2,930
Deer Bundle	42,788 (38.5%)	2,443 (2.2%)	45,231
Deer Crossbow	1,611 (1.4%)	229 (0.2%)	1,840
Deer Firearm	6,739 (6.1%)	1,292 (1.2%)	8,031
Deer Military/Refuge	472 (0.4%)	17 (0.0%)	489
Deer Muzzleloader	691 (0.6%)	79 (0.1%)	770
Deer Reduction Zone	2,275 (2.0%)	31 (0.0%)	2,306
Early State Park Reduction	794 (0.7%)	4 (0.0%)	798
Landowner Exemption	12,761 (11.5%)	337 (0.3%)	13,098
Late State Park Reduction	244 (0.2%)	0 (0.0%)	244
Lifetime License	20,817 (18.7%)	377 (0.3%)	21,194
Military Exempt - IC 14-22-11-11	96 (0.1%)	5 (0.0%)	101
Youth Free Hunt Days	201 (0.2%)	5 (0.0%)	206
Youth Hunt/Trap	9,805 (8.8%)	118 (0.1%)	9,923
Total	105,722 (95.0%)	5,529 (5.0%)	111,251

Deer License Sales

The number of deer licenses sold in 2018 decreased by 3.8% from 2017 (Table 3-15). The number of privileges (number of deer legally allowed to be harvested, excluding youth) was 1.7% less than in 2017. Each deer license bundle included three deer privileges.

Table 3-15. Deer license sales in Indiana by license type, 2013-2018. Total license sale numbers are subject to change slightly as refunds or voids are made.

License Type	2013	2014	2015	2016	2017	2018
Resident Deer License Bundle	59,546	62,092	65,604	69,035	67,756	67,970
Resident Archery/Crossbow/Reduction Zone	32,667	31,108	29,258	24,756	25,016	24,777
Resident Firearm	52,173	47,158	43,991	40,576	37,253	34,575
Resident Muzzleloader	6,450	6,641	6,088	4,669	4,376	3,898
Resident Military/Refuge	1,116	1,352	1,277	1,343	1,355	1,611
Resident Bonus Antlerless	27,993	24,241	21,088	18,063	16,187	13,866
Nonresident	10,626	10,937	11,034	11,386	11,671	11,540
Youth	41,158	39,292	33,661	33,006	30,503	28,473
Total Licenses (Excluding Youth)	190,571	183,529	178,340	169,828	163,614	158,237
Total Privileges (Excluding Youth)*	314,877	313,235	315,388	314,344	305,592	300,395

* Includes additional privileges from nonresident bundle licenses

Bonus Antlerless Licenses and Quotas

In addition to standard seasonal bag limits, hunters could purchase bonus antlerless licenses to take additional antlerless deer in any county. County bag limits (quotas) ranged from A to 8. These licenses were valid for one antlerless deer, and licensed deer hunters could purchase an unlimited number of Bonus Antlerless licenses as long as the county quotas were observed. These licenses could be used during any deer hunting season, using equipment legal for that season, except the Deer Reduction Zone season. Bonus Antlerless licenses could only be used to take one antlerless deer in "A"-designated counties Nov. 29 through Jan. 6. Quotas in 51 counties decreased from 2017, while the quota in Clark County increased (Table 3-16). The number of Bonus Antlerless deer harvested in each county can be found in the County Deer Data section.

Table 3-16. Indiana County Bonus Antlerless Quotas 2016-2018.

	Bonus Antlerless Quota				Bonus Antlerless Quota		
County	2016	2017	2018	County	2016	2017	2018
Adams	2	2	1	Lawrence	8	8	4
Allen	4	3	2	Madison	4	3	2
Bartholomew	8	4	4	Marion	8	8	3
Benton	A	A	A	Marshall	3	2	2
Blackford	1	1	1	Martin	4	4	4
Boone	4	4	2	Miami	3	2	2
Brown	4	4	4	Monroe	8	8	4
Carroll	3	2	2	Montgomery	4	4	2
Cass	3	2	2	Morgan	4	3	3
Clark	8	4	8	Newton	3	2	2
Clay	4	4	3	Noble	4	3	3
Clinton	2	2	2	Ohio	4	4	3
Crawford	8	8	4	Orange	4	4	4
Daviess	1	1	1	Owen	4	4	4
Dearborn	4	4	4	Parke	8	8	4
Decatur	3	3	3	Perry	4	4	4
Dekalb	4	3	2	Pike	3	2	2
Delaware	4	4	2	Porter	8	4	3
Dubois	4	3	3	Posey	2	1	1
Elkhart	4	4	3	Pulaski	8	4	3
Fayette	4	4	3	Putnam	4	4	4
Floyd	8	8	8	Randolph	2	2	1
Fountain	8	4	2	Ripley	8	8	4
Franklin	8	8	4	Rush	1	2	1
Fulton	4	3	2	Saint Joseph	4	4	3
Gibson	3	3	2	Scott	4	4	4
Grant	4	4	2	Shelby	3	3	2
Greene	3	4	4	Spencer	4	3	3
Hamilton	4	4	2	Starke	8	4	3
Hancock	3	3	1	Steuben	3	2	1
Harrison	8	8	8	Sullivan	3	3	3
Hendricks	8	8	3	Switzerland	4	4	3
Henry	4	4	2	Tippecanoe	3	3	2
Howard	3	2	2	Tipton	A	A	A
Huntington	3	2	2	Union	3	3	2
Jackson	4	4	4	Vanderburgh	8	4	2
Jasper	8	4	3	Vermillion	4	4	4
Jay	2	1	1	Vigo	8	4	3
Jefferson	8	8	4	Wabash	3	2	2
Jennings	8	8	4	Warren	4	3	2
Johnson	8	8	3	Warrick	3	2	2
Knox	4	4	2	Washington	8	8	4
Kosciusko	4	4	3	Wayne	3	3	3
Lagrange	3	2	1	Wells	A	A	A
Lake	4	4	3	White	4	4	3
LaPorte	4	4	3	Whitley	2	1	1

HUNTER SUCCESS AND HUNTERS AFIELD

The number of Indiana deer hunting licenses sold each year represents the number of licensed hunters afield during the hunting season, but that number does not include all hunters attempting to harvest a deer in a given year. A portion of Indiana hunters have a lifetime license, which requires no annual purchase. These hunters are not tracked in yearly license sales data, and a hunter with a lifetime license is not necessarily still an active hunter. Indiana also allows for license exemptions for landowners and active military members who are not tracked in the license sales data. Lifetime license holders accounted for 18% of the deer harvest in 2017 and 19% in 2018. More than 11% of deer were harvested by landowners or military exempt hunters in 2018. Estimating the total number of hunters afield sheds light on how many hunters are using the resource and how they are using it (i.e., license or exemption type).

DNR defines a successful hunter as an individual that harvests at least one deer during the hunting season, regardless of how many deer the hunter attempted to harvest or actually harvested. Hunter success can be calculated using license sales and harvest data: hunters who attempted to harvest a deer (hunters who purchased a license) compared to hunters who actually harvested a deer (hunters who bought a license and checked in a deer on that license). However, not every hunter is required to purchase an annual hunting license (e.g., lifetime license holders and landowner and military exempt hunters), so with this method, success rates for lifetime and exempt license holders is assumed to be similar to annual licensed hunters. This calculation is not applicable at the county level because where a license was purchased may not have been where the deer was harvested. Only a statewide success rate is attainable.

Hunter success can also be calculated from hunter survey responses. In the 2018-19 Deer Management Survey (DMS), hunters were asked to report the number of deer they wanted to harvest, the number of deer they actually harvested, the county of harvest, and the license or exemption used to harvest the deer. This information allows for the calculation of hunter success in a similar way as the license sales and harvest data: hunters who attempted to harvest deer (based on reporting they wanted to harvest deer) compared to if those hunters actually harvested a deer. Since the DMS was available for all hunters with a valid email address in the DNR system, this calculation captures all hunters regardless of license type or exemption, thus providing more accurate success rates for lifetime license holders, landowners and military exempt hunters.

In addition, hunter success rates themselves are an index that may indicate the relative herd size in an area (Roseberry and Woolf 1991). For example, a comparably high hunter success rate over time may mean it is becoming easier to harvest a deer because the deer population is increasing while a low hunter success rate over time may mean it is becoming more difficult to harvest a deer because the deer population is decreasing in that area. These comparisons are useful for determining how the deer population is fluctuating over time in an area that then helps in setting hunting quotas and regulations.

Methods. – For the 2018 hunting season, license sales and harvest data were used to determine the number of non-youth hunters who checked-in a deer who also 1) purchased an annual deer hunting license (excluding youth licenses), 2) were lifetime license holders, 3) were landowners, or 4) were active military members. Hunters who purchased a license were only counted if the same CID number was used to check in a deer that was used to purchase the license. For example, a hunter may have purchased a license under a new CID number but checked in a deer under a previous CID number. In this case, the hunter was not counted in this calculation. Youth hunters were not included in the license sales or harvest check-ins because youth hunting licenses are valid for all game species in Indiana, not just deer, so it is impossible to determine which youth licenses were purchased specifically for deer hunting. The success rate for hunters who purchased an annual license was calculated using the formula:

License Success Rate (SR_L) = Non-youth hunters who purchased an annual deer license and checked in a deer using the same CID number as the license ÷ Non-youth hunters who purchased an annual deer hunting license

To calculate hunter success rate using DMS data, hunter responses were first filtered (Microsoft Excel filter function) to better closely match the license sales data. In the survey, hunters were able to select all license types they used to harvest deer, including youth licenses, lifetime licenses, and landowner and military exemptions. We filtered out any responses that included youth licenses, lifetime licenses, and military exemptions because additional licenses are not necessary to harvest deer if using these types. We also filtered out any responses that were landowner exemptions only. However, if a hunter selected landowner exemption and another license type not already excluded, they were included. These remaining hunters represented non-youth hunters that purchased an annual hunting license.

The survey asked hunters how many deer they wanted to harvest during the deer hunting season. If any of the included hunters recorded a response, they attempted to harvest a deer and were considered equivalent to the non-youth hunters that purchased an annual hunting license. Of those hunters, we counted the number of hunters that actually harvested at least one deer (i.e., successful hunters).

Similarly to the license sales and harvest data success rate calculation, hunter success was calculated for survey responses using the formula:

Survey Success Rate (SR_s) = Non-youth hunters who said they harvested a deer ÷ non-youth hunters who said they wanted to harvest a deer

Using the success rates of non-youth hunters who purchased a license, the number of non-youth hunters afield was calculated using the formula:

$$\text{Hunters Afield} = (HCD_{AL}/SR) + (HCD_{LL}/SR) + (HCD_{LO}/SR) + (HCD_{ME}/SR) + (HCD_{Y}/SR)$$

Where,

HCD_{AL} = Adult hunters who checked-in a deer and purchased an annual deer hunting license
HCD_{LL} = Hunters who checked-in a deer and are lifetime license holders
HCD_{LO} = Hunters who checked-in a deer and are landowners
HCD_{ME} = Hunters who checked-in a deer and are military exempt
HCD_{Y} = Youth hunters who checked-in a deer and purchased a youth license

Results. – Hunter success rate and the total number of hunters afield were estimated for the 2018-2019 deer hunting season. In 2018, 126,617 non-youth hunters purchased a deer hunting license, and 45,321 of those hunters harvested a deer using the same CID as the license for a success rate of 35.8% (CI_{95}=35.5%, 36.1%, Table 3-17). An estimated 215,037 total hunters were afield during the 2018-2019 hunting season (Table 3-18).

In the DMS data, 10,732 hunters surveyed attempted to harvest a deer in 2017-18, and 5,583 of them were successful resulting in a success rate of 52.02%. In 2018-19, 14,322 hunters surveyed attempted to harvest a deer, and 8,225 of them were successful, resulting in a success rate of 57.43%. Hunter-success rates calculated from DMS responses were much higher than the license sales calculation, suggesting the DMS data may be biased toward successful hunters. As a result, we cannot use the success rate calculated from DMS responses as an estimate of actual hunter success or to calculate and estimated number of non-youth hunters afield. However, we can use it as an indicator of

the trend in hunter success over time. Similar to the license sales and harvest data, the survey data revealed a slight increase in hunter success from 2017-18 to 2018-19.

Discussion. – The hunters afield calculation provides a valuable estimate of the number of hunters attempting to harvest deer in a given year, but it has limitations that need to be refined as better data are collected. The entire calculation is based on the success rate of only non-youth hunters who purchased a license and assumes that everyone who purchased a license took advantage of the hunting opportunity. However, the success rate of hunters who purchase an annual license may not be the same for other hunters. For example, lifetime license holders may have more hunting experience, which may result in better success than a new license holder. Similarly, landowners may have higher success rates hunting on their own property if they have spent time tracking their deer and preparing for the hunt, compared to license holders hunting on someone else's property for the first time. Alternatively, they may have a lower success rate if their property is small, overhunted, or has poor-quality deer habitat. Differences in success rates may also exist between adult hunters and youth hunters that are factors of age, strength, and experience. Other factors that influence success rate, such as where and when a hunter hunts, weather patterns, skill, etc., are also not considered in this calculation.

Estimations for the total number of hunters is necessary because the total number of landowner hunters, lifetime license holders, and military exempt hunters is unknown as they are not currently tracked in the license system. Further refining the understanding of the total number of hunters afield is only possible if these hunters are counted in some way. We stated last year (Caudell and Vaught 2017) that future hunter surveys may help overcome these shortcomings by directly asking all hunters for details of their hunt (e.g., when, where, how long, individual harvest, license or exemption type, etc.) regardless of whether they harvested a deer. This was one of the goals of the DMS; however, it is biased toward successful hunters. Before the DMS data can be used to calculate success rates, a correction factor would need to be applied to adjust between hunter success based on license sales data and hunter success calculated from the DMS. The trend in hunter success, however, should remain consistent regardless of the actual success rate. Thus, the DMS may provide success rates for lifetime license holders, landowners, and military exempt hunters after the correction factor is applied. Ultimately, the most accurate measure of hunter success requires documenting every hunter that attempts to harvest a deer through license sales, registration, or some other record.

There are several practical applications for estimating hunters afield, most notably understanding the change in hunter numbers. It is well known that the number of hunters actively participating in hunting is declining each year, and estimating the number of hunters afield using a standardized method of calculation provides a repeatable index for hunter trends in Indiana. As Indiana DNR puts forth efforts to recruit new hunters, retain current hunters, and reactivate hunters who have stopped hunting, having an estimate of the number of hunters actually participating in the hunting season will aid in evaluation of the success of these programs.

Literature Cited. –

Caudell, J. C. and O. D. L. Vaught. 2018. 2017 Indiana White-tailed Deer Report. Indiana Department of Natural Resources, Bloomington, USA.

Roseberry, J. L. and A. Woolf. 1991. A Comparative Evaluation of Techniques for Analyzing White-tailed Deer Harvest Data. Wildlife Monographs 117: 3-59.

Table 3-17. The number of hunters who checked-in a deer per license category 2015-2018. Reporting error rates: ±0.61% (2018), ±1.44% (2017), ±0.73% (2016), and ±0.95% (2015).

	Number of successful hunters			
Type of Hunter	2015-2016	2016-2017	2017-2018	2018-2019
HCD_{AL}	45,239	46,876	45,637	45,321
HCD_{LL}	14,492	13,270	14,169	13,373
HCD_{LO}	12,484	11,548	10,627	10,267
HCD_{ME}	95	85	97	80
HCD_{Y}	6,450	7,203	8,311	7,929

Table 3-18: The calculated success rates (SR) of non-youth hunters who purchased an annual deer license and checked in at least one deer using the same Customer ID number as the license and the estimated number of hunters afield in each Indiana deer hunting season.

Year	Success Rate ± 95% CI	Est. Hunters Afield*
2015-2016	32.98% ± 0.25%	238,810
2016-2017	34.52% ± 0.25%	228,798
2017-2018	34.83% ± 0.26%	226,379
2018-2019	35.79% ± 0.26%	215,037

*Includes youth hunters; however youth licenses are valid for all Indiana game species. There is no way to tease out youth licenses purchased specifically for deer hunting.

CHAPTER 4
DEER CONTROL PERMITS

Joe Caudell, Linnea Petercheff, and Olivia Vaught,
Indiana Department of Natural Resources

Deer control permits grant special permission to take deer outside of the deer hunting season and are issued when individuals, businesses, and/or agencies experience problems with deer. These permits reduce conflict with landowners and alleviate future property damage from deer in localized areas. Deer control permits are not used as a form of population control, as the number of deer taken on control permits is lower compared to the number of deer harvested during the hunting season (Table 4-1). An exception to this is Marion County, where few deer were harvested by hunters because of limited access, and a comparatively large number of deer were removed through the use of control permits. Typical problems in Indiana resulting from deer include browsing damage to crops, orchards, nurseries, vineyards, and plants used for landscaping (Table 4-2). Deer control permits are issued to landowners who demonstrate damage in excess of $500, to address disease concerns (e.g., Franklin and Fayette counties to address issues with bovine tuberculosis), to protect endangered species (e.g., Porter County), or for the safety of the public.

When permits expire, permit holders are required to report to the DNR the number of deer taken on the permit and the sex of each deer taken, the equipment used, and the disposal method for each deer taken. As of Dec. 20, 2018, DNR had received reports from 257 of the 277 deer control permits it issued statewide. An average of 16.6 (n=277; CI_{95}=14.6, 18.5) deer were authorized per permit, and an average of 6.8 (n=257; CI_{95}=5.3, 8.2) deer were taken per permit (Table 4-1). Damages reported at the time of the application ranged from $200 to $88,055. Permit recipients reported an average of 21.7% (n=157; CI_{95}=18.0%, 25.5%) of soybean crops damaged and 21.7% (n=139; CI_{95}=17.5%, 25.8%) of corn crops damaged.

A total of 1,737 deer were reported taken statewide on deer control permits, representing 1.6% of the cumulative deer, which is the aggregate number of hunter-harvested deer and the number of deer taken on control permits in 2018. Most of the deer taken on control permits were does and button bucks (n=1,467), which represented 2.2% of the total number of does harvested by hunters and taken on permits in 2018. Fewer bucks (n=274) were taken on control permits, which represented 0.6% of the total number of bucks harvested by hunters and taken on permits in 2018. The majority of deer (77%) taken on control permits were either consumed or donated for human consumption. Some error exists in the total number and the individual numbers of bucks, does, and button bucks reported taken on deer control permits due to permit-holder reporting error or due to the total take being split between counties for permits that cover multiple counties.

Table 4-1. Deer control permits issued by county in 2018, including the number of deer authorized to be taken and the number of deer actually taken per permit. Cumulative Deer is the number of hunter-harvested deer plus the number of deer taken on control permits.

County	Permits Issued	Deer Taken	Avg Deer Taken / Permit	% of Cumulative Deer	County	Permits Issued	Deer Taken	Avg Deer Taken / Permit	% of Cumulative Deer
Adams	0	0	0	0.0	Lawrence	5	14	2.8	0.7
Allen	1	0	0	0.0	Madison	3	2	0.7	0.4
Bartholomew	5	5	1	0.5	Marion	4	123	30.8	22.0
Benton	1	2	2	2.0	Marshall	10	52	5.2	2.9
Blackford	0	0	0	0.0	Martin	0	0	0	0.0
Boone	0	0	0	0.0	Miami	1	0	0	0.0
Brown	9	107	11.9	6.9	Monroe	11	92	8.4	6.8
Carroll	0	0	0	0.0	Montgomery	2	23	11.5	2.8
Cass	0	0	0	0.0	Morgan	4	1	0.3	0.1
Clark	5	45	9	2.9	Newton	0	0	0	0.0
Clay	0	0	0	0.0	Noble	4	11	2.8	0.4
Clinton	0	0	0	0.0	Ohio	5	25	5	4.4
Crawford	5	11	2.2	0.6	Orange	1	3	3	0.2
Daviess	2	5	2.5	0.5	Owen	5	17	3.4	0.9
Dearborn	14	83	5.9	3.5	Parke	3	8	22.0	0.3
Decatur	0	0	0	0.0	Perry	6	91	15.2	5.0
DeKalb	2	36	18	1.8	Pike	1	2	2	0.1
Delaware	2	3	1.5	0.5	Porter	3	55	18.3	3.9
Dubois	0	0	0	0.0	Posey	1	7	7	0.7
Elkhart	2	0	0	0.0	Pulaski	3	14	4.7	0.8
Fayette	1	17	17	1.9	Putnam	0	0	0	0.0
Floyd	3	16	5.3	2.4	Randolph	0	0	0	0.0
Fountain	0	0	0	0.0	Ripley	6	12	2	0.7
Franklin	7	45	6.4	1.8	Rush	0	0	0	0.0
Fulton	2	14	7	1.1	Saint Joseph	4	20	5	1.6
Gibson	1	1	1	0.1	Scott	2	8	4	1.0
Grant	0	0	0	0.0	Shelby	0	0	0	0.0
Greene	6	18	3	0.8	Spencer	6	14	2.3	1.3
Hamilton	0	0	0	0.0	Starke	3	8	2.7	0.6
Hancock	1	0	0	0.0	Steuben	5	21	4.2	0.9
Harrison	14	141	10.1	5.1	Sullivan	5	39	7.8	2.0
Hendricks	1	0	0	0.0	Switzerland	8	66	8.3	3.5
Henry	0	0	0	0.0	Tippecanoe	1	1	1	0.1
Howard	0	0	0	0.0	Tipton	1	0	0	0.0
Huntington	0	0	0	0.0	Union	2	6	3	0.9
Jackson	7	33	4.7	2.2	Vanderburgh	3	3	1	0.4
Jasper	1	0	0	0.0	Vermillion	2	23	11.5	2.1
Jay	0	0	0	0.0	Vigo	1	2	2	0.1
Jefferson	5	38	7.6	2.0	Wabash	1	2	2	0.2
Jennings	4	16	4	0.9	Warren	1	0	0	0.0
Johnson	2	7	3.5	1.2	Warrick	5	33	6.6	2.4
Knox	0	0	0	0.0	Washington	10	95	9.5	4.1
Kosciusko	0	0	0	0.0	Wayne	3	3	1	0.3
Lagrange	3	11	3.7	0.5	Wells	0	0	0	0.0
Lake	3	9	3	0.7	White	3	16	5.3	2.0
LaPorte	4	14	3.5	0.8	Whitley	0	0	0	0.0

Table 4-2. Number of damage reports for each crop type or other reason for 2018 deer control permits. Some individuals reported multiple crops or reasons.

Crop or Reason for Permit	Number of Reports
Alfalfa	13
Apples	3
Christmas Trees	3
Corn	162
CRP	2
Disease	4
Endangered Species	2
Fruit	7
Grapes	3
Hay	27
Landscaping	11
Mint	1
Nursery Production	3
Orchard	7
Other	5
Popcorn	3
Produce	23
Proving Grounds	1
Pumpkins	9
Reforestation	3
Rye	2
Soybeans	187
Timber Production	2
Wheat	9
Woods	5

CHAPTER 5.
DEER-VEHICLE COLLISIONS

Joe Caudell and Olivia Vaught, *Indiana Department of Natural Resources*

Deer-vehicle collisions are reported by state and local police to the Indiana Department of Transportation (INDOT) anytime an accident report is completed for insurance purposes. These reports include information on the direction the vehicle was moving, location of the accident, type of road, road conditions, estimated cost of damage, and other data used in road safety analyses. Data on deer-vehicle collisions are provided to DNR each year for this report and for deer population analysis. This data set is especially valuable for the DNR, as it is an independent data set that has been collected in a similar fashion over a long period of time. Deer-vehicle collisions are also standardized across years and counties by using INDOT's statistics on the Daily Vehicle Miles Traveled. Analyzing collisions per billion miles traveled accounts for changes in traffic volume between counties and allows for an unbiased comparison between counties and years.

The total number of deer-vehicle collisions reported across the state decreased from 15,414 in 2017 to 15,270 in 2018 (**Figure** 5-1; **Table** 5-1). The number of deer-vehicle collisions per billion miles traveled (DVC/BMT) was 194 DVC/BMT in 2018, similar to the 198 DVC/BMT reported in 2017.

Ohio (1,157 DVC/BMT), Pulaski (978 DVC/BMT), and Noble (832 DVC/BMT) had the highest number of DVC/BMT (**Figure** 5-2). Marion (10 DVC/BMT) and Lake (41 DVC/BMT) had fewer than 50 DVC/BMT. Compared to 2017, DVC/BMT decreased in 42 counties and increased in 50 counties. Twelve counties showed a greater than 15% increase in DVC/BMT compared to 2017, while 15 counties showed a greater than 15% decrease. Only one county, Union, had a greater than 50% increase in the number of DVC/BMT compared to 2017.

Most deer-vehicle collisions in 2018 occurred on state roads (36.5%) and county roads (28.4%; Table 5-2). From 2013 to 2018, state roads had the highest average number of DVC/BMT by road type per year (442 DVC/BMT). U.S. routes had the highest average number of deer-vehicle collisions (85 DVC) per 100 miles of road from 2013 to 2018 (**Table 5-2**).

More than 50% of deer-vehicle collisions in 2018 occurred between September and December (**Figure** 5-3). Additionally, deer-vehicle collisions occurred most often during dawn and dusk, which varies by month and coincides with the average length of daylight (**Figure** 5-4).

The estimated economic cost of deer-vehicle collisions from damage to vehicles in 2018 was more than $66.7 million based on the average estimated cost per collision (Table 5-3). From 2013 to 2018, deer-vehicle collisions cost drivers a total of more than $365 million (**Table 5-3**).

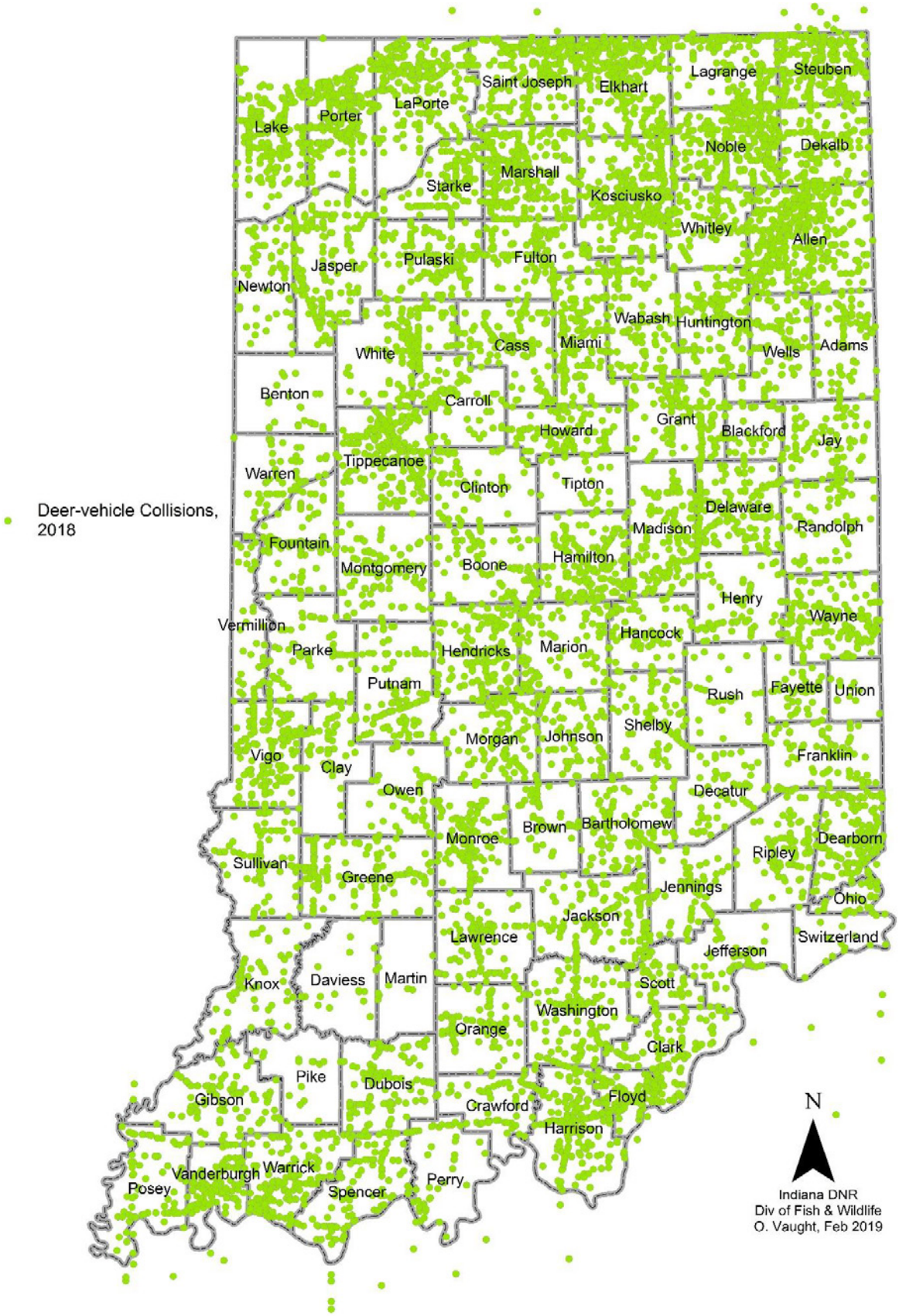


Figure 5-1. Locations of 2018 deer-vehicle collisions. Only 12,718 (83.3%) of the 15,270 deer-vehicle collisions reported to INDOT included GPS location data to map.

Table 5-1. Number of deer-vehicle collisions by Indiana county in 2017 and 2018.

	Deer-vehicle Collisions			Deer-vehicle Collisions	
County	2017	2018	County	2017	2018
Adams	107	116	Lawrence	192	200
Allen	455	475	Madison	160	165
Bartholomew	180	166	Marion	131	113
Benton	26	25	Marshall	311	342
Blackford	38	52	Martin	25	15
Boone	109	134	Miami	190	189
Brown	114	99	Monroe	191	158
Carroll	116	128	Montgomery	190	145
Cass	226	169	Morgan	160	174
Clark	237	198	Newton	93	88
Clay	106	109	Noble	330	365
Clinton	118	78	Ohio	50	56
Crawford	125	120	Orange	177	147
Daviess	43	32	Owen	105	105
Dearborn	287	256	Parke	154	155
Decatur	93	82	Perry	111	87
Dekalb	273	308	Pike	16	24
Delaware	188	202	Porter	349	340
Dubois	232	207	Posey	114	118
Elkhart	365	341	Pulaski	213	191
Fayette	47	53	Putnam	162	174
Floyd	158	161	Randolph	77	88
Fountain	88	122	Ripley	182	124
Franklin	97	111	Rush	62	42
Fulton	154	163	Scott	95	320
Gibson	135	162	Shelby	110	64
Grant	182	183	Spencer	140	106
Greene	295	262	St Joseph	331	169
Hamilton	205	223	Starke	173	148
Hancock	108	122	Steuben	430	470
Harrison	323	289	Sullivan	92	127
Hendricks	181	207	Switzerland	22	21
Henry	100	86	Tippecanoe	312	312
Howard	123	129	Tipton	42	36
Huntington	205	228	Union	6	10
Jackson	255	204	Vanderburgh	185	154
Jasper	207	217	Vermillion	70	72
Jay	128	132	Vigo	222	216
Jefferson	96	86	Wabash	177	182
Jennings	104	104	Warren	87	119
Johnson	132	120	Warrick	269	258
Knox	130	131	Washington	171	213
Kosciusko	418	447	Wayne	188	196
Lagrange	220	222	Wells	99	127
Lake	239	241	White	150	158
LaPorte	325	339	Whitley	205	146

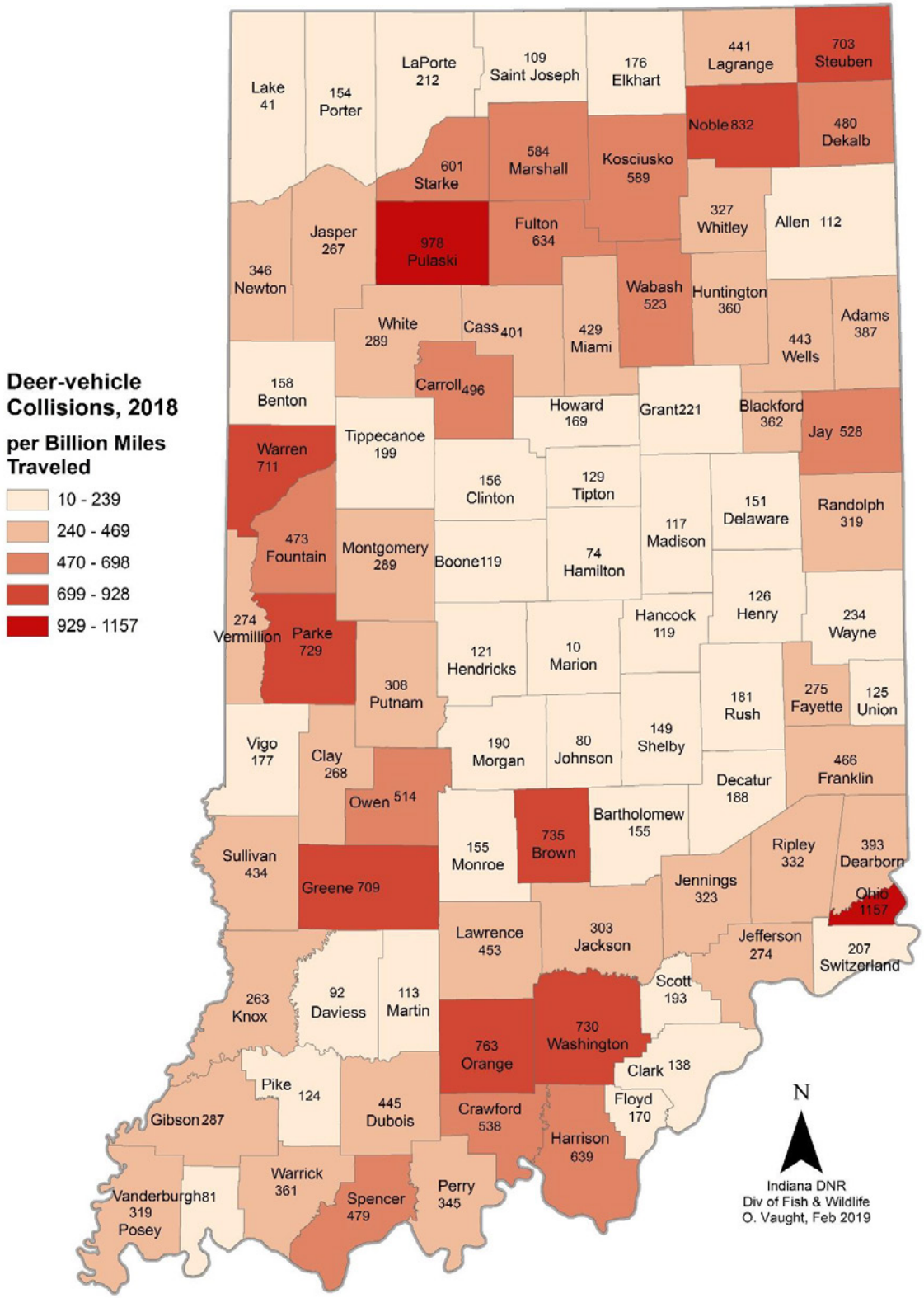


Figure 5-2. The number of 2018 deer-vehicle collisions per billion miles traveled (DVC/BMT) by Indiana county. DVC/BMT provides the relative rate of deer-vehicle collisions given the amount of miles driven in that county per year. Counties with high DVC/BMT have proportionally more deer-vehicle collisions per the number of miles traveled than counties with lower DVC/BMT. Counties with low DVC/BMT may have a high number of deer-vehicle collisions that is offset by a high estimate of miles traveled (e.g., Lake County).

Table 5-2. Number of 2018 deer-vehicle collisions (DVC) by road type, average number of deer-vehicle collisions per year from 2013-2018, average deer-vehicle collisions per 100 miles of road type, and average deer-vehicle collisions per billion miles traveled (DVC/BMT) from 2013-2018. Collision values were averaged from 2013-2018, and miles-traveled values were averaged from 2012-2017. Collisions on unknown road type were excluded.

Road Type	DVCs 2018	Avg DVCs 2013-2018	Road Length (mi)	Avg DVCs per 100mi of Road	Avg BMT per year	Avg DVC/BMT per year
County Road	4,312 (28.4%)	4,173 (28.0%)	65,211	6.4	19.4	215.4
Interstate	1,196 (7.9%)	1,215 (8.2%)	1,860	65.3	19.0	63.9
Local/City Road	1,776 (11.7%)	1,554 (10.4%)	19,612	7.9	20.3	76.7
State Road	5,553 (36.5%)	5,510 (37.0%)	7,272	75.8	12.5	442.2
US Route	2,372 (15.6%)	2,432 (16.3%)	2,863	84.9	10.0	243.0

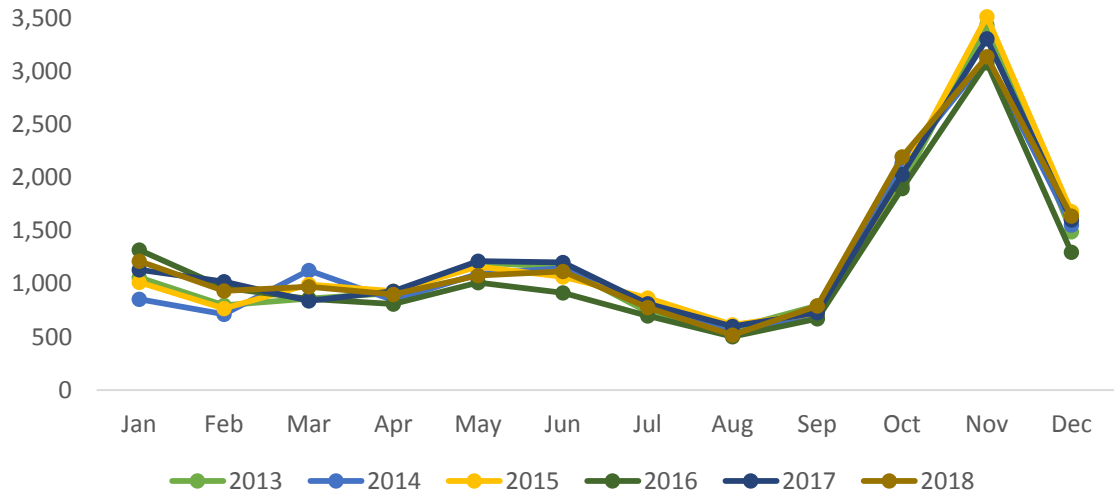


Figure 5-3. Number of deer-vehicle collisions by month in Indiana from 2013-2018.

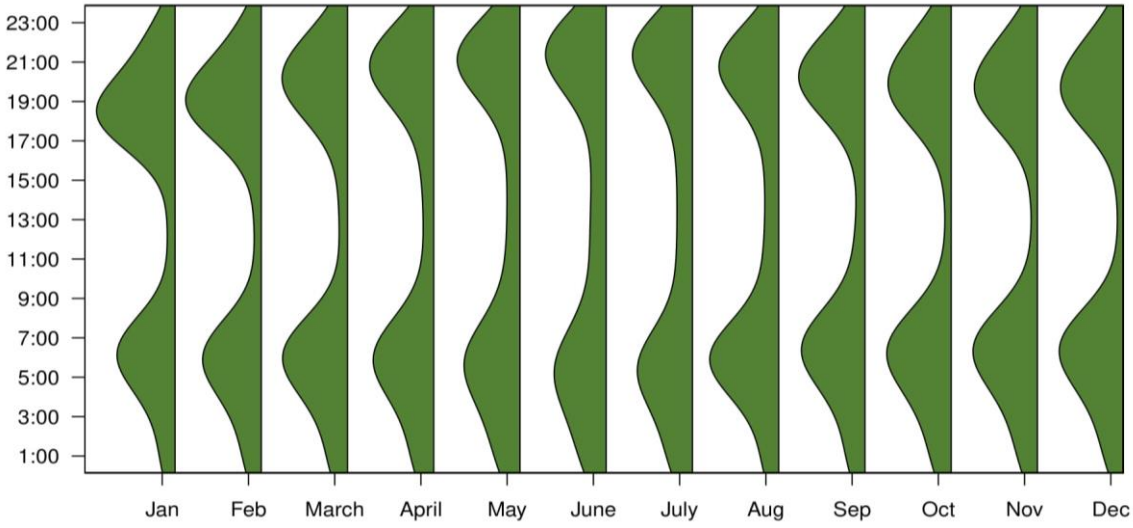


Figure 5-4. The proportion of deer-vehicle collisions by time of day in Indiana from 2013-2018.

Table 5-3. Reported economic loss due to deer-vehicle collisions in Indiana from 2013-2018. Collisions with an unknown estimate or an estimate less than $1000 were not included. Total Damage Estimate 2013-2018 is calculated by multiplying the total number of collisions for that damage estimate range by the average value of damage.

Damage Estimate Range	2018 DVCs	2017 DVCs	2016 DVCs	2015 DVCs	2014 DVCs	2013 DVCs	Total DVCs	Avg Value of Damage	Total Damage Estimate 2013-2018
$1,001 to $2,500	5,365 (36.7%)	5,501 (37.3%)	5,157 (38.7%)	6,017 (41.2%)	5,817 (41.9%)	6,178 (43.7%)	34,035 (39.9%)	$1,750	$59,561,250
$2,501 to $5,000	5,851 (40.0%)	5,917 (40.1%)	5,397 (40.5%)	5,750 (39.4%)	5,541 (39.9%)	5,665 (40.0%)	34,121 (40.0%)	$3,750	$127,953,750
$5,001 to $10,000	2,826 (19.3%)	2,806 (19.0%)	2,366 (17.7%)	2,456 (16.8%)	2,208 (15.9%)	2,014 (14.2%)	14,676 (17.2%)	$7,500	$110,070,000
$10,001 to $25,000	520 (3.6%)	488 (3.3%)	373 (2.8%)	345 (2.4%)	273 (2.0%)	279 (2.0%)	2,278 (2.7%)	$17,500	$39,865,000
$25,001 to $50,000	40 (0.3%)	30 (0.2%)	37 (0.3%)	22 (0.2%)	25 (0.2%)	13 (0.1%)	167 (0.2%)	$37,500	$6,262,500
$50,001 to $100,000	7 (0%)	11 (0.1%)	5 (0%)	4 (0%)	4 (0%)	1 (0%)	32 (0%)	$75,000	$2,400,000
Over $100,000	2 (0%)	4 (0%)	1 (0%)	1 (0%)	5 (0%)	1 (0%)	14 (0%)	$100,000	$1,400,000
Total	14,611	14,757	13,336	14,595	13,873	14,151	85,323		$347,512,500

CHAPTER 6. DEER HEALTH

Joe Caudell and Olivia Vaught, *Indiana Department of Natural Resources*

Epizootic Hemorrhagic Disease

Epizootic hemorrhagic disease (EHD) is a virus spread to white-tailed deer (*Odocoileus virginianus*) through the biting midge (*Culicoides variipennis)* in Indiana. Often worse in drought years, outbreaks tend to occur in five- to 10-year cycles. Although Indiana DNR received occasional reports of mortality in white-tailed deer from around the state in 2018, no cases of EHD were confirmed in Indiana. Localized mortality in deer from EHD can occur at any time, even if there is not a significant outbreak. The last major outbreak of EHD in Indiana occurred in 2012. A less-widespread but significant outbreak occurred in 2013.

Chronic Wasting Disease

Chronic wasting disease (CWD) is a neurodegenerative disease that affects members of the cervid family. Members of the cervid family include white-tailed deer, mule deer (*O. hemionus*), elk (*Cervis elaphus*), moose (*Alces alces*), and reindeer (*Rangifer tarandus*). CWD is in a class of prion-caused diseases known as transmissible spongiform encephalopathies (TSE). Prions are misfolded proteins that cause lesions in the brains of infected animals. CWD is thought to be shed in the saliva, feces, and urine of infected deer and transmitted either by direct deer-to-deer contact or through contact with contaminated soil.

There is much ongoing research related to CWD, but there is no effective cure or vaccine. CWD is always fatal to the infected cervid. CWD attacks the animal's brain and causes behavioral changes, excessive salivation, and loss of appetite. It leads to progressive degradation of body condition and death. CWD has a long incubation period that averages from 18 to 24 months between infection and clinical signs. Infected animals often appear healthy in the early stages of the disease. In advanced stages, however, they become emaciated, may lose fear of humans, stand with legs wide apart, and hold their head and ears low. Infected individuals rarely live more than 2.5 years from the time they are infected until death (B. Richards, USGS National Wildlife Health Center, personal communication).

CWD was first detected as a clinical syndrome in 1967, in captive mule deer at a Colorado research facility. In 1978, CWD was determined to be a spongiform encephalopathy and was found in captive deer and elk in Wyoming. Three years later, the disease was observed in free-ranging elk in Colorado. By 2002, it had been detected in nine states (Colorado, Illinois, Kansas, Minnesota, Montana, Oklahoma, South Dakota, Wisconsin, and Wyoming) and two Canadian provinces. As of early 2018, CWD had been found in wild and captive cervid herds in 26 U.S. states, two Canadian provinces, Norway, South Korea, and Finland (Carlson et al. 2018). Later in 2018, it was identified in Mississippi and Tennessee (Richards 2019).

CWD has been detected in white-tailed deer in three states surrounding Indiana. CWD has been detected in captive deer in Ohio (Carlson et al. 2018). Michigan has detected CWD in both wild and captive deer with the closest positive white-tailed deer found approximately 35 miles from the Indiana border (C. Stewart, personal communication). Illinois reported 51 new detections of CWD in wild deer during fiscal year 2018. No new cases were reported in Kankakee County, Illinois, which is approximately 25 miles west of the Illinois/Indiana boundary. However, only four positive deer have been detected in that county since 2014 (Dufford and McDonald 2018).

Each year, Indiana DNR collects tissue samples from hunter-harvested and road-killed deer throughout the state for CWD testing. Samples are collected as part of the statewide CWD surveillance program to monitor the presence of CWD in Indiana. Sick deer reported by citizens are also tested through the statewide CWD surveillance program. Because diseased prions accumulate in lymphoid and neural tissues, CWD is diagnosed by examination of brain or lymphoid tissue from a dead animal.

In 2018, we used a scaled-down, risk-based approach (Walsh and Otis 2012) for determining CWD surveillance effort. Proximity to known CWD-positive free-ranging populations was the primary risk factor, and we included only two levels of risk (i.e., high and low risk; we are currently working to significantly expand the risk-analysis

using similar factors applied in other states [Schuler et al. 2018]). As a result of this approach, Indiana DNR increased CWD surveillance and testing of hunter-harvested deer in the northwest corner of the state during the entire deer season and in the northeast corner of the state during opening weekend of firearms season (Nov. 17 and 18, 2018). We used the Bayesian weighted surveillance approach (Jennelle et al. 2018) to determine the number of samples necessary to achieve sampling goals. We identified seven northwestern counties for targeted surveillance, including Newton, Jasper, Lake, LaPorte, Porter, Pulaski, and Starke counties. Steuben County was the only targeted county in the northeast, although we assumed we would get additional samples from LaGrange, Noble, and DeKalb counties because of increased awareness of the heightened surveillance effort in Steuben County.

Once we determined our high-risk areas and the number of samples required for a range of sampling objectives, we used past harvest records (Caudell and Vaught 2017) and predictions of hunter behavior for providing samples to determine what level of surveillance was possible for a given level of input (i.e., staff time, funds, other resources). We determined that an achievable objective was collecting enough samples to detect CWD if it were in 2% of the population in Newton and southern Lake County, and between 2% and 5% in the remaining northwest Indiana counties. We determined that an objective of 2-5% in Steuben County was possible with hunter-harvested samples.

To achieve these sampling goals, we determined that voluntary surveillance through the hunting season in northwestern Indiana would be required because of the relatively low deer population, but that a large effort on opening weekend of firearms season would suffice in the northeast. Additionally, we increased efforts in these counties to obtain samples from community-reported sick deer (Jennelle et al. 2018). In the northwestern surveillance zone, we ran two to three CWD check stations at high-value areas, such as processors and businesses frequented by hunters. During opening weekend of firearms season, we expanded this to eight locations throughout the seven-county area in the northwest. Additionally, several processors and taxidermists collected heads throughout the week for surveillance purposes. In northeast Indiana, we had five check station locations in or near Steuben County. Two processors and taxidermists continued to collect heads throughout firearms season. These heads were later sampled by Indiana DNR personnel.

The remaining counties in the state were considered low-risk in this analysis. Wildlife biologists and state wildlife property managers already collect routine samples from road-killed deer and hunter-harvested deer each year. In addition, based on the high value of community-reported sick deer for surveillance (Jennelle et al. 2018), we instructed wildlife biologists and property personnel to respond when possible to calls about sick deer if they were consistent with clinical signs of CWD. We also created a website through which the public could report sick deer online. These data were continually monitored, and biologists followed up on calls regarding sick deer with clinical signs consistent with CWD.

Collected samples were transported to the Animal Disease Diagnostic Lab at Purdue University and tested using immunohistochemical staining procedures. Results were posted online for hunters to access using their name, phone number, and/or the confirmation number for that hunter-harvested deer. Any positive deer would have resulted in a phone call prior to results being posted online.

A total of 756 hunter-harvested deer, 180 road-killed deer, 26 targeted deer, and seven found-dead deer were tested statewide in 2018, including 15 hunter-harvested deer from Illinois, Michigan, and Missouri (Table 6-1). Detection abilities were calculated for each targeted surveillance county and non-target counties (**Figure** 6-1). Our ability to detect the disease ranged from 3.26% to 1.63% in the northwest targeted area and was 1.31% in Steuben County in the northeast (Table 6-2). To date, no wild deer from Indiana have tested positive for CWD.

Bovine Tuberculosis Surveillance

Bovine tuberculosis (bTB) is a chronic disease caused by the bacterium *Mycobacterium bovis*. Indiana DNR and other State and federal partners test wild white-tailed deer for bTB because it was found in Franklin County cattle in 2008, 2009, and 2016, and in Dearborn County in 2011. The disease was also detected in captive deer from a farm in Franklin County in 2009. Between 2009 and early 2017, a total of 3,524 wild hunter-harvested white-tailed deer were sampled in the bTB surveillance

zones, and none of these deer tested positive for the disease (Caudell and Vaught 2017).

In December 2016, another case of bTB was detected in a different cattle farm in Franklin County. As a result, surveillance in the 2017-2018 deer hunting season was focused in a 225-square-mile area centered on this farm in Franklin and Fayette counties. Just prior to the 2017-2018 hunting season, U.S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA-APHIS) Wildlife Services collected 37 raccoons, 12 opossums, and 16 deer from or adjacent to the affected premises for testing. One wild raccoon from the December 2016 farm was found to be positive for bTB. As was the case with the positive deer and raccoon collected from the May 2016 farm, genetic analysis of the mycobacterial organism cultured from this raccoon strongly suggested that the infection was transmitted from cattle to the wildlife. During the 2017-2018 hunting season, hunters brought in a total of 531 deer to the various check stations. From within the bTB surveillance zone, a total of 480 deer were collected, consisting of 65 male and female fawns, 104 male and female yearlings, 141 females > 2 years old, and 169 males > 2 years old. Bovine tuberculosis was not detected in any of these deer samples.

During the 2018-2019 hunting season, the surveillance area was reduced to a 1.5-mile radius centered on the affected farm, although deer could still be submitted from within the 225- square-mile area if hunters were concerned about bTB. Indiana DNR tested a total of 89 samples from deer within the bTB surveillance area (84 hunter-harvested, one road killed, and four targeted samples). Hunters submitted samples at a single check station on weekends or at a partnering deer processor (**Figure** 6-2). Samples included 14 male and female fawns, 15 male and female yearlings, 18 females > 2 years old, and 42 males > 2 years old. Additionally, DNR sampled two deer from outside the bTB surveillance area that exhibited signs of a potential bTB infection. However, bTB was not detected in these deer or any others tested during the season.

Automated Deer Disease Report Form

Starting in 2018, anyone in the state of Indiana could report sick or dead deer, via a form available on the Indiana DNR website deer.dnr.IN.gov . This form was primarily used to track reports of sick deer with clinical signs consistent with various diseases, such as EHD and CWD. Reports of clinical signs of CWD received a phone call from a wildlife biologist or technician to assess if the animal was still around, verify the clinical signs and lack of obvious injury, and collect a sample or submit the animal for testing if necessary. We attempted to collect samples from all deer that were reported from within the CWD high-priority surveillance area. From Nov. 1, 2018 until Jan. 31, 2019, a total of 82 reports of sick and dead deer were received. Nine had at least one clinical sign consistent with CWD. Two of the deer were from counties in the target area.

Literature Cited

Caudell, J. N., and O. D. L. Vaught. 2018. 2017 Indiana White-tailed Deer Report. Indiana Department of Natural Resources, Bloomington, USA.

Caudell, J. N., and O. D. L. Vaught. In preparation. 2018 Indiana White-tailed Deer Report. Indiana Department of Natural Resources, Bloomington, USA.

Carlson, C. M., M. C. Hopkins, M. T. Nguyen, B. T. Richards, D. P. Walsh, and W. David Walter. 2018. Chronic Wasting Disease: Status, Science, and Management Support by the U.S. Geological Survey. Open-file Report 2017-1138. Wildlife Health Center, Madison, Wisconsin, USA.

Jennelle, C. S., D. P. Walsh, M. D. Samuel, E. E. Osnas, R. Rolley, J. Langenberg, J. G. Powers, R. J. Monello, E. D. Demarest, R. Gubler, and D. M. Heisey. 2018. Applying a Bayesian weighted surveillace approach to detect chronic wasting disease in deer. Journal of Applied Ecology 55:2944-2953.

Kentucky Department of Fish and Wildlife (KDFW). 2017. EHD Status 2017. Kentucky Department of Fish and Wildlife Resources, Frankfort, KY. https://fw.ky.gov/Wildlife/Pages/ehd-status-2017.aspx

Miller, C. A., M. E. McCleary, E. E. Harper, and L. K. Campbell. 2013. Stakeholder Attitudes Toward Deer Management and Chronic Wasting Disease in Illinois. Illinois Natural History Survey Technical Report 2013(32). Illinois Natural History Survey, Prairie Research Institute, University of Illinois, Urbana-Champaign, USA.

Richards, B. 2019. Distribution of chronic wasting disease in North America, 2019 update. https://www.usgs.gov/media/images/distribution-chronic-wasting-disease-north-america-0

Schuler, K. L., M. Hollingshead, J. D. Kelly, R. D. Applegate, and C. Yoest. 2018. Risk-based surveillance for chronic wasting disease in Tennessee. TWRA Wildlife Technical Report 18-4. Tennessee Wildlife Resources Agency, Nashville, USA.

Walsh, D. P., and D. L. Otis. 2017. Disease surveillance: incorporating available information to enhance disease-detection events. Pp. 11-23 in Walsh, D. P., editor. 2012. Enhanced Surveillance Strategies for Detecting and Monitoring Chronic Wasting Disease in Free-ranging Cervids. Open-file Report 2012-1036. US Geological Service National Wildlife Health Center, Madison, Wisconsin, USA.

Table 6-1: Results of chronic wasting disease (CWD) surveillance in targeted northwest and northeast Indiana counties including three counties surrounding Steuben County.

County	Hunter-Harvested Samples	Road Killed Samples	Targeted Deer	Found-Dead Deer	Total Samples	County	Hunter-Harvested Samples	Road Killed Samples	Targeted Deer	Found-Dead Deer	Total Samples
Adams	0	0	0	0	0	Martin	3	0	0	1	4
Allen	0	0	0	0	0	Miami	0	0	0	0	0
Bartholomew	16	0	0	0	16	Monroe	0	6	0	0	6
Benton	0	0	0	0	0	Montgomery	0	2	0	0	2
Blackford	0	0	0	0	0	Morgan	1	1	0	0	2
Boone	0	0	0	0	0	Newton	66	4	1	0	71
Brown	3	1	0	0	4	Noble	11	3	1	0	15
Carroll	1	0	0	0	1	Ohio	0	0	0	1	1
Cass	0	0	0	0	0	Orange	0	1	0	0	1
Clark	0	0	1	0	1	Owen	0	2	0	0	2
Clay	0	1	0	0	1	Parke	3	0	0	0	3
Clinton	0	0	0	0	0	Perry	1	0	0	0	1
Crawford	1	2	0	0	3	Pike	4	4	0	0	8
Daviess	3	5	0	0	8	Porter	75	5	2	0	82
Dearborn	0	0	0	0	0	Posey	18	2	0	0	20
Decatur	0	1	0	0	1	Pulaski	65	7	1	0	73
Dekalb	8	0	0	0	8	Putnam	3	8	1	0	12
Delaware	0	2	0	0	2	Randolph	0	1	0	0	1
Dubois	7	0	0	0	7	Ripley	0	0	0	0	0
Elkhart	4	0	0	0	4	Rush	0	1	0	0	1
Fayette	31	2	2	1	36	Saint Joseph	3	1	0	0	4
Floyd	0	0	0	0	0	Scott	1	1	0	0	2
Fountain	0	1	0	0	1	Shelby	0	0	0	0	0
Franklin	39	5	2	0	46	Spencer	0	1	0	0	1
Fulton	3	0	0	0	3	Starke	65	9	0	0	74
Gibson	2	0	2	0	4	Steuben	71	5	3	0	79
Grant	0	0	2	0	2	Sullivan	0	7	0	0	7
Greene	1	18	0	0	19	Switzerland	0	0	0	0	0
Hamilton	0	0	0	0	0	Tippecanoe	0	2	1	0	3
Hancock	0	0	0	0	0	Tipton	0	0	0	0	0
Harrison	0	0	0	0	0	Union	0	0	0	0	0
Hendricks	0	0	0	0	0	Vanderburgh	0	1	0	2	3
Henry	0	10	0	0	10	Vermillion	3	0	1	0	4
Howard	0	0	0	0	0	Vigo	1	0	0	0	1
Huntington	7	7	0	0	14	Wabash	0	0	0	0	0
Jackson	1	13	0	2	16	Warren	2	0	0	0	2
Jasper	52	4	1	0	57	Warrick	2	3	0	0	5
Jay	0	0	0	0	0	Washington	0	1	0	0	1
Jefferson	0	0	0	0	0	Wayne	4	0	0	0	4
Jennings	4	9	0	0	13	Wells	0	0	0	0	0
Johnson	8	4	0	0	12	White	0	0	1	0	1
Knox	0	0	0	0	0	Whitley	1	3	0	0	4
Kosciusko	8	0	0	0	8	Other States					
Lagrange	27	5	2	0	34	Branch County, MI	2	0	0	0	2
Lake	65	1	0	0	66	Hillsdale County, MI	4	0	0	0	4
LaPorte	31	0	1	0	32	Johnson County, IL	2	0	0	0	2
Lawrence	9	6	0	0	15	Massac County, IL	1	0	0	0	1
Madison	0	2	0	0	2	Saline County, IL	3	0	0	0	3
Marion	0	0	1	0	1	Will County, IL	2	0	0	0	2
Marshall	7	0	0	0	7	Missouri	1	0	0	0	1

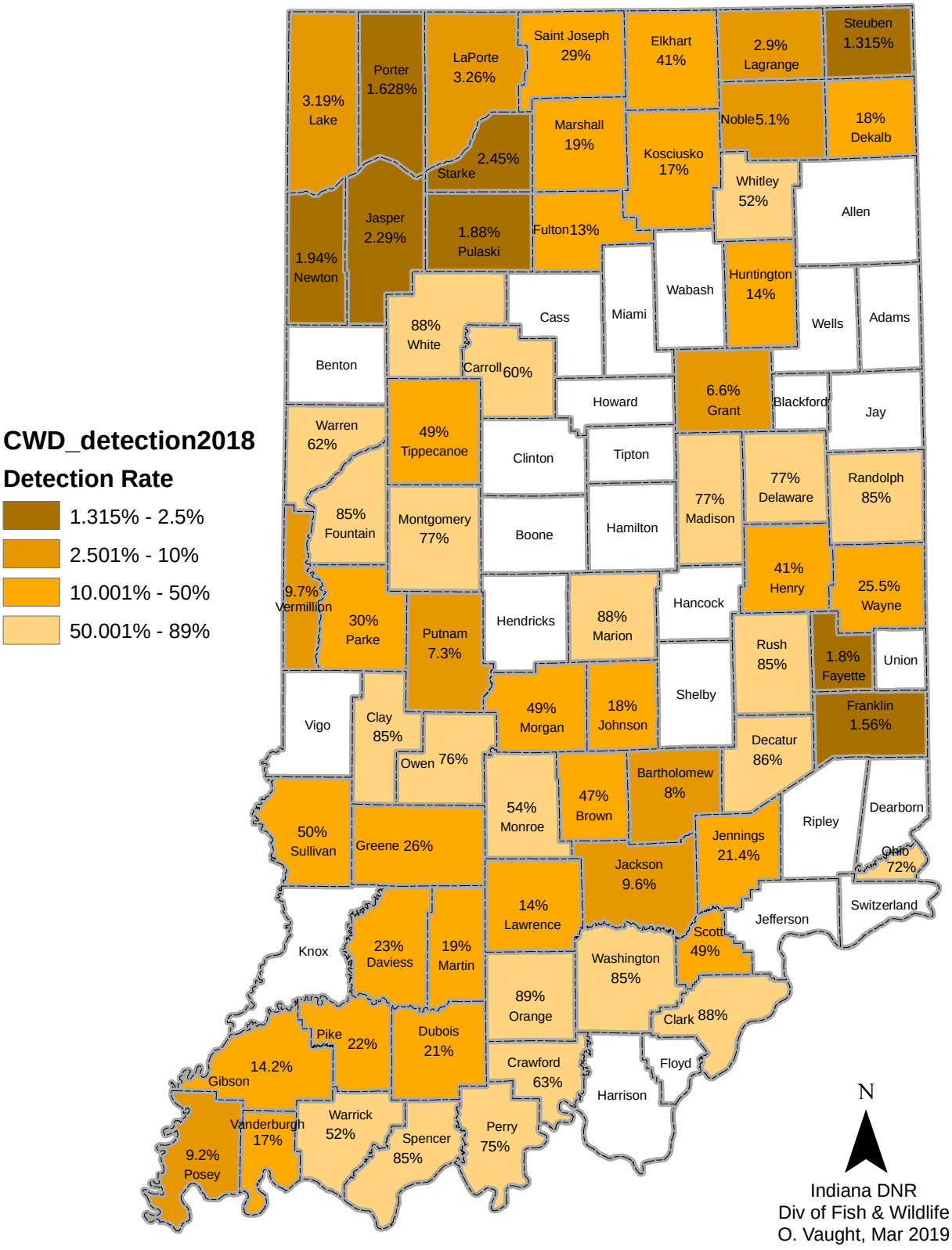


Figure 6-1. Chronic wasting disease (CWD) detection thresholds statewide for 2018-2019 deer hunting seasons. The CWD threshold is the ability to detect CWD with the level of surveillance used if it were in that percentage of the deer population (Jennelle et al. 2018).

Table 6-2: Chronic wasting disease (CWD) detection thresholds for the 2018-2019 CWD surveillance areas in northwest and northeast Indiana. The CWD threshold is the ability to detect CWD with the level of surveillance used if it were in that percentage of the deer population (Jennelle et al. 2018).

County	CWD Detection Threshold (CWD in % of deer population)
Northwest Indiana	
JASPER	2.29%
LAKE	3.19%
LAPORTE	3.26%
NEWTON	1.94%
PORTER	1.63%
PULASKI	1.88%
STARKE	2.45%
Northeast Indiana	
STEUBEN	1.31%
DEKALB	18.00%
LAGRANGE	2.90%
NOBLE	5.10%

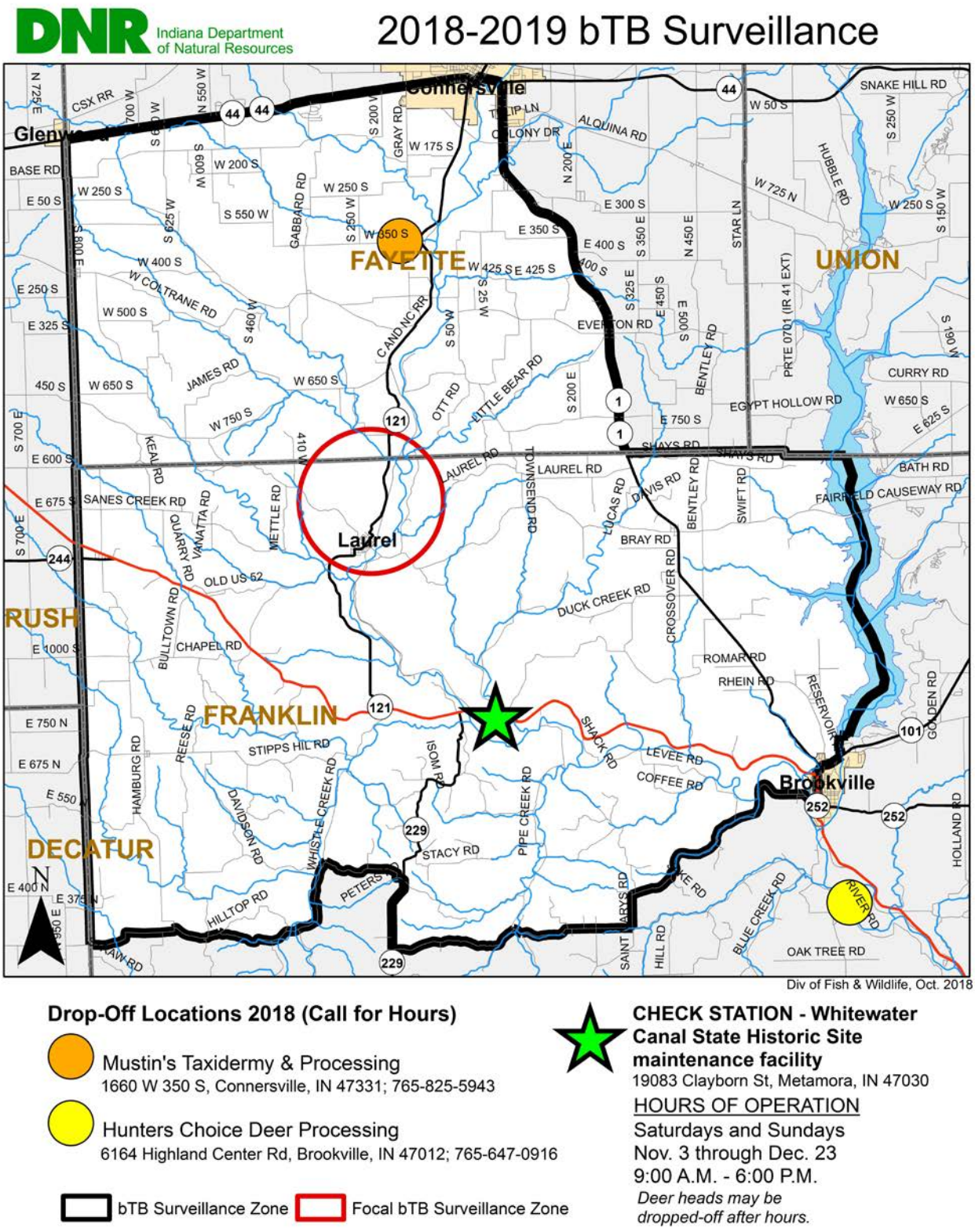


Figure 6-2. The 2018-2019 bovine tuberculosis surveillance area in southeastern Indiana. Samples were collected from anywhere within the unshaded area, but the focal area was within the 3-mile circle in red. Hunters could take samples to a DNR check station on weekends or drop-off samples at a partnering deer processor.

CHAPTER 7.
DEER MANAGEMENT SURVEY
2018 DEER MANAGEMENT SURVEY

Joe Caudell and Olivia Vaught, *Indiana Department of Natural Resources*

Understanding public opinion on topics and policies that affect deer hunting and management is an important part of the decision-making process for Indiana Department of Natural Resources (DNR). These data are used in setting harvest regulations and for examining the potential effect of proposed regulatory changes. In the 2017 Deer Management Review, hunters indicated they would like the opportunity to provide more input in the deer management process (Caudell and Vaught 2018). Other states such as Wisconsin (Wisconsin DNR 2016) and Pennsylvania (Fleegle et al. 2013) have used County Deer Advisory Councils in an attempt to obtain input from both hunters and non-hunters. Some states such as Ohio and Wisconsin have, for years, used random hunter surveys to seek input on deer management. Likewise, Indiana used random surveys of a portion of hunters and landowners to assess opinions about deer management until 2016. To increase participation from hunters and to provide a convenient method for any interested hunter or non-hunter to share their opinions, we started a survey program in 2018 using Qualtrics, an online survey tool.

In the 2018 Deer Management Survey, Indiana DNR asked several questions to assess opinions and/or gather data about chronic wasting disease (CWD), the importance and characteristics of a desirable buck harvest, harvest regulations, season lengths, and management priorities reported at the state level. The survey was distributed soon after the 2017-2018 deer hunting season, and some of the data were reported in the 2017 Indiana White-tailed Deer Report (Caudell and Vaught 2018) along with previously unreported data regarding management priorities from the 2013 and 2016 deer hunter surveys. However, the data were only reported at the county level and not the state level.

The CWD portion of the survey was administered in Indiana before the implementation of any concerted efforts to educate the public about CWD and is considered a baseline level of knowledge. The baseline data can be used to guide educators' efforts in CWD awareness and education. In many cases, there is a general assumption that hunters and non-hunters have differing knowledge about CWD-related topics, acceptance of CWD management methods, and beliefs in the effectiveness of various management methods. Education efforts catered to each group's level of awareness and knowledge, based on survey results, may be more effective than a generalized approach.

This chapter does not report all survey question responses. Some survey questions were used for additional analysis such as examining the relationship between how many years individuals have been hunters and their opinion on various topics, and those data may not be reported in a table or graph. Other questions may be reported elsewhere in this document and are not presented in this chapter. For instance, questions regarding the desires of hunters and non-hunters about the direction of the size of the deer herd, number of deer desired and taken, and other questions related to the deer population status are reported in the County and Deer Management Unit data sheets.

The inclusion of specific questions should not be interpreted as a desire to change policy or a preference for a particular regulation by Indiana DNR or the public. The information gathered from these questions may be useful in answering questions from the public about how Indiana DNR should approach the management of CWD (if or when it is found in Indiana), what Indiana DNR's management priorities should be for deer management, and how hunters value different aspects of hunting. Some questions are useful for long-term trend studies in hunter opinion, such as monitoring support or opposition for various CWD management options. Here we report the results of the 2018 Deer Management Survey on these topics.

Methods

The 2018 Deer Management Survey was emailed to individuals that the Division of Fish & Wildlife had prior contact with, such as those who purchased any type of hunting, trapping, or fishing license; anyone who checked in a deer; and anyone who had created an electronic account with Indiana DNR for other reasons (e.g., obtaining the survey). Because lifetime license holders and hunters who use their property exemption do not have to purchase a yearly license, they can only be surveyed if they harvested a deer, purchased another license type (e.g., fishing, Deer Reduction Zone license, etc.), or signed up on Indiana DNR's electronic system specifically to receive the survey. Because of this, lifetime license holders and hunters who only use their land-

owner exemption and do not harvest a deer are likely not represented in the survey.

Survey invitations were distributed via email with Qualtrics using the email list generated by Indiana DNR on March 12, 2018. In 2018, a reminder was planned for two weeks after the survey was emailed, but the reminder to complete the survey was not sent because of a temporary change in Indiana DNR policy. The survey was open and available for six weeks. Descriptive statistics were generated using StatsIQ, the statistical package integrated in Qualtrics. We used chi-squared tests to examine differences between hunter and non-hunter opinions on CWD management and desires for other deer management priorities. We used Cramer's V as an estimate of effect size to look at the magnitude of the difference when it existed between the two populations.

Results and Discussion: 2018 General Questions

General Demographics of Respondents – The 2018 Deer Management Survey was sent to 269,389 individuals who had purchased some type of license(s) in the last five years through the Indiana DNR online point of sale system (i.e., hunting, fishing, and trapping) or had checked in a white-tailed deer during the past season. Of those sent, 23,283 surveys were started and 12,659 surveys were finished. A total of 4,265 emails were returned as undeliverable, and 83 duplicate emails were identified.

Because much of the survey is dependent upon being assigned to a county for reporting, survey respondents were required to include a county they hunted in or lived in to be included in the final data. Respondents from 21,226 surveys included a county of residence. Of those who responded, 976 non-residents started the survey and 795 non-residents self-identified as being a hunter (671 reported they hunted during the 2018-2019 deer hunting season), while 122 non-residents indicated they did not hunt (Figure 7-1). When residents of Indiana were asked ***Do you consider yourself a deer hunter even if you did not hunt during the 2018-2019 deer hunting season,*** 17,614 respondents indicated they were deer hunters (14,768 hunted in the 2017-2018 season) while 2,550 indicated they were not deer hunters (**Figure 7-1**).

A total of 15,225 hunters responded to the question ***What hunting equipment did you use during the 2017-2018 deer hunting seasons (select all that apply).*** Of those respondents, 56.2% used rifles, 47.8% used a compound bow, 39.1% used a modern inline muzzleloader, 38.4% used a shotgun, 30.9% used a crossbow, 7.4% used a traditional muzzleloader, 5.8% used a handgun, 3.4% used a traditional bow, 1.0% used a modern recurve bow, and 0.7% used some other type of firearm. Indiana DNR asked hunters to ***Select which license(s) type(s) they used in the 2017-2018 hunting season,*** and of the 15,225 hunters who responded, 48.7% used the bundle license, 18.4% used a lifetime license, 17.6% used a firearms license, 12.7% used an archery license, 10.6% used a landowner exemption, 7.2% used the bonus antlerless license, 4.1% used a muzzleloader license, 2.9% used a deer reduction zone license, 2.4% used a youth license, and 0.5% used a military exemption.

Indiana DNR asked hunters if they live and hunt in the same county. Of the 14,950 respondents, 36.4% chose *I usually hunt in the county where I live*; 23.8% chose *I live in one county, but hunt in a different county*; 22.7% chose *I mostly hunt in the county where I live, but I also hunt in different counties*; and 21.6% chose *I occasionally hunt in the county where I live, but I mostly hunt in other counties*.

Indiana DNR asked hunters to choose a response for ***How many deer did you want to harvest in the 2017-2018 deer hunting season***. Of the 14,906 hunters who responded, 31% of hunters wanted to harvest a buck and a doe, 19.6% of hunters wanted to harvest a buck and two does, 14.8% of hunters wanted to harvest a buck only, 10.5% of hunters wanted to harvest two deer regardless of sex, 7.7% of hunters wanted to harvest one deer regardless of sex, 6% of hunters wanted to harvest three deer regardless of sex, 3.8% of hunters wanted to harvest one buck and three does, 2.5% of hunters wanted to harvest one buck and more than three does, 1.6% of hunters wanted to harvest four deer regardless of the sex, 1.4% of hunters wanted to harvest more than four does regardless of the sex, and 1.3% of hunters wanted to harvest one doe.

Results and Discussion: 2018 CWD Questions

General Knowledge about CWD. – Potential respondents were asked a series of questions about the extent and prevalence of CWD in Indiana and the Midwest. This is useful for Indiana DNR managers and communicators to understand so that we have a baseline for what knowledge the various publics currently have. Specifically, individuals were asked to indicate whether the following statements were correct or incorrect: ***CWD does not exist in Indiana*** (**Figure 7-2**), ***CWD has always been present in Indiana*** (**Figure 7-3**), ***CWD is present in the Illinois deer herd*** (**Figure 7-4**), and ***CWD is present in the Michigan deer herd*** (**Figure 7-5**). In most cases, there were no significant differences in the answers between hunters and non-hunters, and all four questions were answered accurately. Only a small percentage (<20%) answered these questions inaccurately when asked the correctness of the statement "***CWD has always been present in Indiana.***" The accuracy of the responses was even greater (i.e., <5%) for the statements regarding the presence of CWD in Illinois and Michigan. At the time of the survey, CWD had not been detected anywhere in Indiana but was found in both Michigan and Illinois. Asked whether CWD exists in Indiana, non-hunters were more likely to respond with the correct answer by a subtle difference (**Figure 7-2**).

When asked ***Do you live in a county in which CWD has been found in deer*** (**Figure 7-6**) there was a statistically significant (p<0.001) but subtle (Cramer's V=0.208) difference between hunters (n=13,418) and non-hunters (n=1,609). Most respondents (49.3% of hunters and 82.9% of non-hunters) indicated they were not sure if a CWD-positive deer had been found in their county or not. Hunters correctly responded ***No*** slightly less than half of the time (41.7%) while non-hunters answered that CWD had not been found in their county 14.5% of the time. Hunters and non-hunters were also asked to evaluate the false statement, ***CWD is found in every state*** (**Figure 7-7**). There was no significant difference between answers from hunters and non-hunters. There were differences in responses about the distribution of CWD throughout the United States; 37.8% of respondents incorrectly indicated that CWD is found in every state, and 62.2% reported this statement was incorrect (CWD is not found in every state; n=6,008).

DNR asked respondents if these two statements were correct or incorrect: ***There is no known cure for CWD in deer*** (**Figure 7-8**) and ***CWD is a fatal disease to every deer infected*** (**Figure 7-9**). Both of these statements were true at the time of the survey, although there is some disagreement as to whether CWD is a fatal disease for every deer. In general, if CWD runs its course, it is fatal. However, we know that some deer will survive longer with the disease (Robinson et al. 2012) and based on the theory of natural selection, there should occasionally be a deer that survives. But in general, CWD is fatal to deer. Most respondents believed that there was no known cure for CWD (90.4% of hunters and 90.7% of non-hunters; Figure 7-8) and believed that CWD is fatal to every infected deer (65.3% of hunters and 67.0% of non-hunters; Figure 7-9).

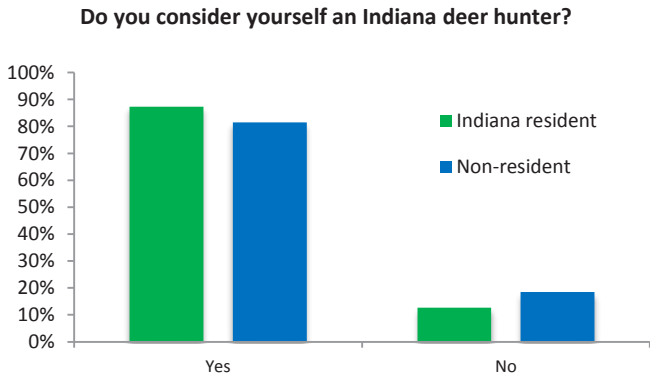


Figure 7-1. Proportion of Indiana residents (n=20,164) and non-residents (n=976) responding to the survey who consider themselves hunters and non-hunters.

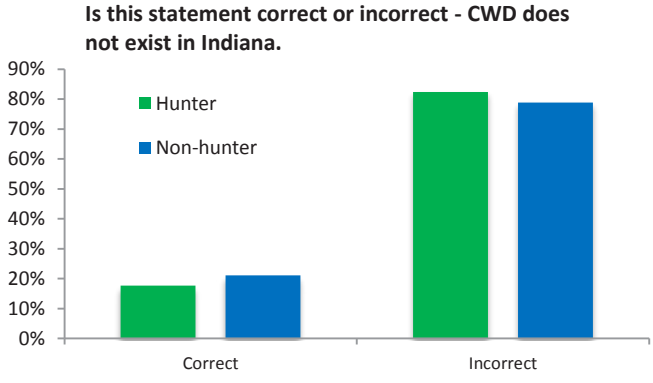


Figure 7-2. Hunter and non-hunter opinion about whether or not CWD exists in Indiana. There was a very subtle (Cramer's V=0.022), but significant difference (p<0.001) between hunters (n=8,748) and non-hunters (n=597).

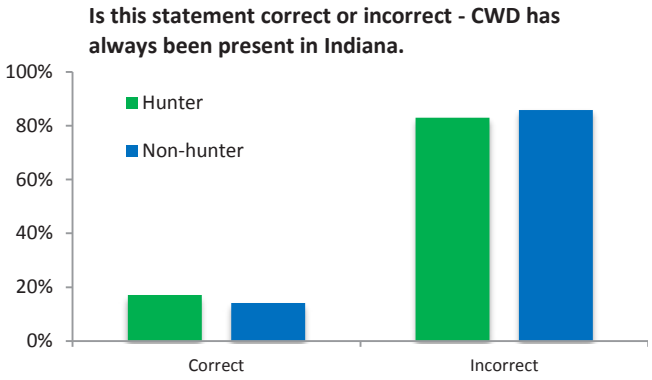


Figure 7-3. Hunter and non-hunter opinion about whether or not CWD has always been present in Indiana. There was no statistically significant difference (p=0.167, Cramer's V=0.019) between hunters (n=5,198) and non hunters (n=360).

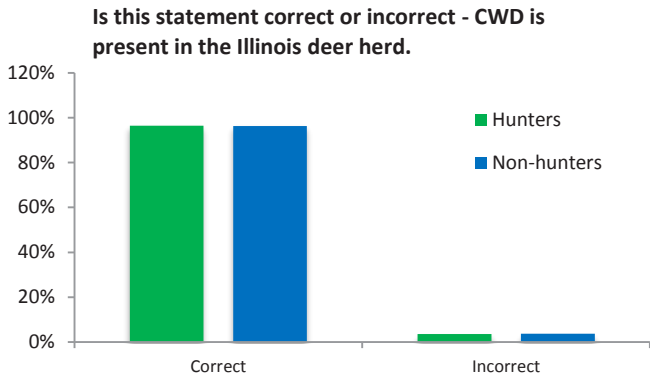


Figure 7-4. Hunter and non-hunter opinion about whether or not CWD is present in Illinois. There was no statistically significant difference (p=0.882, Cramer's V=0.002) between hunters (n=5,608) and non hunters (n=354).

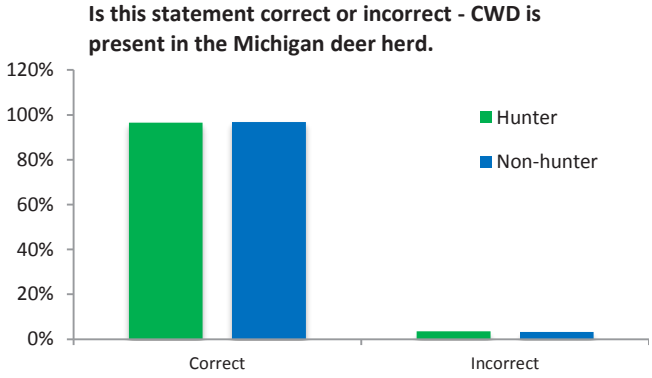


Figure 7-5. Hunter and non-hunter opinion about whether or not CWD exists in Indiana. There was no statistically significant difference (p=1, Cramer's V=0.002) between hunters (n=5,874) and non hunters (n=367).

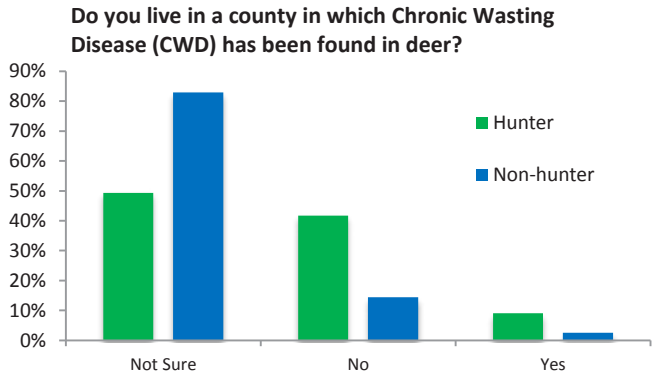


Figure 7-6. Hunter and non-hunter knowledge about whether or not CWD has been found in the county where hunters and non-hunters live. There was a subtle (Cramer's V=0.208), but significant difference (p<0.001) between hunters (n=13,418) and non-hunters (n=1,609).

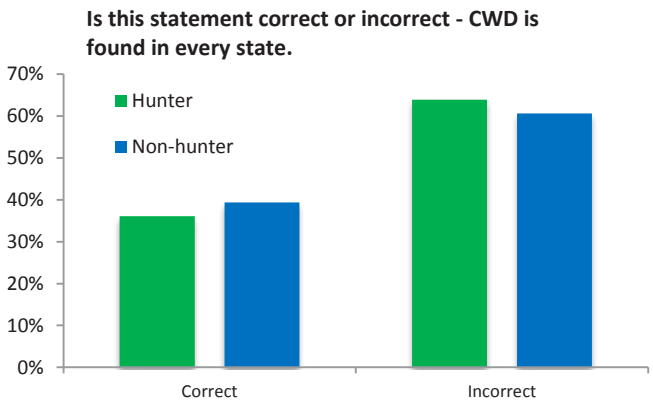


Figure 7-7. Hunter and non-hunter knowledge about whether or not CWD is found in every state. There was no statistically significant difference (p=1, Cramer's V=0.017) between hunters (n=5,607) and non hunters (n=401).

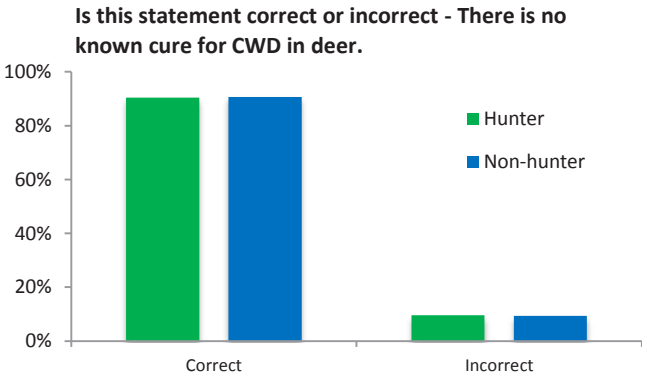


Figure 7-8. Hunter and non-hunter opinion about whether or not there is a cure for CWD. There was no statistically significant difference (p=1, Cramer's V=0.002) between hunters (n=5,287) and non hunters (n=354).

Respondents were uncertain if a CWD-positive deer had been found in the county where they live. Hunters were more confident that there had not been a CWD-positive deer found in their county. One possible explanation for this difference is that this information is reported in annual deer reports and in the Hunting Guide so hunters would have had greater opportunities to learn about the past CWD surveillance and results (i.e., that no CWD-positive deer have been detected anywhere in Indiana). Non-hunters currently do not have a mechanism by which they would know of our routine surveillance and if a CWD-positive deer were found. If a CWD-positive deer is discovered in Indiana, Indiana DNR has developed a communication plan for announcing the discovery of a positive deer in a manner that should reach both hunters and non-hunters.

CWD Management Strategies – States have used various management strategies to address CWD. Management has included intensive population-level control, removing affected deer in localized areas, doing nothing but monitoring prevalence, and various combinations of these and other strategies (Manjerovic et al. 2014, Gillin and Mawdsley 2018). To assess how much individuals know about these various management approaches, we asked several questions related to various management options that are recommended practices and/or have been used in other states. Our expectation was that many individuals may not know about specific techniques or how effective each technique is, but the goal was to gain an understanding of what individuals

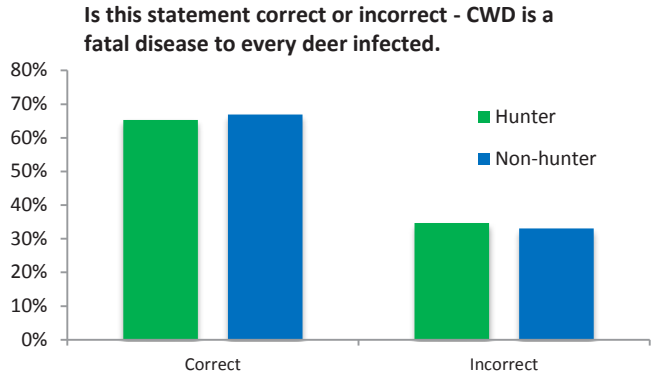


Figure 7-9. Hunter and non-hunter knowledge about if CWD is fatal to every deer it infects. There was no statistically significant difference (p=0.511, Cramer's V=0.008) between hunters (n=7,353) and non hunters (n=460).

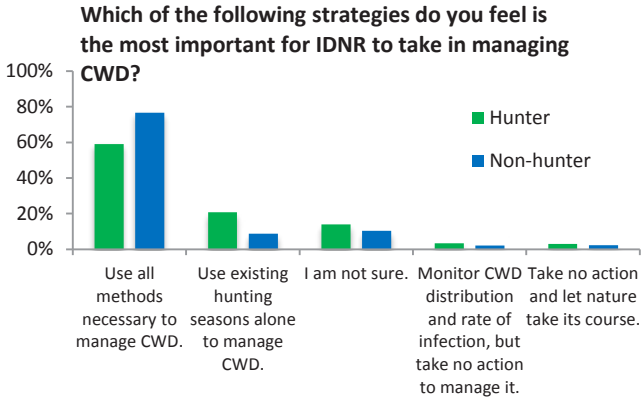


Figure 7-10. Hunter and non-hunter opinion for the proper strategy for managing CWD if it were found in Indiana. There was a very subtle (Cramer's V=0.100), but significant difference (p<0.001) between hunters (n=11,840) and non-hunters (n=982).

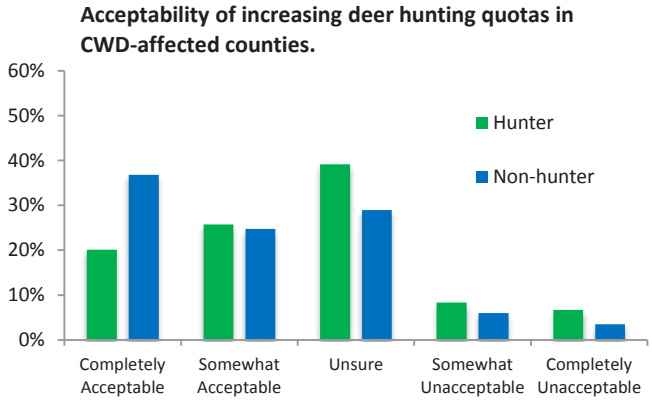


Figure 7-11. Hunter and non-hunter opinion about the acceptability of increased deer hunting quotas in CWD-affected counties. There was a subtle (Cramer's V=0.117), but significant difference (p<0.001) between hunters (n=12,067) and non-hunters (n=1,084).

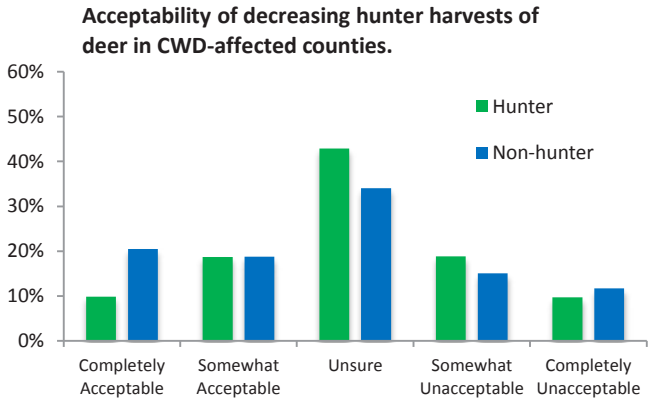


Figure 7-12. Hunter and non-hunter opinion about the acceptability of decreased hunter harvest of deer in CWD affected counties. There was a very subtle (Cramer's V=0.099), but significant difference (p<0.001) between hunters (n=11,857) and non-hunters (n=1,017).

currently know about management practices used to address CWD. Given this, we expected a common answer to be *I am not sure* or *I do not know* for this section of the survey.

Individuals were asked to gauge the effectiveness of ***Which strategies [they] feel are most important for DNR to take in managing CWD*** (Figure 7-10). Approximately 60% of hunters and 80% of non-hunters believed that DNR should *Use all methods necessary to manage CWD*. A much smaller percentage of hunters (approximately 20%) and non-hunters (approximately 10%) believed that Indiana DNR should *Use existing seasons alone to manage CWD*. Only a very small percentage of hunters and non-hunters (less than 5%) believed that Indiana DNR should not try to take management actions to stop or slow the spread of CWD.

Indiana DNR asked individuals several questions related to the acceptability of CWD management approaches including the acceptability of ***increasing deer hunting quotas in CWD-affected counties*** (Figure 7-11), ***decreasing hunter harvests of deer in CWD-affected counties*** (Figure 7-12), ***significantly decreasing deer hunting quotas in CWD-affected counties*** (Figure 7-13), ***slightly decreasing deer hunting quotas in CWD-affected counties*** (Figure 7-14), ***seeing fewer deer because of CWD management*** (Figure 7-15), ***reduced populations of deer in CWD-affected counties*** (Figure 7-16), and ***taking no actions to manage CWD*** (Figure 7-17). Respondents generally accepted ***increasing deer hunting quotas*** (Figure 7-11), ***seeing fewer deer because of CWD management*** (Figure 7-15), and ***having reduced populations in CWD-affected counties*** (Figure 7-16). There was strong objection to ***taking no action to manage CWD*** (Figure 7-17) with 52.5% of hunters and 61.4% of non-hunters stating this was *completely unacceptable* and only 2.6% of hunters and 3.7% of non-hunters stating this was *completely acceptable*.

Indiana DNR asked individuals to indicate their level of agreement with several management strategies related to CWD including that ***DNR should reduce the deer population in CWD-affected areas as much as needed to control the disease*** (Figure 7-18) and ***Hunters would be more effective at managing CWD than DNR*** (Figure 7-19). Most hunters and non-hunters agreed or strongly agreed that Indiana DNR should be able to reduce the deer population in CWD-affected areas as much as needed to control the disease (Figure 7-18). There was not clear consensus about if hunters would be more effective at managing CWD than the Indiana DNR. Most hunters and non-hunters neither agreed nor disagreed with the statement that hunters would be more effective at managing CWD than Indiana DNR. A large percentage of non-hunters disagreed with this statement to some degree (Figure 7-19).

Individuals were asked about their perception of the effectiveness of several management actions used to manage CWD, including: ***Holding special CWD management hunts in CWD-affected counties*** (Figure 7-20), ***Reducing populations of deer in CWD-affected counties*** (Figure 7-21), and ***Increased deer harvest through hunting in CWD-affected counties*** (Figure 7-22). Both hunters and non-hunters felt that a special hunt in CWD-

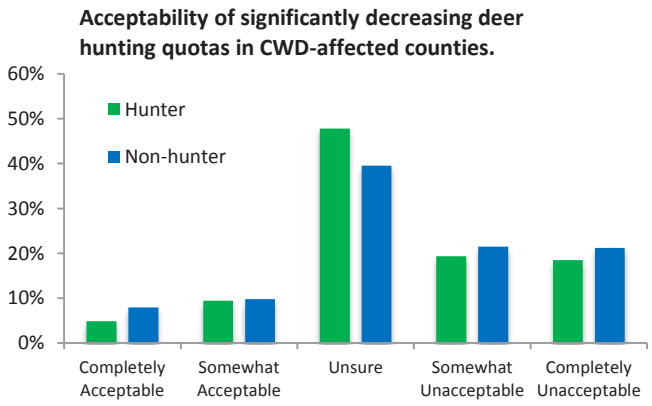


Figure 7-13. Hunter and non-hunter opinion about the acceptability of significantly decreasing deer hunting quotas in CWD-affected counties. There was a very subtle (Cramer's V=0.055), but significant difference (p<0.001) between hunters (n=12,023) and non-hunters (n=1,080).

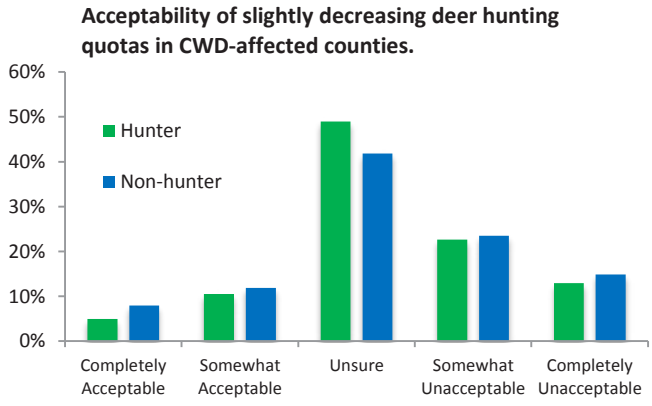


Figure 7-14. Hunter and non-hunter opinion about the acceptability of reduced populations of deer in CWD-affected counties. There was a very subtle (Cramer's V=0.050), but significant difference (p<0.001) between hunters (n=12,042) and non-hunters (n=1,078).

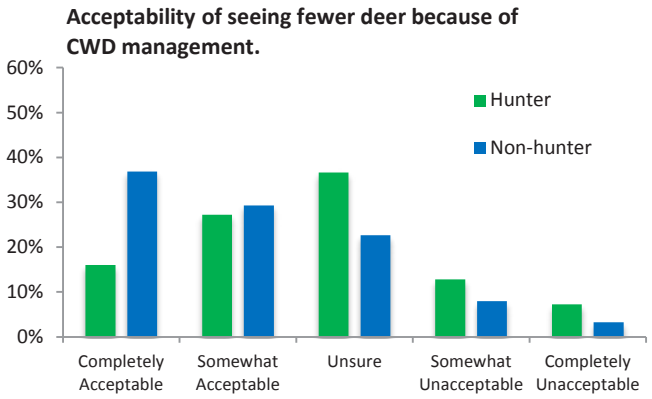


Figure 7-15. Hunter and non-hunter opinion about the acceptability of seeing fewer deer because of CWD management. There was a subtle (Cramer's V=0.158), but significant difference (p<0.001) between hunters (n=11,888) and non-hunters (n=1,018).

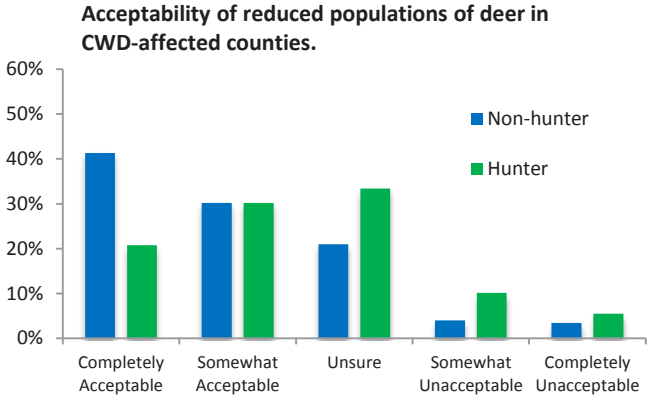


Figure 7-16. Hunter and non-hunter opinion about the acceptability of reduced populations of deer in CWD-affected counties. There was a subtle (Cramer's V=0.143), but significant difference (p<0.001) between hunters (n=11,893) and non-hunters (n=1,019).

Figure 7-17. Hunter and non-hunter opinion about the acceptability of taking no action to manage CWD in Indiana. There was a very subtle (Cramer's V=0.060), but significant difference (p<0.001) between hunters (n=11,967) and non-hunters (n=1,076).

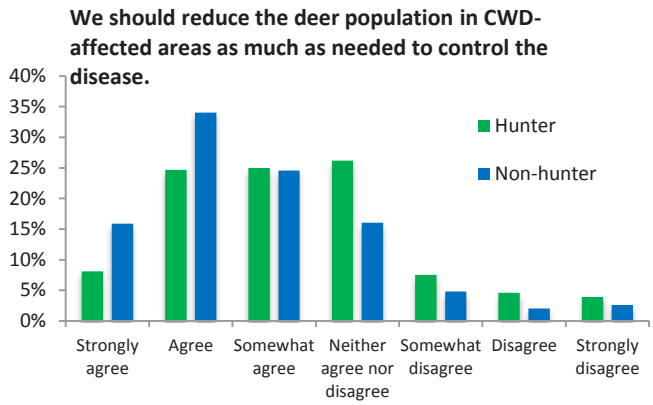


Figure 7-18. Hunter and non-hunter opinion about reducing the size of the deer herd to control CWD. There was a subtle (Cramer's V=0.101), but significant difference (p<0.001) between hunters (n=11,065) and non hunters (n=729).

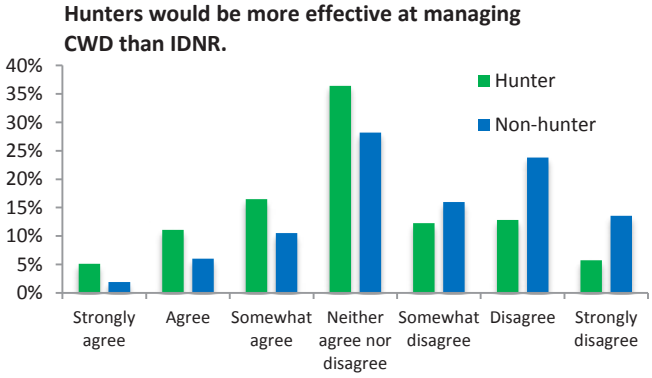


Figure 7-19. Hunter and non-hunter opinion when asked if they believe that hunters would be more effective at managing CWD than Indiana DNR. There was a subtle (Cramer's V=0.129), but significant difference (p<0.001) between hunters (n=11,054) and non hunters (n=731).

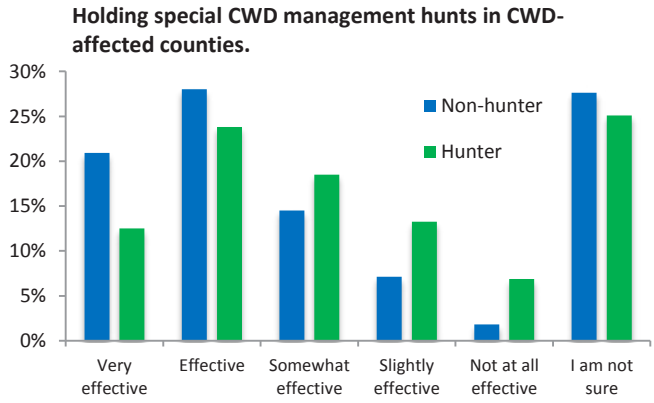


Figure 7-20. Hunter and non-hunter opinion about their perception of the effectiveness using special managed hunts to manage CWD in Indiana. There was a subtle (Cramer's V=0.113), but significant difference (p<0.001) between hunters (n=12,939) and non-hunters (n=1,434).

affected counties would be an effective tool. The single most selected category of response from both hunters and non-hunters was *I am not sure* about the effectiveness of these strategies; however, most individuals believed that these techniques are effective to some extent. Of those who reported perceptions of effectiveness, most respondents indicated each would be effective to some degree while only a small percentage (< 10%) of individuals believed they would not be effective at all.

Asked ***Which of the following strategies would be most important for Indiana DNR to use to manage CWD*** (Figure 7-23), 59% of hunters and 76.6% of non-hunters believed Indiana DNR should *Use all methods necessary to manage CWD*, and 20.7% of hunters and 8.8% of non-hunters believed DNR should *Use existing hunting seasons alone to manage CWD*. Only a small percentage of hunters (3.4%) and non-hunters (2.0%) believed DNR should *Monitor CWD and rate of infection, but take no action to manage it*. Likewise, only 2.9% of hunters and 2.2% of non-hunters believed Indiana DNR should *Take no action and let nature take its course* (Figure 7-23). Even without knowing what techniques might be effective, most individuals believed that the Indiana DNR should take the necessary actions to manage CWD.

Asked about ***DNR's approach to control CWD if it shows up in Indiana's deer herd*** and ***their belief about the aggressiveness of Indiana's CWD management plan***, most individuals reported that they did not know the details of the management plan (50.3% of hunters and 58.1% of non-hunters) or they were not sure (27.5% hunters and 21.5% non-hunters; Figure 7-24). This is not a surprising result because the current plan has not been widely published. Likewise, asked if ***DNR has taken the right steps to control the introduction of CWD into Indiana***, most respondents neither agreed nor disagreed (Figure 7-25), which is likely an indicator that people are generally not aware of steps Indiana DNR has taken to prevent the introduction of CWD in Indiana.

Most hunters and non-hunters believed that Indiana DNR should take actions to prevent the spread of CWD (Figure 7-10). The majority of hunters and non-hunters believed that we should take every action necessary to stop or slow the spread of CWD as long as it does not affect their own recreation. CWD will likely have long-term effects that happen relatively far into the future. For example, Wisconsin has had the disease since 2001, and the prevalence of the disease has only recently surpassed infecting 50% of the population of adult males in the areas where the disease was first found. Adult females have only recently surpassed a 30% infection rate in the same area (unpublished data; Wisconsin DNR; https://dnr.wi.gov/topic/wildlifehabitat/prevalence.html; last accessed on 8/5/2019). Currently, Wisconsin is working to assess the effect on the population because it is not readily apparent. This type of chronic effect, compared to the effect of a disease like epizootic hemorrhagic disease (EHD) that has immediate and apparent significant effects, can make it difficult for the public to support certain forms of management, such as localized sharpshooting (Manjerovic et al. 2014). However, successfully managing the prevalence and spread of CWD requires consistent management practices once the disease is found.

Testing and Resource Commitment for Addressing CWD – Indiana DNR has conducted surveillance for CWD since 2001. Surveillance was relatively high during the first several years because funds were available from the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (USDA-APHIS). As those funds declined and state funds were used to conduct surveillance, surveillance decreased to the current levels with targets of approximately 1,000 deer per year. To assess what hunters and non-hunters think about the current level of surveillance, we asked several questions on this topic. As with the distribution of CWD, it is expected that hunters would be more aware of the surveillance than non-hunters because they may have had a deer tested, read the annual deer report, or seen summaries of surveillance in the Hunting Guide.

Asked ***How important is testing of deer in non-CWD counties to determine whether CWD has spread to new areas***, most respondents indicated this action was moderately important, very important, or extremely important (93.6% of hunters and 93.4% of non-hunters; Figure 7-26). Most respondents also indicated that ***testing of deer in CWD counties to monitor local distribution and percent of deer with CWD*** was moderately important, very important, or extremely important (>94% of hunters and non-hunters; Figure 7-27).

Asked about ***the amount of resources (time/money/personnel) the Indiana DNR should commit toward controlling the spread of CWD,*** most individuals reported they were *not sure* (45.6% of hunters and 51.9% of non-hunters). However, more than 30% of hunters and non-hunters believed Indiana DNR should be committing *More resources* to this effort (Figure 7-28). Only 2.3% of hunters and 1.7% of non-hunters believed Indiana DNR should be committing *Fewer resources* (Figure 7-28).

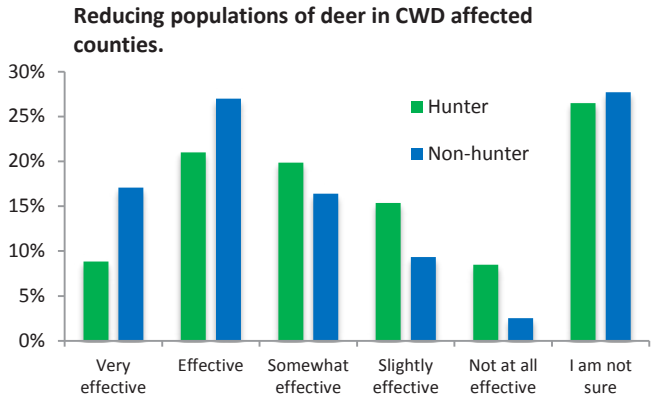


Figure 7-21. Hunter and non-hunter opinion about their perception of the effectiveness of reducing deer populations to manage CWD. There was a subtle (Cramer's V=0.121), but significant difference (p<0.001) between hunters (n=12,921) and non-hunters (n=1,434).

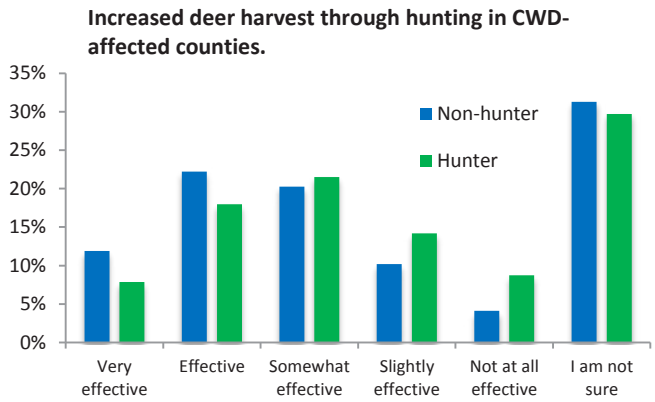


Figure 7-22. Hunter and non-hunter opinion about their perception of the effectiveness increasing harvest to manage CWD in Indiana. There was a subtle (Cramer's V=0.079), but significant difference (p<0.001) between hunters (n=12,948) and non-hunters (n=1,435).

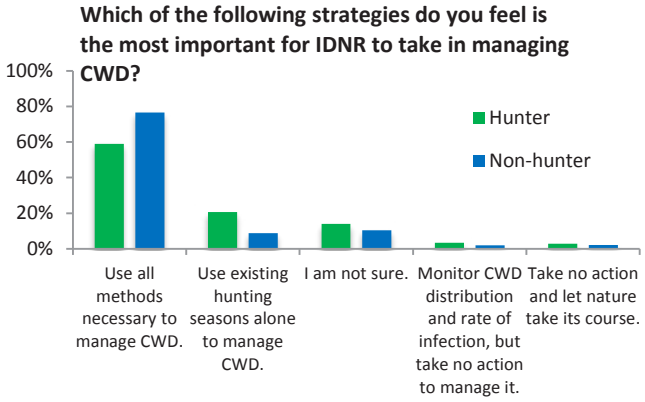


Figure 7-23. Hunter and non-hunter opinion for the proper strategy for managing CWD if it were found in Indiana. There was a very subtle (Cramer's V=0.100), but significant difference (p<0.001) between hunters (n=11,840) and non-hunters (n=982).

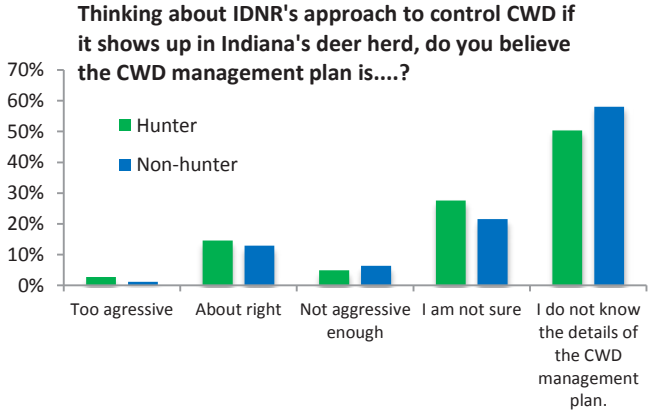


Figure 7-24. Hunter and non-hunter knowledge and opinion about Indiana DNR's CWD management plan. There was a very subtle (Cramer's V=0.051), but significant difference (p<0.001) between hunters (n=11,376) and non-hunters (n=854).

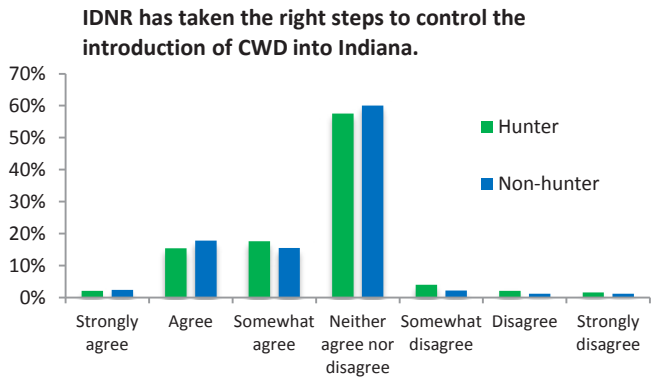


Figure 7-25. Hunter and non-hunter opinion when asked if they believe that Indiana DNR has taken the correct steps to control the introduction of CWD into Indiana. There was a very subtle (Cramer's V=0.034), but significant difference (p<0.001) between hunters (n=10,893) and non-hunters (n=693).

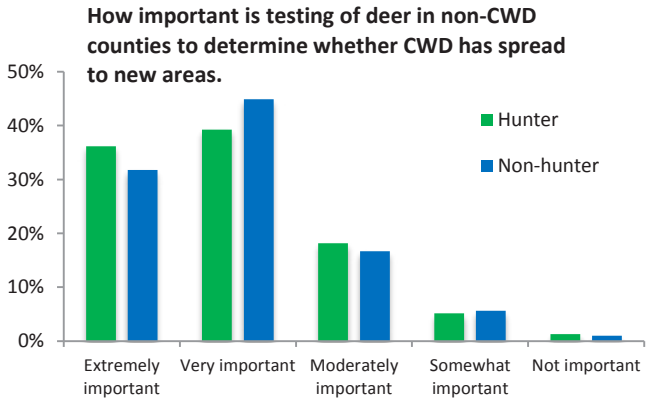


Figure 7-26. Hunter and non-hunter opinion about testing deer to determine if CWD has spread to new areas. There was a very subtle (Cramer's V=0.037), but significant difference (p<0.001) between hunters (n=12,733) and non-hunters (n=1,331).

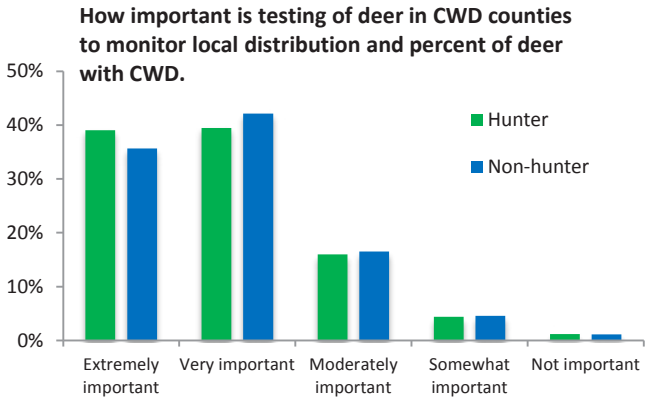


Figure 7-27. Hunter and non-hunter opinion about testing deer in CWD-affected counties to monitor local distribution and percent of deer with CWD. There was a very subtle (Cramer's V=0.020), but significant difference (p<0.001) between hunters (n=12,758) and non-hunters (n=1,334).

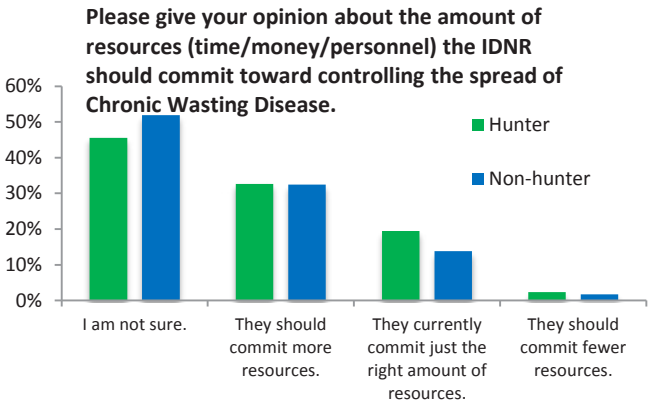


Figure 7-28. Hunter and non-hunter opinion about the amount of time that Indiana DNR commits to managing CWD. There was a very subtle (Cramer's V=0.042), but significant difference (p<0.001) between hunters (n=11,409) and non-hunters (n=859).

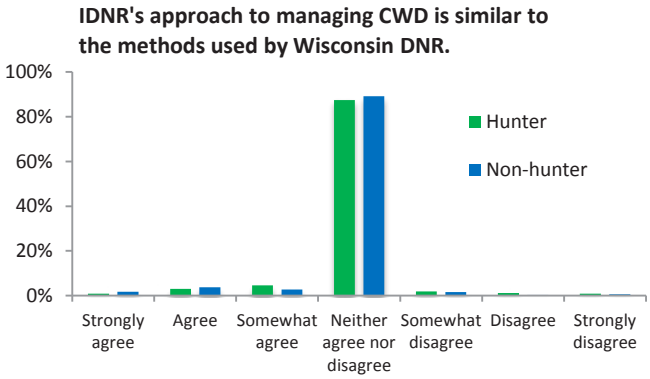


Figure 7-29. Hunter and non-hunter opinion about whether or not Indiana's approach to managing CWD is similar to the methods used by Wisconsin DNR. There was a very subtle (Cramer's V=0.040), but significant difference (p<0.001) between hunters (n=10,709) and non-hunters (n=663).

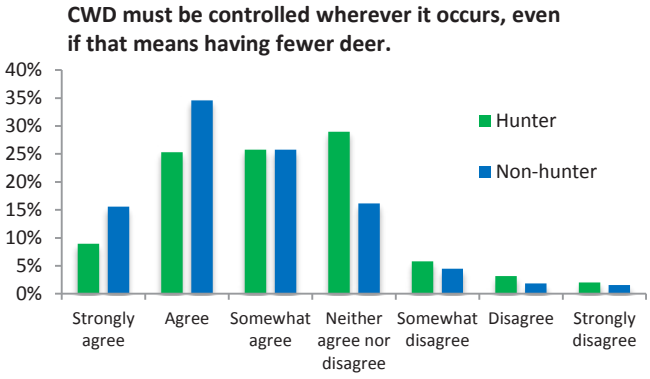


Figure 7-30. Hunter and non-hunter belief about whether or not CWD should be controlled, even if it means having fewer deer. There was a subtle (Cramer's V=0.143), but significant difference (p<0.001) between hunters (n=10,894) and non hunters (n=694).

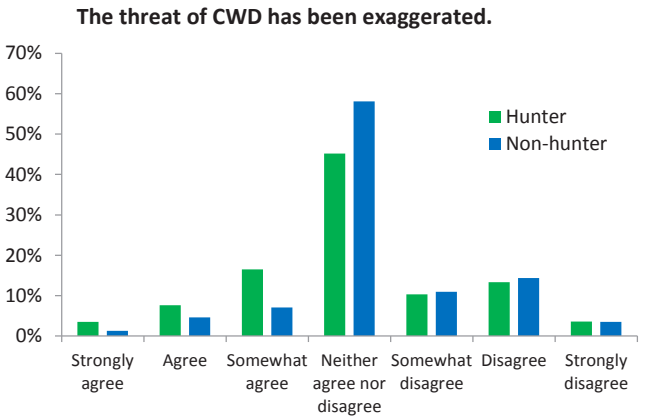


Figure 7-31. Hunter and non-hunter belief about the threat of CWD being exaggerated. There was a very subtle (Cramer's V=0.090), but significant difference (p<0.001) between hunters (n=11,503) and non hunters (n=904).

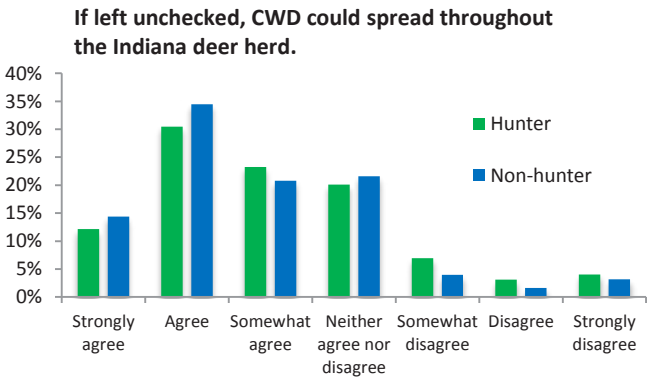


Figure 7-32. Hunter and non-hunter belief about whether or not CWD could spread throughout the deer herd if left uncontrolled. There was a very subtle (Cramer's V=0.045), but significant difference (p<0.001) between hunters (n=11,085) and non hunters (n=731).

Similar to the current CWD plan and the effectiveness of management actions, the costs of the current surveillance efforts and the cost projections of CWD management are not easily accessible by the public. We would expect that most individuals would not know the extent of resources dedicated to preventing and surveilling for CWD.

Most individuals (87.4% of hunters and 89.1% of non-hunters) *neither agreed nor disagreed* that ***DNR's approach to managing CWD is similar to the methods used by Wisconsin DNR*** (Figure 7-29). Given that most individuals are unaware of the details of the Indiana CWD management plan (Figure 7-24), we would expect this. Asked if ***CWD must be controlled wherever it occurs, even if it means having fewer deer***, most respondents agreed with this statement to some degree; less than 10% of hunters disagreed to some degree with this statement (Figure 7-30).

Most hunters and non-hunters felt that surveillance was important and that Indiana DNR was either committing approximately the correct amount of resources to this effort or could commit more. CWD has gotten closer to Indiana in recent years. It has been in a neighboring Illinois county for approximately four years and is found in Michigan approximately 60 miles from the northeast corner of Indiana. Indiana DNR has worked to increase surveillance in parts of the state close to these neighboring risks and will continue to target counties with a high risk for CWD, as well as respond to calls about sick deer that exhibit possible clinical signs of CWD statewide (Caudell and Vaught 2018).

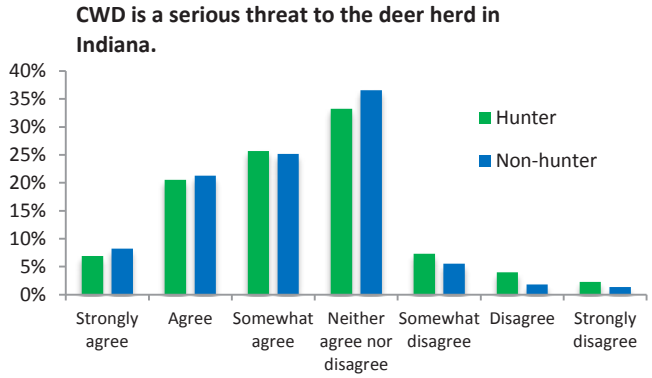


Figure 7-33. Hunter and non-hunter opinion when asked if they believe that hunters would be more effective at managing CWD than Indiana DNR. There was a very subtle (Cramer's V=0.038), but significant difference (p<0.001) between hunters (n=10,781) and non-hunters (n=667).

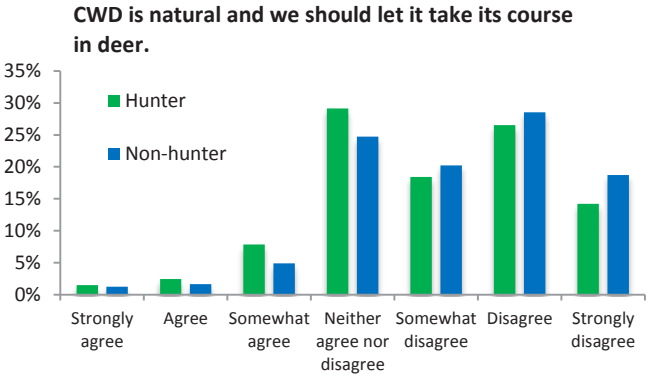


Figure 7-34. Hunter and non-hunter opinion when asked if they believed that CWD is natural and we should let it take its course in deer. There was a very subtle (Cramer's V=0.047), but significant difference (p<0.001) between hunters (n=11,050) and non hunters (n=732).

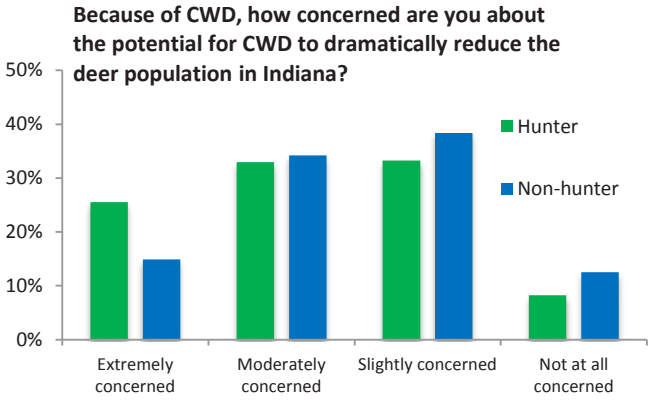


Figure 7-35. Hunter and non-hunter opinion when asked if they are concerned about CWD dramatically reducing the deer population. There was a very subtle (Cramer's V=0.072), but significant difference (p<0.001) between hunters (n=11,633) and non-hunters (n=941).

Level of Concern about CWD – Indiana DNR asked respondents to indicate their level of agreement with several statements related to CWD including: ***The threat of CWD has been exaggerated*** (Figure 7-31), ***If left unchecked, CWD could spread throughout the Indiana deer herd*** (Figure 7-32), ***CWD is a serious threat to the deer herd in Indiana*** (Figure 7-33), ***CWD is natural and DNR should let it take its course in deer*** (Figure 7-34). More than half of both hunters and non-hunters neither agreed nor disagreed that the threat of CWD has been exaggerated. Most individuals believed that CWD could spread through the deer herd, that it is a serious threat, and that it is not a natural disease.

Indiana DNR asked individuals about their level of concern about: ***the potential for CWD to dramatically reduce the deer population in Indiana*** (Figure 7-35), ***the health of the deer population in Indiana*** (Figure

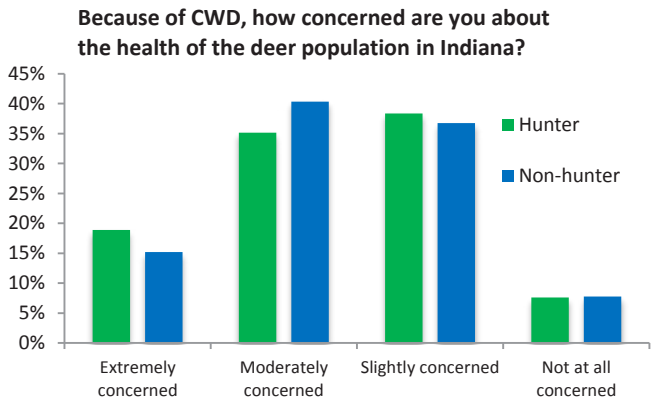


Figure 7-36. Hunter and non-hunter opinion when asked if they are concerned about CWD affecting the health of the deer population. There was a very subtle (Cramer's V=0.033), but significant difference (p<0.001) between hunters (n=11,652) and non-hunters (n=942).

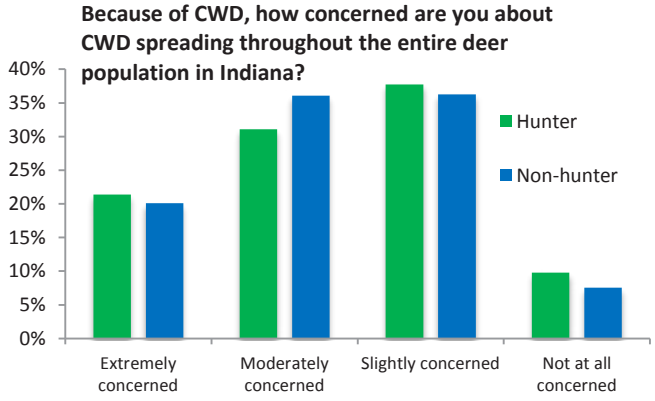


Figure 7-37. Hunter and non-hunter opinion when asked if they are concerned about CWD spreading through the deer population in Indiana. There was a very subtle (Cramer's V=0.032), but significant difference (p<0.001) between hunters (n=11,640) and non-hunters (n=940).

7-36), ***CWD spreading throughout the entire deer population in Indiana*** (Figure 7-37), and ***the potential for CWD to kill the entire deer population in Indiana*** (Figure 7-38). Most respondents (71.5% of hunters and 72.2% of non-hunters) had some level of concern that CWD would affect the deer herd; however, respondents were much less concerned that CWD would kill the entire deer population in Indiana (Figure 7-38).

Indiana DNR Response to CWD – Indiana DNR asked a series of questions about what the Indiana DNR management response should be if CWD were found in deer. Specifically, Indiana DNR asked ***To what level do you think Indiana DNR should pursue the actions listed below if CWD were to be found in Indiana*** (Figure 7-39), including the management actions: ***Use sharpshooters in known CWD areas to supplement hunting***, ***Increase deer harvest through hunting in CWD-affected counties***, ***Reduce populations of deer in CWD-affected counties***, ***Testing deer harvested in counties not affected by CWD***, ***Holding special CWD management hunts in CWD affected counties***, and ***Testing deer harvested by hunters in CWD-affected counties***. In general, respondents felt that Indiana DNR should decide how and when to use the indicated actions (Figure 7-39). The use of sharpshooters to supplement hunting received the strongest negative response with 25.8% of respondents stating that this action should not be used at all. However, the remaining 74.2% felt Indiana DNR should use this management tool to some degree (Figure 7-39).

Risk Perception and Changes in Hunter Behavior in Response to CWD – Indiana DNR asked respondents

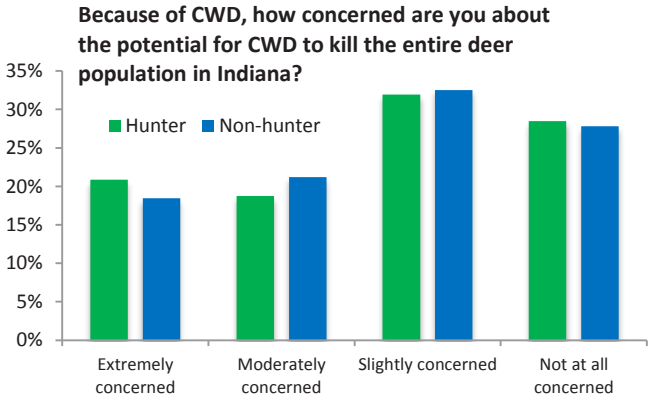


Figure 7-38. Hunter and non-hunter opinion when asked if they are concerned about CWD killing the entire deer population in Indiana. There was a very subtle (Cramer's V=0.021), but significant difference (p<0.001) between hunters (n=11,626) and non-hunters (n=938).

several questions related to the consumption of deer meat and CWD including: ***Because of CWD, I have concerns about eating deer meat*** (Figure 7-40), ***Because of CWD, members of my family have concerns about eating deer meat*** (Figure 7-41), ***CWD poses a risk to deer, but not to humans*** (Figure 7-42), ***CWD may cause disease in humans if they eat meat from animals infected with CWD*** (Figure 7-43), ***CWD may pose a risk to humans, but not enough is currently known to be sure***, (Figure 7-44), ***Indiana DNR is exaggerating the risk CWD-infected venison poses to my health*** (Figure 7-45), ***How important is testing of YOUR deer so that you can decide whether you should eat it*** (Figure 7-46), ***Because of CWD, how concerned are you about your***

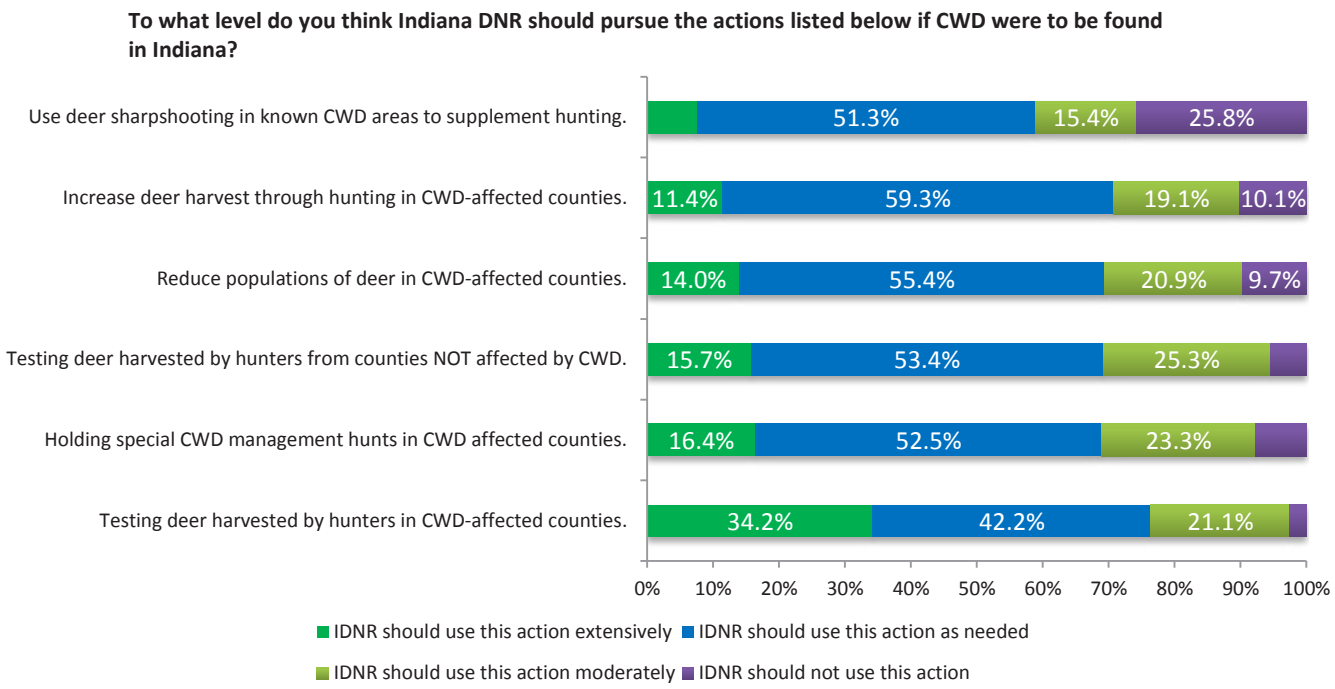


Figure 7-39. Opinion of hunter and non-hunter combined about what level Indiana DNR should use various management actions to manage CWD.

own personal health (Figure 7-47). In general, hunters and non-hunters neither agreed nor disagreed with statements that CWD could infect humans. Most respondents (78.1% of hunters and 87.8% of non-hunters) felt it was important to test deer for CWD before eating it (Figure 7-46); however, most hunters and non-hunters were only slightly concerned or not concerned at all about CWD in regard to their personal health (Figure 7-47).

When Indiana DNR asked hunters ***Have you ever had a deer you harvested tested for CWD***, 0.7% (n=61) have had every deer tested, 8.7% (n=817) have had some deer tested, 86.1% (n=8,046) had never had a deer tested, and 4.5% (n=425) had never harvested a deer. Indiana DNR also asked hunters to ***Choose the answer that best describes your attitude toward having a deer tested for CWD***. Approximately half (55.6%; n=5,407) of hunters responded that *I would voluntarily let Indiana DNR test my deer for CWD if they asked, but I am not personally concerned with CWD*, 22.0% (n=2,140) of hunters answered *I would like to have all of my deer tested for CWD before I consume my deer*, 20.9% (n=2,029) of hunters answered *I would like to have all of my deer tested for CWD before I pay for processing my deer*, and 1.5% (n=147) answered *I would not have my deer tested for CWD and I would not let Indiana DNR test it either*.

Indiana DNR asked hunters to choose between the two following statements: ***I prefer more deer in the areas I hunt, even if that means there is a greater chance of shooting a deer with CWD*** or ***I prefer fewer deer in the areas I hunt to have a lower chance of shooting a deer with CWD***. Hunters were generally split between these two options. Approximately half (54.7%; n=5,200) of hunters selected that they would prefer more deer in the area they hunted even with a greater chance of shooting a CWD-positive deer while 45.3% (n=4,304) of hunters would prefer fewer deer and a lower risk of CWD.

Indiana DNR asked individuals to indicate how much risk they feel from several domestic animal and wildlife-related diseases, including mad cow disease, CWD, rabies, salmonella food poisoning, *E. coli* food poisoning, West Nile virus, and Lyme disease. Indiana DNR included this question to contextualize the risk individuals feel from CWD. Perceived risk from CWD ranked second lowest behind the perceived risk of contracting mad cow disease and with a similar perceived risk to contracting rabies (Figure 7-48). Related to this, Indiana DNR asked hunters to state how they would react if CWD were found at varying hypothetical prevalences in the deer herd (Table 7-1). When 0.1% of the deer herd is infected, 63.8% of hunters will keep hunting and consuming deer meat as normal, and 30.1% will hunt as usual, but eat deer meat only if they are able to test it first (Table 7-1). When this

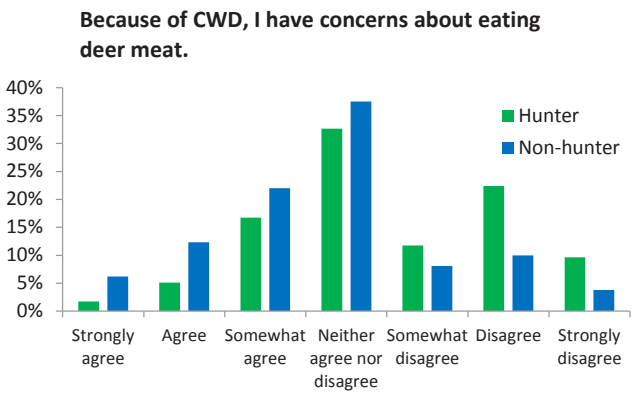


Figure 7-40. Hunter and non-hunter responses to concerns about CWD and members of their family eating deer meat. There was a subtle (Cramer's V=0.151), but significant difference (p<0.001) between hunters (n=11,444) and non hunters (n=900).

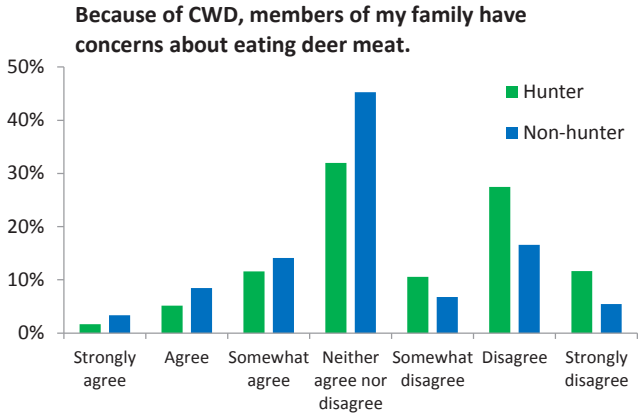


Figure 7-41. Hunter and non-hunter responses to concerns about CWD and personally eating deer meat. There was a subtle (Cramer's V=0.112), but significant difference (p<0.001) between hunters (n=11,482) and non hunters (n=899).

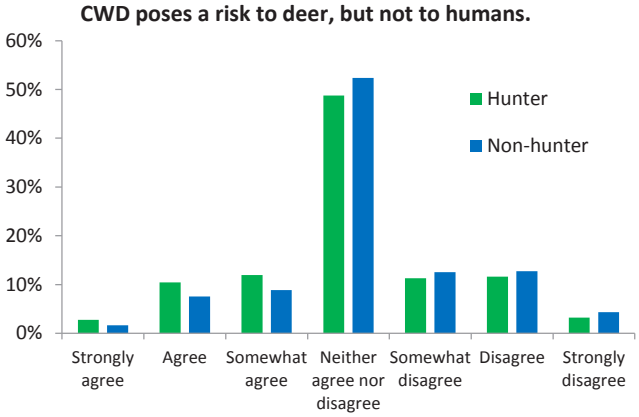


Figure 7-42. Hunter and non-hunter belief about CWD posing a risk to deer, but not humans. There was a very subtle (Cramer's V=0.045), but significant difference (p<0.001) between hunters (n=11,503) and non hunters (n=904).

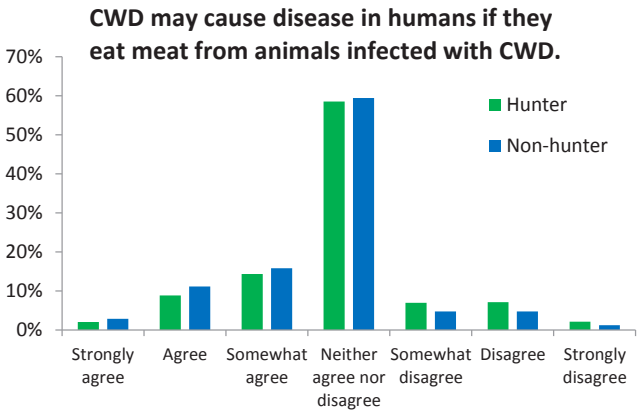


Figure 7-43. Hunter and non-hunter belief about whether or not CWD may cause disease in humans in they eat meat from animals infected with CWD. There was a very subtle (Cramer's V=0.045), but significant difference (p<0.001) between hunters (n=11,453) and non hunters (n=899).

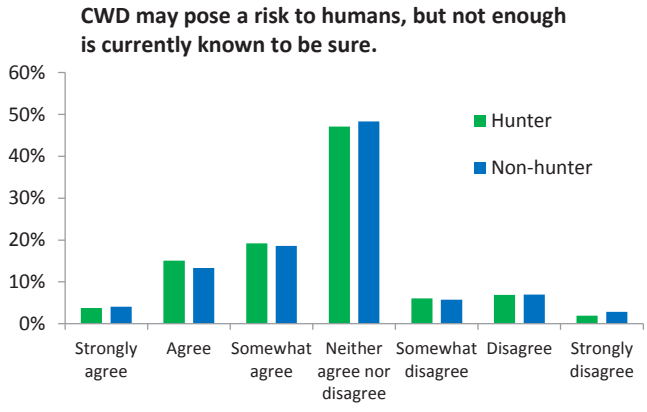


Figure 7-44. Hunter and non-hunter belief about whether or not CWD poses a risk to humans. There was no statistically significant difference (p=0.358, Cramer's V=0.023) between hunters (n=11,459) and non hunters (n=900).

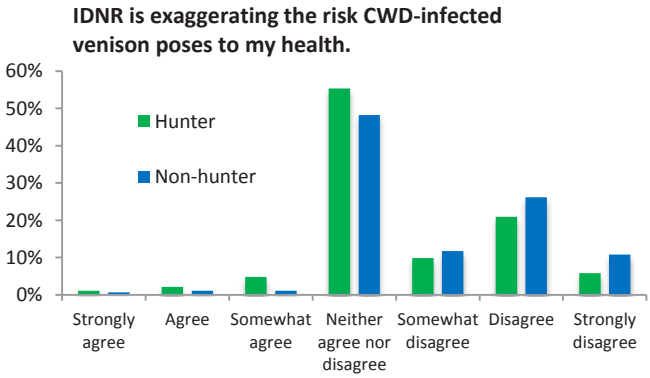


Figure 7-45. Hunter and non-hunter belief about whether or not Indiana DNR is exaggerating the risk that CWD infected venison poses to their heath. There was a very subtle (Cramer's V=0.075), but significant difference (p<0.001) between hunters (n=10,916) and non hunters (n=696).

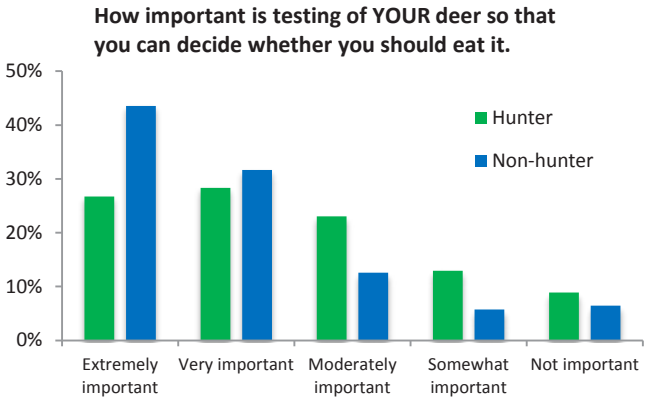


Figure 7-46. Hunter and non-hunter opinion about testing deer meat before they decide to eat it. There was a subtle (Cramer's V=0.132), but significant difference (p<0.001) between hunters (n=12,730) and non-hunters (n=1,327).

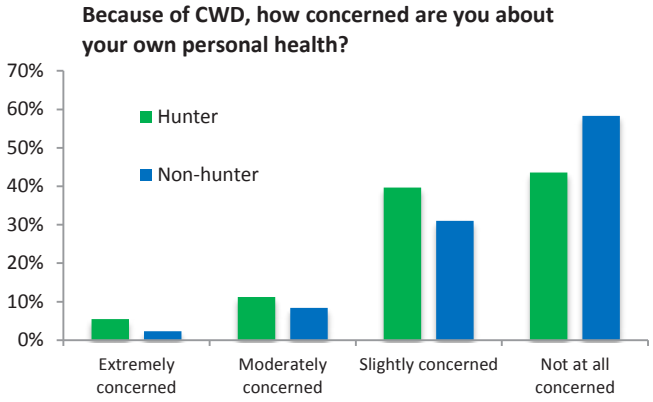


Figure 7-47. Hunter and non-hunter opinion when asked if they are concerned about their personal health because of CWD. There was a very subtle (Cramer's V=0.081), but significant difference (p<0.001) between hunters (n=11,666) and non-hunters (n=944).

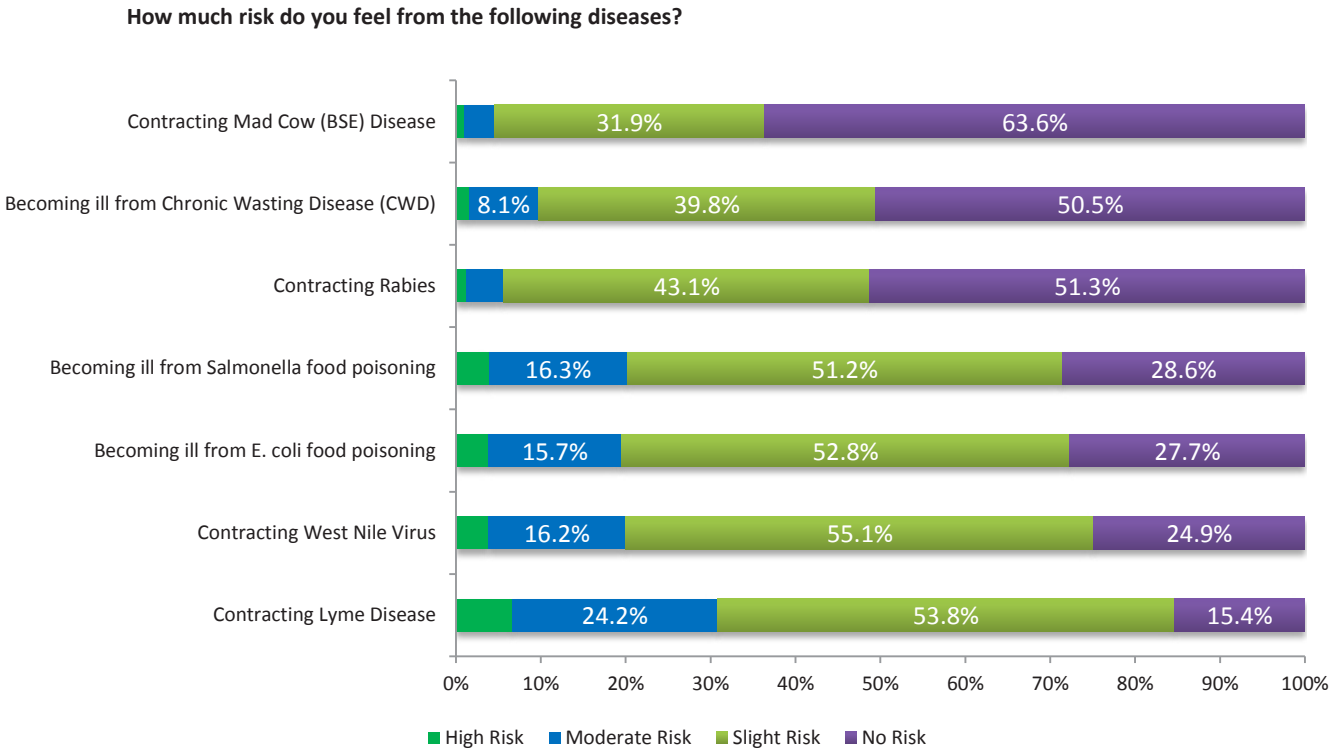


Figure 7-48. Opinion of hunter and non-hunter combined about the level of risk they feel from each of these diseases.

Hypothetical % of deer in population infected	Reaction of hunters to varying prevalence rates of CWD in Indiana white-tailed deer						
	I will hunt as usual, and eat deer meat if I harvest a deer.	I will hunt as usual but only eat deer meat if I am able to test it for CWD first.	I will hunt as usual and eat deer meat but my family will not.	I will hunt as usual but no longer eat deer meat.	I will NOT hunt as usual and hunt in a different county.	I will NOT hunt deer in Indiana, but will go out of state to hunt deer.	I will NOT go deer hunting at all.
0.10%	63.8%	30.1%	2.3%	1.6%	1.1%	0.3%	0.8%
1%	35.5%	50.1%	5.0%	4.3%	2.5%	0.6%	1.9%
10%	13.5%	56.2%	2.4%	10.0%	8.1%	2.7%	7.2%
20%	11.0%	53.9%	1.9%	10.3%	9.3%	4.1%	9.5%
30%	9.7%	50.4%	1.8%	11.2%	10.1%	5.3%	11.5%
50%	8.2%	43.4%	1.5%	13.5%	10.7%	7.4%	15.3%
100%	6.9%	25.7%	1.1%	20.3%	11.4%	9.6%	25.0%

Table 7-1. Self-reported reactions of hunters when posed with the question of how their deer hunting would change with varying degrees of prevalence rates of CWD in deer where they hunt.

prevalence increases to 1% of the deer herd, 35.5% of respondents will continue to hunt and eat deer meat as they normally would, and 50.1% of hunters would continue to hunt as usual, but only eat deer meat if they can test their deer first. There is a gradual shift through the various categories with greater extremes in reactions as prevalence in the deer herd increases. However, reactions level off at the highest prevalences (i.e., 50% and 100% of the deer herd infected with CWD). When 100% of the herd is infected, 6.9% of hunters will continue to hunt deer and eat the meat as normal. A quarter (25.7%) of hunters will hunt as normal, but would want to test their deer before consuming it; 20.3% of hunters will hunt as normal but no longer eat deer meat; 11.4% of hunters will hunt in a different county; 9.6% of hunters would hunt out of state; and 25.0% would stop hunting altogether (Table 7-1).

It is important to understand that hunters' reactions to the presence of CWD in the deer population would likely be a localized reaction to the presence of CWD in the local management unit, which for Indiana is at the county level. When estimating the potential effect on hunting, you should not expand the results to estimate a statewide effect. It is likely the effect on hunting and consuming deer meat would radiate out from the area where CWD is found, with the strongest effect being found close to the epicenter of where CWD is located.

Trust in Indiana DNR Regarding CWD – Indiana DNR asked respondents a series of questions about their trust in Indiana DNR relating to CWD. Specifically, Indiana DNR asked respondents to rate their level of agreement with the following: ***I trust Indiana DNR to properly address CWD in Indiana*** (Figure 7-49), ***I trust Indiana DNR to provide truthful information on the number of CWD-positive deer discovered in Indiana*** (Figure 7-50), ***I trust Indiana DNR to follow the best available science in managing CWD*** (Figure 7-51), ***I trust Indiana DNR to provide adequate opportunities to listen to citizens' concerns about CWD*** (Figure 7-52), ***I trust Indiana DNR to provide truthful information about population trends*** (Figure 7-53), ***I trust Indiana DNR to provide truthful information about human safety issues related to CWD*** (Figure 7-54), ***I trust Indiana DNR to provide timely information regarding CWD issues*** (Figure 7-55), ***I trust Indiana DNR to provide truthful information about how CWD spreads*** (Figure 7-56), ***I trust Indiana NR to make good deer management decisions regarding CWD issues*** (Figure 7-57), ***I trust Indiana DNR to provide me with enough information to decide what actions I should take regarding CWD*** (Figure 7-58), and ***I trust Indiana DNR to provide the best available information on CWD in Indiana*** (Figure 7-59). In general, more than half of hunters (approximately > 75%) and non-hunters (approximately >85%) agreed to some degree with these questions. The median response for all of these questions from both hunters and non-hunters was *Agree*, with a lesser but approximately even response for *Strongly Agree* and *Somewhat Agree*. Only a small amount of respondents, generally <12% of hunters and <5% of non-hunters, disagreed to any degree with any of these statements. The strongest negative reaction from hunters was that 15.8% disagreed to some degree that Indiana DNR would provide truthful information about population trends.

Hunter and Non-hunter Opinion toward Sharpshooting – Sharpshooting is a tool that is often used to control

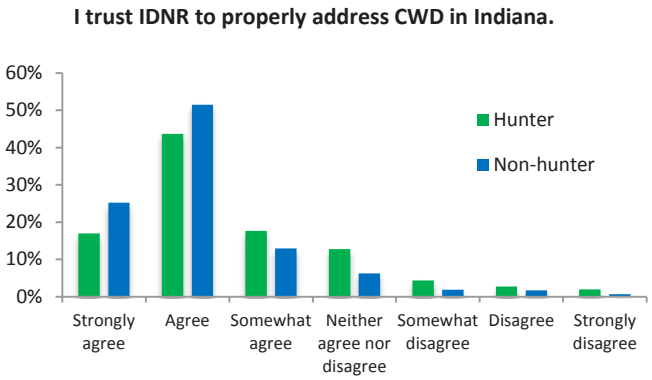


Figure 7-49. Hunter and non-hunter opinion in their trust for Indiana DNR to properly address CWD in Indiana. There was a very subtle (Cramer's V=0.088), but significant difference (p<0.001) between hunters (n=11,112) and non-hunters (n=767).

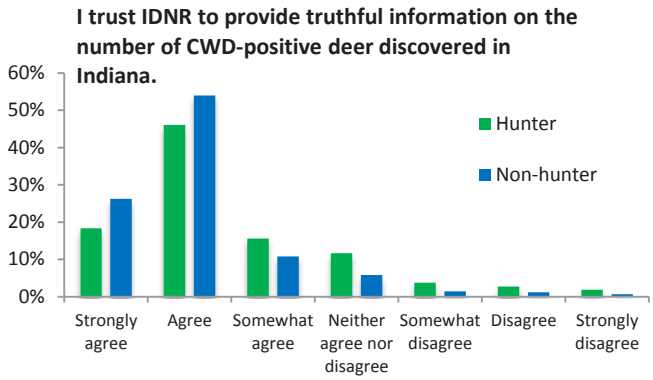


Figure 7-50. Hunter and non-hunter opinion about if they trust Indiana DNR to provide truthful information on the number of CWD-positive deer in Indiana. There was a very subtle (Cramer's V=0.087), but significant difference (p<0.001) between hunters (n=11,158) and non-hunters (n=773).

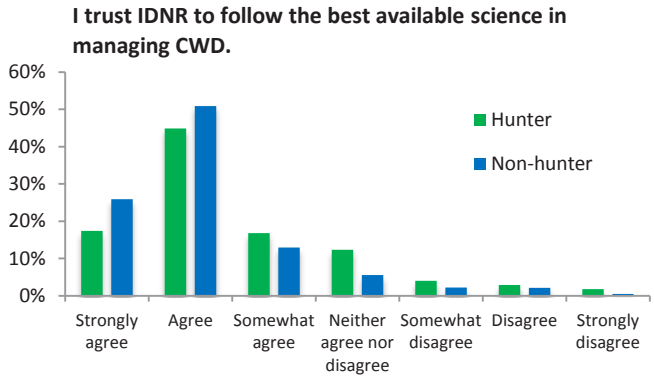


Figure 7-51. Hunter and non-hunter opinion about if they trust Indiana DNR to follow the best available science for managing CWD. There was a very subtle (Cramer's V=0.084), but significant difference (p<0.001) between hunters (n=11,134) and non-hunters (n=773).

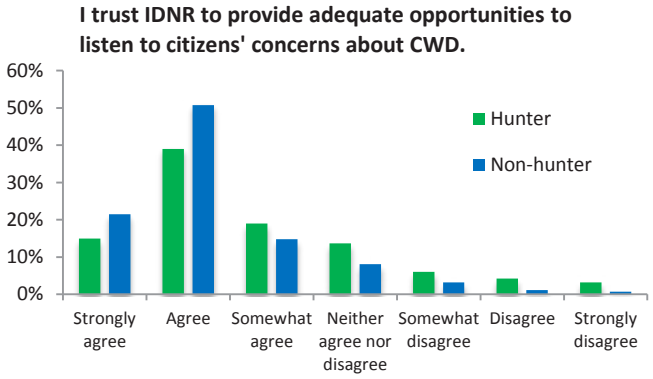


Figure 7-52. Hunter and non-hunter opinion about if they trust Indiana DNR to provide adequate opportunity to listen to citizens' concerns about CWD. There was a very subtle (Cramer's V=0.099), but significant difference (p<0.001) between hunters (n=11,280) and non-hunters (n=820).

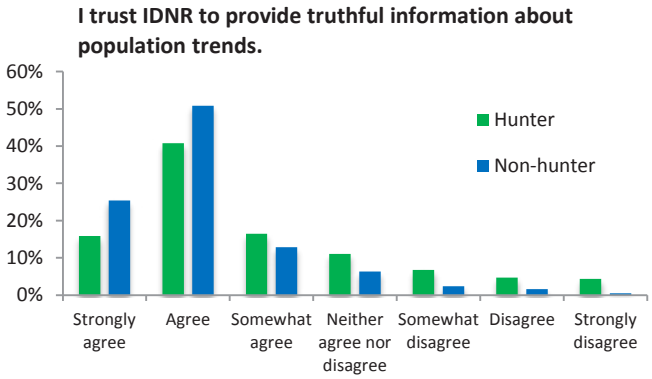


Figure 7-53. Hunter and non-hunter opinion about if they trust Indiana DNR to provide truthful information about population trends. There was a subtle (Cramer's V=0.110), but significant difference (p<0.001) between hunters (n=11,181) and non-hunters (n=799).

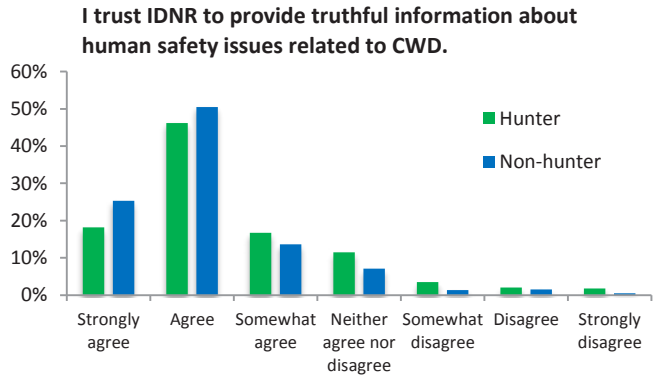


Figure 7-54. Hunter and non-hunter opinion about if they trust Indiana DNR to provide truthful information about human safety issues related to CWD. There was a very subtle (Cramer's V=0.070), but significant difference (p<0.001) between hunters (n=11,197) and non-hunters (n=798).

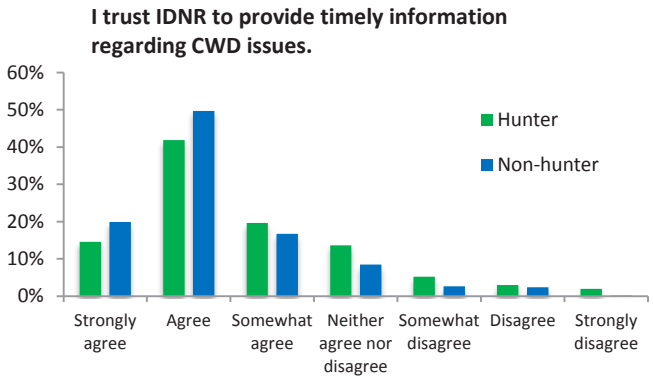


Figure 7-55. Hunter and non-hunter opinion in their trust for Indiana DNR to properly address CWD in Indiana. There was a very subtle (Cramer's V=0.075), but significant difference (p<0.001) between hunters (n=11,217) and non-hunters (n=799).

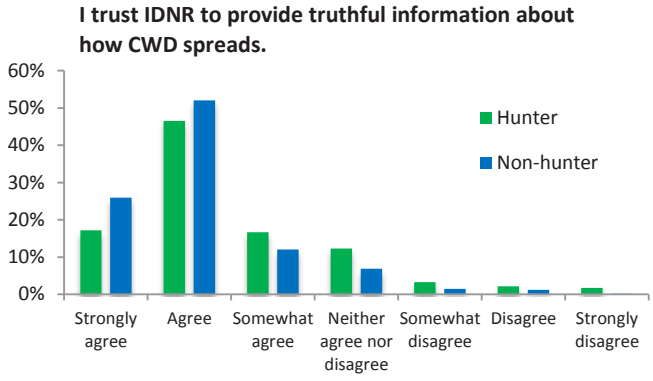


Figure 7-56. Hunter and non-hunter opinion about if they trust Indiana DNR to provide truthful information about how CWD spreads. There was a very subtle (Cramer's V=0.084), but significant difference (p<0.001) between hunters (n=11,168) and non-hunters (n=797).

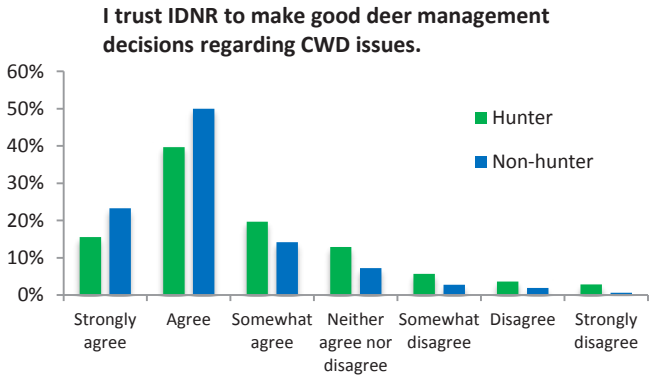


Figure 7-57. Hunter and non-hunter opinion about if they trust Indiana DNR to make good deer management decisions regarding CWD issues. There was a very subtle (Cramer's V=0.096), but significant difference (p<0.001) between hunters (n=11,294) and non-hunters (n=825).

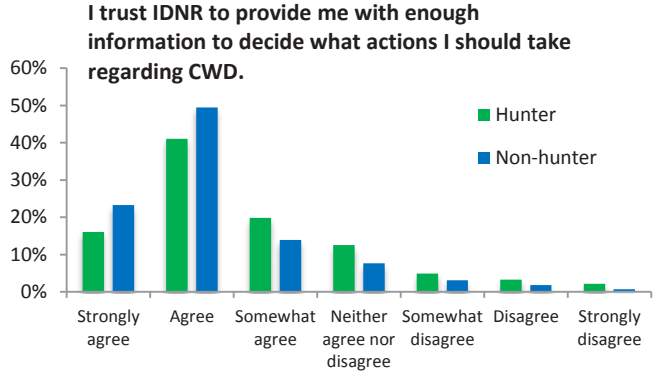


Figure 7-58. Hunter and non-hunter opinion about if they trust Indiana DNR to provide enough information to decide what actions I should take regarding CWD. There was a very subtle (Cramer's V=0.084), but significant difference (p<0.001) between hunters (n=11,326) and non-hunters (n=825).

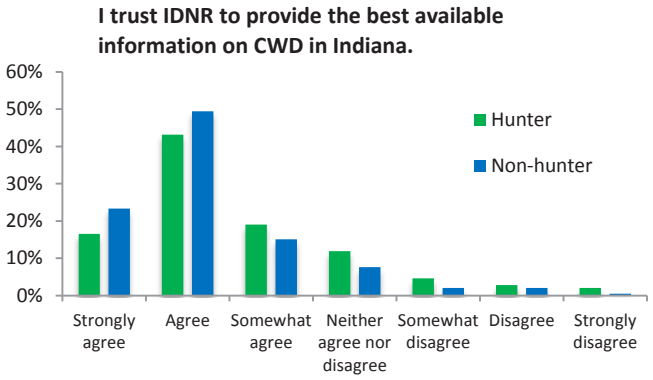


Figure 7-59. Hunter and non-hunter opinion about if they trust Indiana DNR to provide the best available information on CWD in Indiana. There was a very subtle (Cramer's V=0.075), but significant difference (p<0.001) between hunters

the prevalence and spread of a disease when harvest does not adequately reduce the localized population to address the disease. While this is an unpopular tool with many hunters, it has been shown to be effective if applied correctly (Manjerovic et al. 2014). To assess hunter and non-hunter attitudes toward sharpshooting, Indiana DNR asked respondents' level of agreement about the use of sharpshooting as a tool to manage CWD. Specifically, Indiana DNR asked if ***Indiana DNR should use sharpshooting to control CWD in newly affected areas until it has been eradicated from the state*** (Figure 7-60), ***CWD will spread without sharpshooting operations*** (Figure 7-61), ***Hunting can control CWD more effectively than sharpshooting*** (Figure 7-62), the ***Effectiveness of Using deer sharpshooting in known CWD areas to supplement hunting*** (Figure 7-63), and ***Acceptability of using deer sharpshooting in known CWD areas to supplement hunting*** (Figure 7-64). In general, neither agree nor disagree was the median response as well as the most frequent response to questions 7-60, 7-61, and 7-62, with a roughly equal distribution of answers on the agree and disagree side (Figures 7-60, 7-61, and 7-62). Most respondents (28.8% of hunters and 30.2% of non-hunters) were not sure how effective sharpshooting would be for controlling CWD (Figure 7-63), but most would find it an acceptable technique (36.5% of hunters and 62.0% of non-hunters; Figure 7-64). While 11.0% of non-hunters believed using sharpshooting was unacceptable, 28.5% of hunters believed this to be an unacceptable technique for managing CWD (Figure 7-64).

Because respondents may be unaware of the effectiveness of sharpshooting as an effective tool for managing CWD, Indiana DNR asked respondents to give their opinion on the following statement: ***If sharpshooting is the most effective method in controlling the spread of CWD in Indiana, please give your opinion about using sharpshooting as a possible control method if CWD is found in Indiana*** (Figure 7-65). Most respondents indicated that *It should be used as Indiana DNR determines is appropriate* (50.9% of hunters and 77.8% of non-hunters) or that *It should be used minimally and only as a last resort* (36.7% of hunters and 18.1% of non-hunters). Only 12.4% of hunters and 4.1% of non-hunters believed *sharpshooting should not be used at all* (Figure 7-65).

Indiana DNR asked respondents to choose between the following two statements: ***I believe that Indiana DNR should not use sharpshooting even if it that means there will be a greater likelihood that CWD will spread to more counties*** or ***I believe that Indiana DNR should use sharpshooting to reduce the likelihood of CWD spreading to more counties*** (Figure 7-66). Both hunters and non-hunters responded in a similar fashion to this question, with 30.6% of hunters and 11.3% of non-hunters selecting that they believe Indiana DNR should not use sharpshooting even if that means that CWD will spread to more counties (Figure 7-66). Indiana DNR also asked respondents to choose between the following two statements: ***Having a higher population of deer is better than sharpshooting deer to control the spread of CWD*** or ***Using sharpshooting to reduce the population of deer is better than having CWD spread*** (Figure 7-67). Only 27.7% of hunters and 10.2% of non-hunters be-

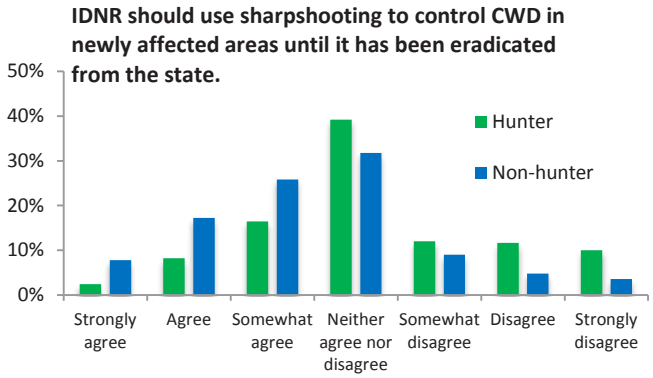


Figure 7-60. Hunter and non-hunter opinion when asked if they believe that sharpshooting should be used to control CWD in newly affected areas in the state. There was a subtle (Cramer's V=0.139), but significant difference (p<0.001) between hunters (n=10,738) and non-hunters (n=667).

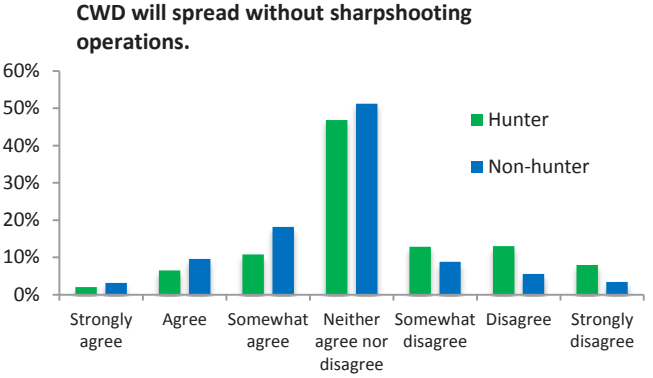


Figure 7-61. Hunter and non-hunter opinion when asked if they believe that CWD will spread without sharpshooting operations. There was a very subtle (Cramer's V=0.092), but significant difference (p<0.001) between hunters (n=10,749) and non-hunters (n=666).

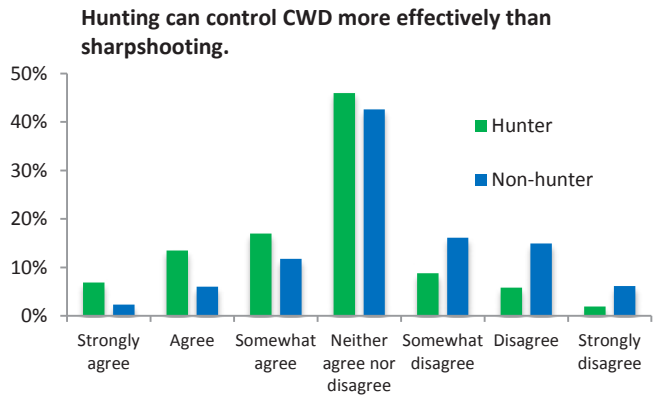


Figure 7-62. Hunter and non-hunter belief about whether or not hunters could control CWD better than sharpshooters. There was a subtle (Cramer's V=0.143), but significant difference (p<0.001) between hunters (n=10,888) and non hunters (n=695).

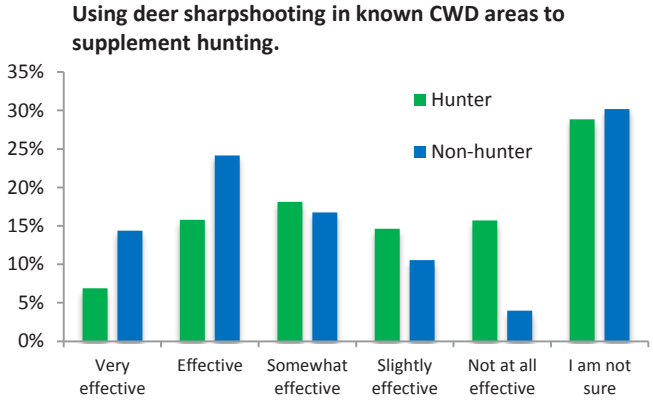


Figure 7-63. Hunter and non-hunter opinion about their perception of the effectiveness of using sharpshooting as a tool to manage CWD. There was a subtle (Cramer's V=0.142), but significant difference (p<0.001) between hunters (n=12,928) and non-hunters (n=1,432).

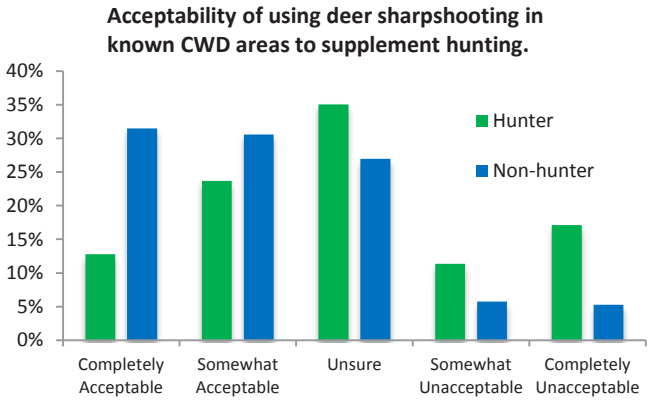


Figure 7-64. Hunter and non-hunter opinion about the acceptability of using sharpshooting in known CWD areas to supplement deer hunting. There was a subtle (Cramer's V=0.174), but significant difference (p<0.001) between hunters (n=12,004) and non hunters (n=1,080).

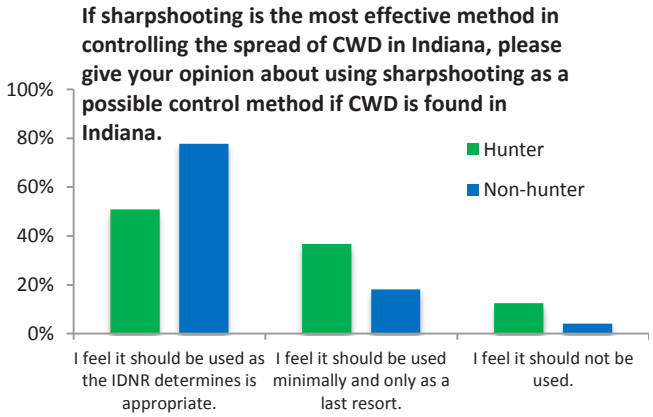


Figure 7-65. Hunter and non-hunter opinion about how much sharpshooting should be used in Indiana to manage CWD if sharpshooting is an effective method for managing CWD. There was a subtle (Cramer's V=0.139), but significant difference (p<0.001) between hunters (n=11,351) and non-

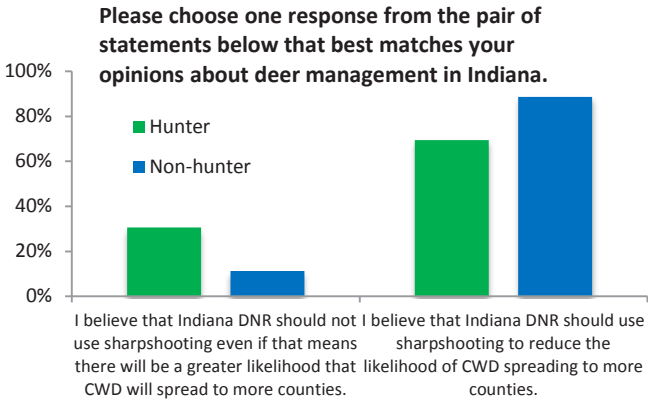


Figure 7-66. Hunter and non-hunter opinion about using sharpshooting to prevent the spread of CWD. There was a subtle (Cramer's V=0.113), but significant difference (p<0.001) between hunters (n=11,743) and non hunters (n=973).

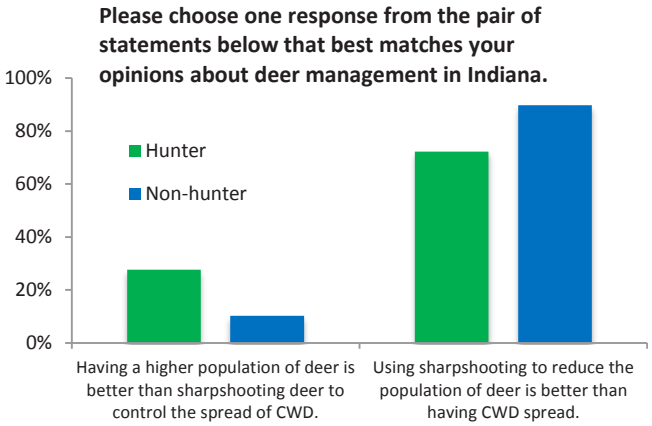


Figure 7-67. Hunter and non-hunter opinion about the use of sharpshooting to control the spread of CWD. There was a subtle (Cramer's V=0.106), but significant difference (p<0.001) between hunters (n=11,634) and non hunters (n=967).

lieved that having a higher population of deer was better than using sharpshooting to control the spread of CWD.

Sharpshooting is a controversial tool in deer management. It often evokes unpleasant mental images, is considered a waste of a valuable resource by hunters, and is believed to be a task that hunters can accomplish if given the opportunity. Many also believe that it is ineffective at controlling CWD and other diseases. Mateus-Pinilla et al. (2013) demonstrated that the use of sharpshooting to manage CWD can be effective; however, the authors did acknowledge that the use of sharpshooting as a disease management tool has not been successful as a universal tool and must be applied in the correct situation. Ultimately, sharpshooting or culling are tools that can help managers achieve measureable objectives in controlling CWD if they are applied correctly.

Respondents were asked if hunting could control CWD more effectively than sharpshooting, and we found that 38% neither agreed nor disagreed with this statement, and 37% agreed to some extent. Additionally, 15% believed it was not effective at all, 14% believed it was only slightly effective, and almost 29% were unsure how effective sharpshooting would be to control CWD. Manjerovic et al. (2014) examined the effectiveness of localized culling by government employees to control CWD in Illinois and Wisconsin from 2003-2007. During this time, there was no difference in these states' prevalence rates, an average of about 1%. Wisconsin ended its localized culling in 2007, and from 2008-2012 there was an increase in prevalence from near 1% in 2007 to approximately 5% in 2012 (Manjerovic et al. 2014). However, since 2012, there has been a significant increase in prevalence in parts of Wisconsin (CWD prevalence trends; unpublished data Wisconsin DNR; https://dnr.wi.gov/topic/wildlifehabitat/prevalence.html) to an average of 35% in adult males and 15% in adult females. Portions of the population are more than 50% infected (CWD Prevalence Trends – Northcentral Iowa County Town 7-8, Range 3-4 E; adult male > 55% infected, adult female >35% infected; https://dnr.wi.gov/topic/wildlifehabitat/documents/nciowa.pdf). During the same time period, Illinois continued to use sharpshooting to control CWD. Since then, the overall infection rate in Illinois has remained between 1-2% depending upon the sex and age of deer (Dufford and McDonald 2018). This significant difference between Illinois and Wisconsin demonstrates that the highly focused, targeted approach that Illinois DNR has employed to control CWD has been much more effective than the approach of using hunting only as a method for controlling CWD.

Respondents from Indiana were supportive of Indiana DNR taking management actions to slow the spread of CWD to new areas, with 70.5% of respondents choosing *I believe Indiana DNR should use sharpshooting to reduce the likelihood of CWD spreading to more counties* and 73.3% of respondents agreeing that *Using sharpshooting to reduce the population of deer is better than having CWD spread* (Figure 7-66). This was similar to the results from Wisconsin, where survey participants were asked to what extent they agreed or disagreed that *CWD should not be allowed to spread further in Wisconsin.* Approximately 62 to 67% of respondents from various parts of Wisconsin agreed with this statement. Conversely, 55-70% of respondents disagreed with the statement that *[Wisconsin] should do nothing to eliminate CWD from the wild deer herd* (Holmsman et al. 2010). However, while hunters supported the efforts of Wisconsin DNR to do something to stop the spread and lower the prevalence of CWD in the deer herd, the perceived population goals set by the Wisconsin DNR to eliminate the deer herd or to reduce it to extremely low deer densities (5 deer per square mile) were not supported (Holmsman et al. 2010). To avoid this issue, Indiana DNR should be explicit in stating the population goals for the deer herd, the extent of how and where the sharpshooting would occur, and other methods used to achieve the goals of slowing the spread and increase in prevalence of CWD in the deer herd.

In general, respondents acknowledged that sharpshooting as a tool may need to be employed to manage CWD. More emphasis should be placed on determining objectives rather than a focus on the tools used to achieve those objectives.

Conclusion to CWD Survey – In general, there was a lot of variation among respondents about the acceptability of potential techniques to manage CWD, such as increasing quotas. This is likely due to a lack of knowledge about the effectiveness of methods used to address CWD or to general opposition to killing deer outside of hunting. To address this, some education efforts should focus on informing the public about the various techniques that might be used to manage CWD in the deer

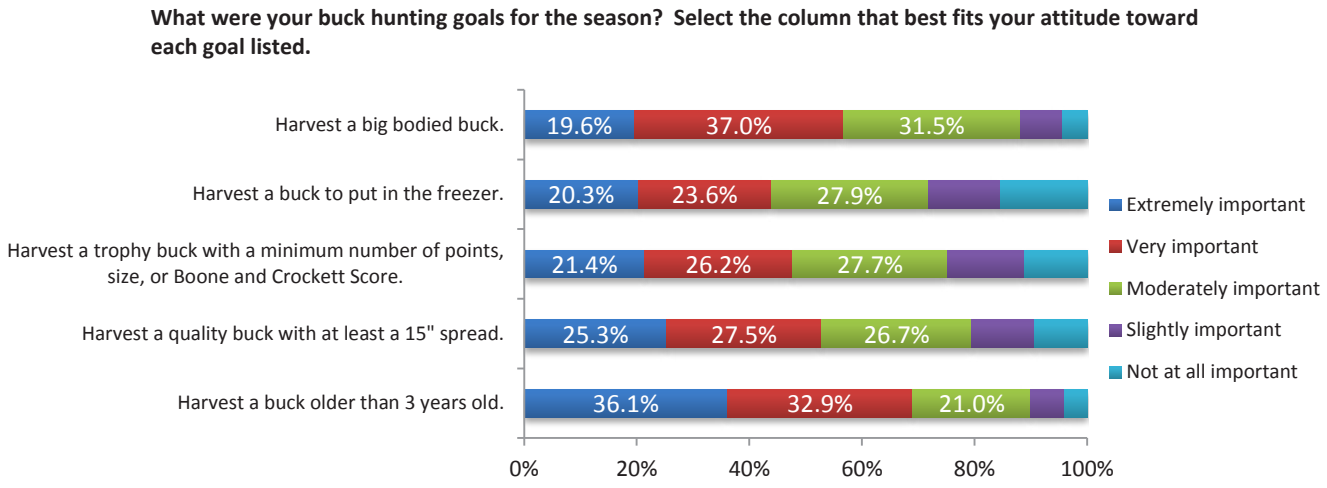


Figure 7-68. Hunters who indicated that harvesting a buck was important to them were asked to rank the importance of various goals for harvesting a buck.

population and their relative effectiveness, costs, and impact to the local and statewide deer population. There was strong objection to taking no action to manage CWD (Figure 7-15). This informs managers that we should be taking actions to manage CWD in order to align agency objectives with the desires of the public.

However, it is important to note that a small percentage of hunters (2.6%) and non-hunters (3.7%) believed that taking no action was completely acceptable. While individuals opposed to any action may account for a high number of individual phone calls or complaints that agencies may receive, they represent a minority. Agency administrators should make sure they are aware of this fact.

Results and Discussion: 2018 Opinion toward Deer Management

Opinions about Harvesting Deer – Indiana DNR asked hunters several questions about the reasons they hunt, the importance of hunting to them, and their preference for certain types of deer. Hunters exhibited a strong preference when asked to agree or disagree with these statements: ***I hunt deer to put meat in the freezer*** (89.0% agreed to some degree), ***It takes skill to harvest a deer*** (85.9% agree to some degree), ***I hunt deer for the challenge*** (83.5% agree to some degree), ***I spend a lot of time in the off-season planning for deer hunting*** (82.1% agree to some degree), ***I spend a lot of time before the season scouting*** (80.3% agree to some degree), ***I plan vacation times around deer seasons*** (74.9% agree to some degree), ***I could not substitute any other activity for deer hunting*** (73.7% agree to some degree), and ***I would rather go deer hunting than any other recreation*** (64.7% agreed to some degree; Figure 7-69).

Hunters were asked if harvesting a buck was important to them, and 55.5% (n=8,357) indicated ***harvesting a buck during deer season*** is important to them while 44.5% (n=6,704) indicated they ***do not care if [they] harvest a buck or not***. In general, the characteristics seen in higher-quality or trophy deer were important to those hunters who indicated that harvesting a buck is important (Figure 7-68). Hunters indicated that they felt that the following characteristics of a buck were extremely important to moderately important, including to ***Harvest a buck older than 3 years old*** (90.0%), to ***Harvest a quality buck with at least a 15" inch spread*** (79.5%), and to ***Harvest a big bodied buck*** (88.1%), all of which are typical characteristics of a quality buck as defined by the Quality Deer Management Association (Miller and Marchinton 1995). Hunters also indicated that ***Harvesting a trophy buck with a minimum number of points, size, or Boone and Crockett score*** was important with 75.3% of hunters selecting that it was extremely important to moderately important (Figure 7-68). Based on these results, approximately half of Indiana hunters are interested in harvesting a high-quality buck. While a relatively large percentage of hunters felt that ***Harvesting a buck to put in the freezer*** was extremely important to moderately important (71.8%), the remaining 28.1% of hunters felt that this was slightly important to not important at all (Figure 7-68).

Hunters were asked several questions about their preference toward harvesting and managing for larger or trophy bucks. Hunters exhibited a preference when asked if ***I feel Indiana should have antler restrictions to produce bucks with higher scoring racks***; 51.2% (n=6,438) of hunters exhibited some degree of agreement with this statement, 21.0% (n=2,640) of hunters were neutral on this statement, and only 27.9% (n=3,506) disagreed with this statement (Figure 7-69). Hunters also exhibited a similar preference when asked if ***Harvesting a trophy buck is an important part of why [they] deer hunt*** with 59.7% (n=7,522) of hunters exhibited some degree of agreement with this statement, 16.3% (n=2,056) of hunters were neutral on this statement, and only 24.0% (n=3,028) disagreed with this statement (Figure 7-69). Hunters also exhibited a slightly higher preference when asked if ***[they] usually pass on shots at does in order to take a buck***; 53.6% (n=6,719) of hunters exhibited some degree of agreement with this statement, 15.1% (n=1,892) of hunters were neutral on this statement, and only 31.3% (n=3,924) disagreed with this statement (Figure 7-69). Asked if ***Deer managers should focus on providing bucks with large racks***, 40.5% (n=5,082) of respondents agreed to some degree with this statement, 29.3% (n=3,678) neither agreed nor disagreed with this statement, and 30.1% (n=3,778) disagreed to some extent with this statement (Figure 7-69).

Asked if ***Emphasis on producing trophy bucks has ruined [their] deer hunting*** (Figure 7-69), 58.2% (n=7,315) disagreed with this statement to some degree, 28.6% (n=3,601) neither agreed nor disagreed, and 13.2% (n=1,657) of hunters agreed with this statement to some degree. Most hunters also disagreed with the statement ***Harvesting smaller bucks will help produce a healthy herd*** (Figure 7-69). We found that 47.8% (n=6,021) of hunters disagreed with this statement, 28.6% (n=3,599) neither agreed nor disagreed with this statement, and 23.6% (n=2,966) of hunters agreed with this statement. Hunters were generally split on the statement ***Less emphasis should be placed on producing trophy deer.*** Approximately 1/3 of respondents indicated they agreed to some degree (33.0%, n=4,140), 1/3 of respondents neither agreed nor disagreed (31.8%, n=3,988), and 1/3 of respondents disagreed to some degree (35.1%, n=4,404; Figure 7-69). Slightly more respondents (39.3%, n=4,936) agreed with the statement ***More emphasis should be placed on producing trophy deer*** than disagreed with this statement (34.7%, n=4,358) with 26.0% (n=3,273) indicating they neither agreed nor disagreed (Figure 7-69).

Please indicate the level to which you agree or disagree with the following statements by choosing the appropriate column for each statement

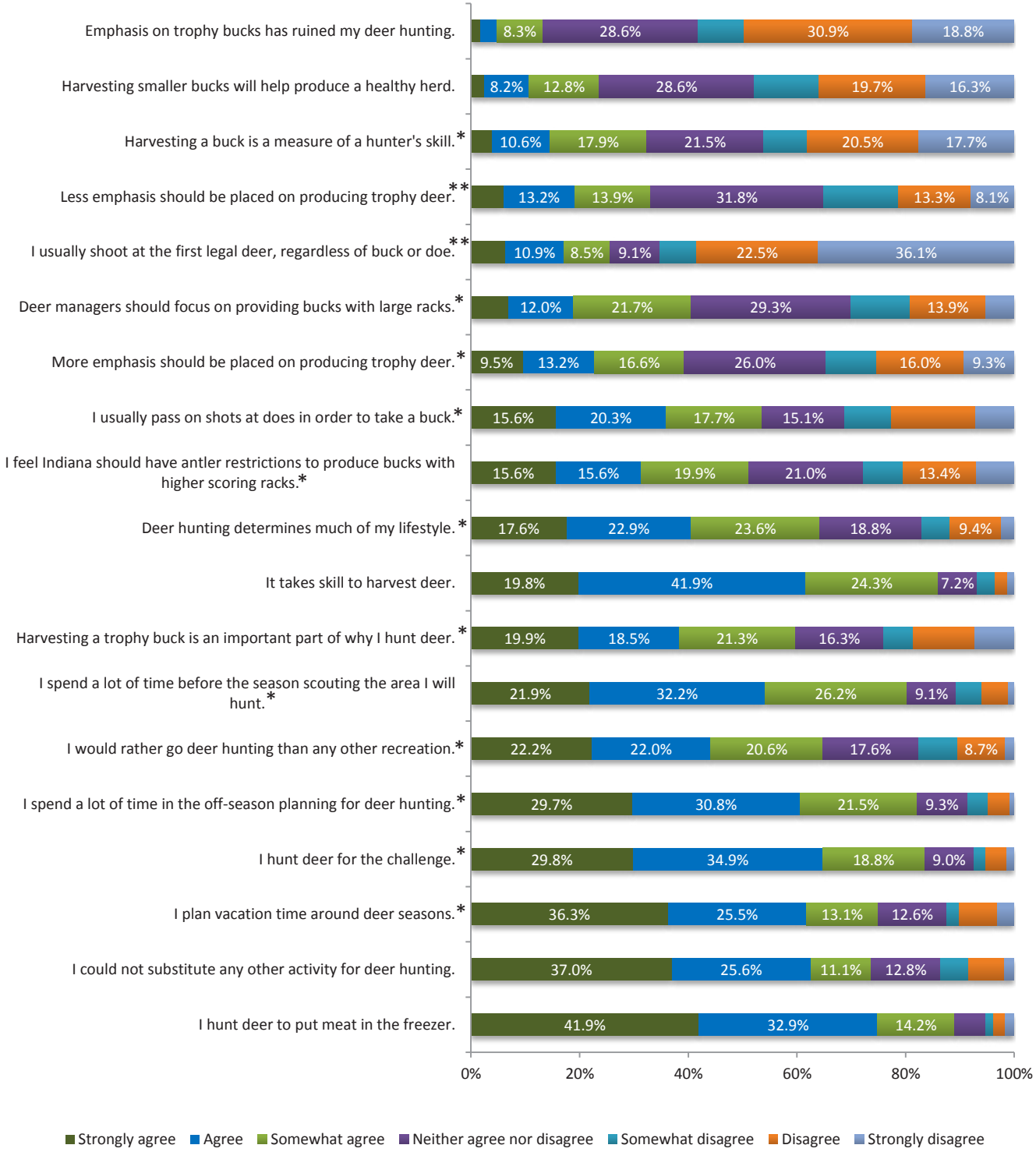


Figure 7-69. Hunters were asked to provide an opinion about several questions related to deer management in Indiana. There was a statistically significant relationship between the response "harvesting a buck was important to me" and twelve of the opinion statements, indicated by an asterisk (*) symbol. There was also a statistically significant relationship between responses of hunters who said they did not care if they harvest a buck or not an two of the above statements, indicated by a double asterisk (**) symbol.

For those hunters who indicated that harvesting a buck was important to them, there was a statistically significant relationship between that statement and ***I would rather go deer hunting than any other recreation*** (n=12,522, *p*=<.001, Cramer's V=0.222), ***Deer managers should focus on providing bucks with larger racks*** (n=12,507, *p*=<.001, Cramer's V=0.339), ***I usually pass on shots at does in order to take a buck*** (n=12,504, *p*=<.001, Cramer's V=0.482), ***I spend a lot of time before the season scouting the area I hunt*** (n=12,551, *p*=<.001, Cramer's V=0.253), ***Deer hunting determines much of my lifestyle*** (n=12,559, *p*=<.001, Cramer's V=0.284), ***More emphasis should be placed on producing trophy deer*** (n=12,535, *p*=<.001, Cramer's V=0.350), ***I feel Indiana should have antler restrictions to produce bucks with higher scoring racks*** (n=12,553, *p*=<.001, Cramer's V=0.201), ***Harvesting a buck is a measure of a hunter's skill*** (n=12,563, *p*=<.001, Cramer's V=0.268), ***I hunt deer for the challenge*** (n=12,571, *p*=<.001, Cramer's V=0.273), ***I spend a lot of time in the off-season planning for deer hunting*** (n=12,574, *p*=<.001, Cramer's V=0.264), ***I plan vacation time around deer season*** (n=12,552, *p*=<.001, Cramer's V=0.269), and ***Harvesting a trophy buck is an important part of why I deer hunt*** (n=12,574, *p*=<.001, Cramer's V=0.548) compared to those that stated that they did not care if they harvested a buck or not. There was a significant, but much weaker association between the statements ***I could not substitute any other activity for deer hunting*** (n=12,575, *p*=<.001, Cramer's V=0.166), ***It takes skill to harvest deer*** (n=12,510, *p*=<.001, Cramer's V=0.074), and a weak inverse relationship with the statement ***Harvesting smaller bucks will help produce a healthy herd*** (n=12,554, *p*=<.001, Cramer's V=0.192) for those hunters who indicated harvesting a buck was important to them.

There was a significant relationship between hunters who indicated that they don't care if they harvest a buck or not and the statements ***I usually shoot at the first legal deer, regardless of buck or doe*** (n=12,587, *p*=<.001, Cramer's V=0.359), and ***Less emphasis should be placed on producing trophy deer*** (n=12,501, *p*=<.001, Cramer's V=0.316). There was a significant but very weak relationship between hunters who indicated that they don't care if they harvest a buck or not and the statements ***Emphasis on trophy bucks has ruined my deer hunting*** (n=12,541, *p*=<.001, Cramer's V=0.087).

In general, hunters showed a preference for harvesting deer with the characteristics of trophy deer, such as larger body sizes, larger antlers, and older ages. However, when specifically asked about trophy deer, hunter preferences for these deer were less pronounced. Past surveys in Indiana asked hunters to rank the importance of six management goals: 1) minimizing damage, 2) balancing habitat, 3) maximizing deer numbers, 4) maximizing hunter opportunity, 5) prevention of disease, and 6) producing trophy bucks. On average, trophy management typically ranks in the bottom half of the list (4th in 2013 and 5th in 2016; unpublished data, Indiana DNR), indicating that trophy management is a low management priority for Indiana hunters. However, when hunters were asked questions regarding the characteristics typically associated with trophy deer without the use of term "trophy," hunters typically agreed more with these statements. Peterson (2004) says that the focus on harvesting a trophy animal over the experience of deer hunting is counter to public acceptance of the sport, citing Kellert (1980) that only 20% of the public approve of trophy hunting. However, it appears that the pursuit of a trophy deer is important to many Indiana hunters.

Hunter Opinion in Changes to Deer Management – Hunters were asked to give their opinion on several questions related to what changes they would like to see in deer management policy in Indiana. Hunters felt there should be no change to the number of antlered bucks that a hunter can legally harvest (70.8% of hunters selected No change) and the number of days of archery deer hunting (65.0% of hunters selected No change; **Figure** 7-70). There was greater variation when hunters provided their opinion about the number of days of firearm deer hunting and the number of different seasons offered each year, but most hunters (43.4% and 56.5% respectively) still preferred the option of No change (**Figure** 7-70). Hunters would like to see a decrease in the number of non-resident deer hunters (47.7% desired a decrease of some degree), the number of Bonus Antlerless Licenses available to hunters (55.4% desired a decrease of some degree), and the total number of deer a hunter can legally harvest (54.2% desired a decrease of some degree; **Figure** 7-70).

Overall Enjoyment of 2017-2018 Hunting Season – Indiana DNR asked hunters to ***rate their overall enjoyment of their 2017-2018 hunting season*** on a scale of 0 (no enjoyment) to 100 (great enjoyment). A total of 11,901 hunters responded with an average score of 75.5 [95% CI; 75.045 to 75.907] with a median score of 81.

Preference toward Deer Management Objectives – In both the 2013 and 2016 Deer Management Surveys,

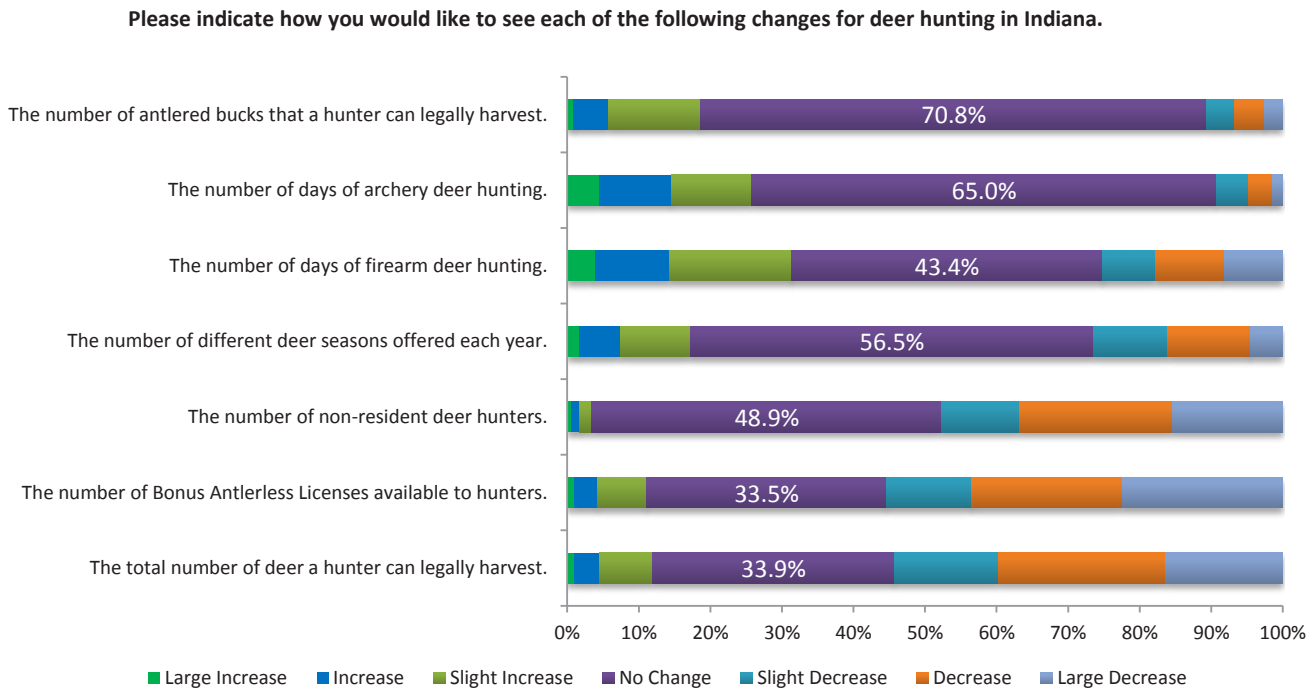


Figure 7-70. Hunters were asked to provide an opinion about several questions related to deer management in Indiana.

Indiana DNR asked hunters to rank their three most important management objectives for Indiana DNR (see Caudell and Vaught 2017 for full details about this survey). Of those who responded in 2013 and 2016, hunters provided ranking for their 1st priority (n=6,998 [2013]; n=8,372 [2016]), 2nd priority (n=4,883 [2013]; n=6,061 [2016]), and 3rd priorities (n=3,829 [2013]; n=6,061 [2016]). In both years, respondents ranked ***Disease Prevention*** as their first priority (21.0% [2013]; 21.8% [2016]), ***Balancing Habitat*** as their second priority (18.1% [2013]; 19.8% [2016]), and ***Maximizing Hunter Opportunity*** as their third priority (17.5% [2013]; 16.0% [2016]). ***Maximizing Trophy Bucks*** ranked 5th in 2013 (14.8%) and 4th in 2016 (15.1%). ***Maximizing Total Deer*** ranked 5th in 2013 (14.8%) and 4th in 2016 (15.1%). Minimizing Damage ranked 6th both years (13.8% [2013]; 12.9% [2016]).

In the 2018 Deer Management Survey, Indiana DNR asked respondents to indicate the importance of various deer management goals. Overall health of the deer herd and Amount of disease in the deer herd ranked highest with at least 90% of respondents indicating that these two management goals were extremely important or very important (**Figure** 7-71), and this was consistent between non-hunters and hunters (**Figure**s 7-74 and 7-75). Addressing deer damage to residential landscaping and gardens, Amount of damage from deer to agricultural crops, and Number of deer acceptable to the general public ranked the lowest (**Figure** 7-71). Both hunters and non-hunters described the importance of taking into account Amount of damage from deer to agricultural crops (**Figure** 7-72) and the Number of deer-vehicle collisions (**Figure** 7-77) as being moderately important in determining deer management goals; however, non-hunters ranked it as being more important that hunters did (**Figure 7-7**7). Most hunters (89.3%) and non-hunters (78.5%) believed that the amount of Damage by deer to residential landscaping and/or gardens was moderately important to not important at all (**Figure** 7-73). One of the largest differences between hunters and non-hunters was the importance of the Number of deer desired by hunters being used to determine harvest goals with 42.1% of hunters describing this as very important to extremely important and 45.3% of non-hunters describing this as slightly important to not important at all (**Figure** 7-76). Both hunters and non-hunters ranked the Number of deer acceptable to the general public as being moderately important (**Figure** 7-77). Both hunters and non-hunters responded that the Impact of deer on their natural habitats as being very important for setting harvest regulations.

Indiana DNR also asked hunters and non-hunters their level of agreement or disagreement with several statements related to deer management. Hunters and non-

hunters were split on whether Deer populations have been overharvested during the past 10 years in Indiana with 58.1% of hunters agreeing with this statement to some degree and 44.1% of non-hunters disagreeing with this statement to some degree (**Figure** 7-80). Both hunters and non-hunters generally agreed that Indiana DNR should mange for the greatest number of healthy deer possible (**Figure** 7-81), Higher deer populations will result in more deer-vehicle accidents (**Figure** 7-83), Deer management must balance the concerns or desires of all Indiana citizens, not just deer hunters (**Figure** 7-84), Sometimes deer numbers need to be reduced even when there is plenty of food for deer (**Figure** 7-85), Quality of deer is more important than quantity of deer (**Figure** 7-86), and Deer damage to crops should be considered part of farming (**Figure** 7-86). Both hunters and non-hunters generally disagreed with the statement the number of deer-vehicle accidents is not affected by the size of the deer population (**Figure** 7-82). Both hunters and non-hunters were generally split between agreeing and disagreeing with the statement Indiana DNR should manage for the greatest number of large antlered deer possible (**Figure** 7-88).

When Indiana DNR asked respondents to agree or disagree with the statements Good deer management will result in deer populations that increase every year (**Figure** 7-89), non-hunters disagreed with this statement more than hunters did, although it was not a large difference ($p<0.001$; Cramer's $V=0.177$). When Indiana DNR asked for respondents to indicate their level of agreement with the statement As long as deer populations are healthy, Indiana DNR should not worry about the number of deer/vehicle accidents (**Figure** 7-90), non-hunters disagreed to some degree more than hunters, although it was not a large difference ($p<0.001$; Cramer's $V=0.170$). When Indiana DNR asked respondents to select their level of agreement or disagreement with the statement As long as deer populations are healthy, Indiana DNR should not worry about crop damage (**Figure** 7-91), results were generally split between agreeing

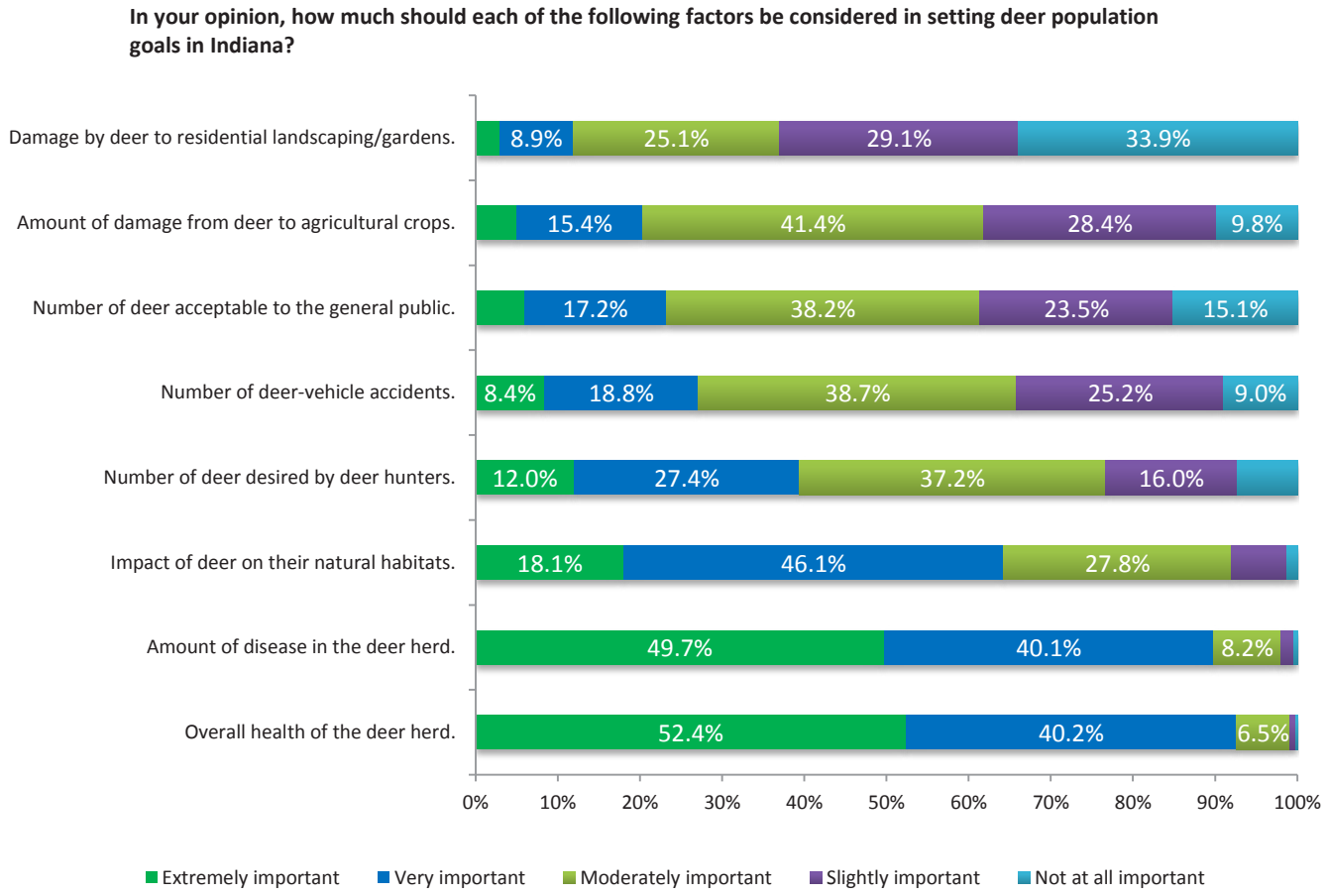


Figure 7-71. Hunters and non-hunters we asked to provide an opinion about several questions related to deer management in Indiana.

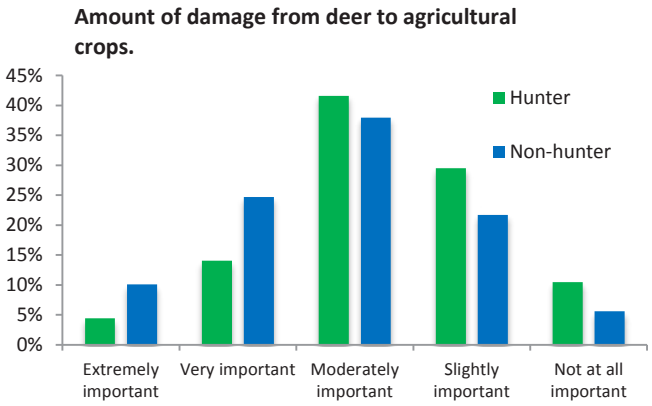


Figure 7-72. Hunter and non-hunter opinion about the importance of deer damage to crops for setting deer population goals in Indiana. There was a subtle (Cramer's V=0.135), but significant difference (p<0.001) between hunters (n=13,591) and non-hunters (n=1,674).

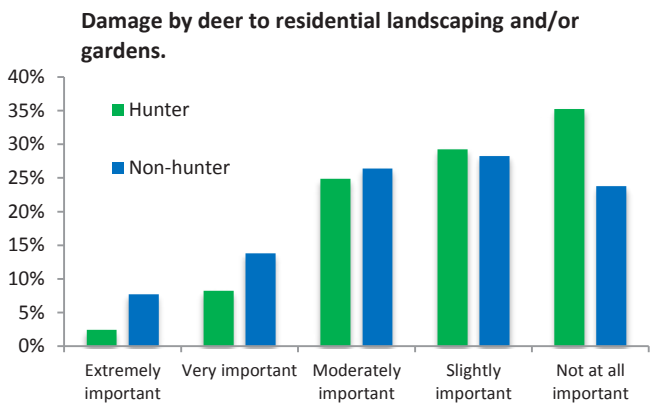


Figure 7-73. Hunter and non-hunter opinion about the importance of deer damage to landscaping and/or gardens is for setting deer population goals in Indiana. There was a subtle (Cramer's V=0.128), but significant difference (p<0.001) between hunters (n=13,569) and non-hunters (n=1,673).

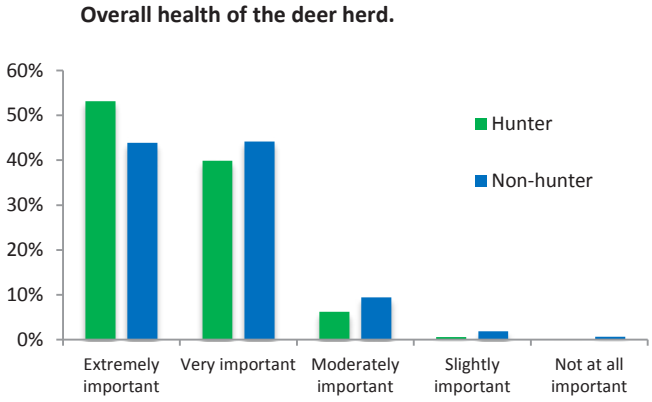


Figure 7-74. Hunter and non-hunter opinion about the importance of the overall health of the deer is for setting deer population goals in Indiana. There was a very subtle (Cramer's V=0.085), but significant difference (p<0.001) between hunters (n=13,551) and non-hunters (n=1,665).

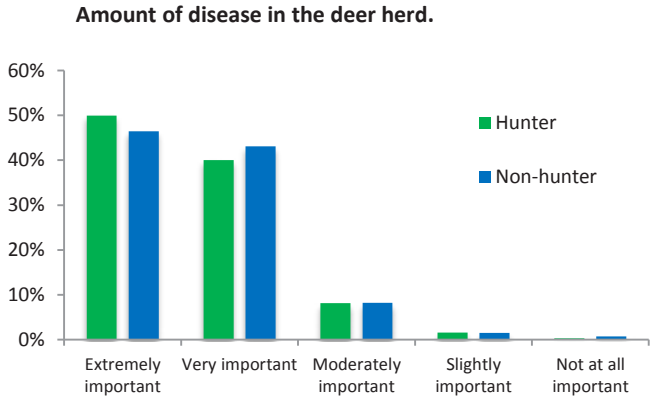


Figure 7-75. Hunter and non-hunter opinion about the importance of the amount of disease in the deer population is for setting deer population goals in Indiana. There was a subtle (Cramer's V=0.029), but significant difference (p=0.013) between hunters (n=13,684) and non-hunters (n=1,709).

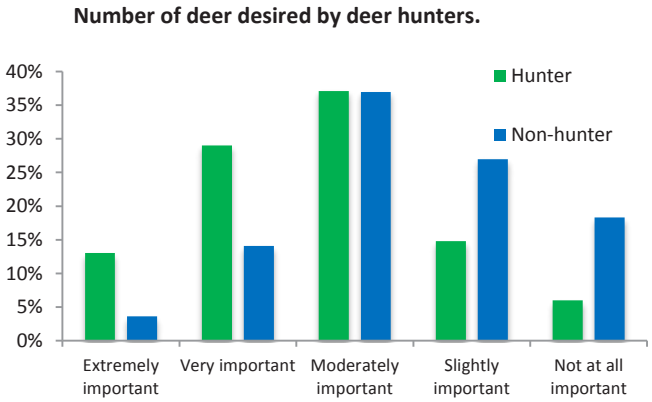


Figure 7-76. Hunter and non-hunter opinion about the importance of the number of deer desired by hunters for setting deer population goals in Indiana. There was a subtle (Cramer's V=0.212), but significant difference (p<0.001) between hunters (n=13,664) and non-hunters (n=1,712).

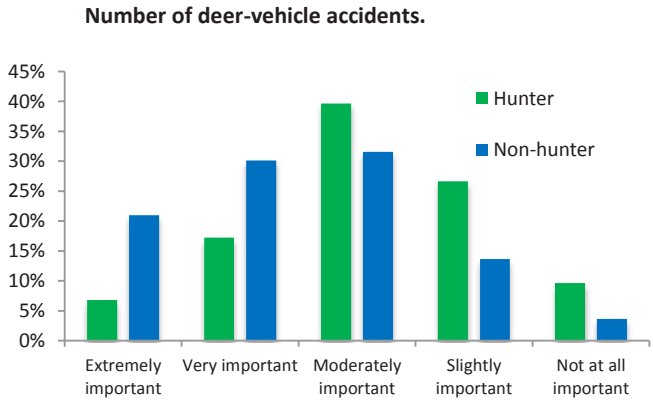


Figure 7-77. Hunter and non-hunter opinion about the importance of the number of deer vehicle collisions for setting deer population goals in Indiana There was a subtle (Cramer's V=0.212), but significant difference (p<0.001) between hunters (n=13,676) and non-hunters (n=1,713).

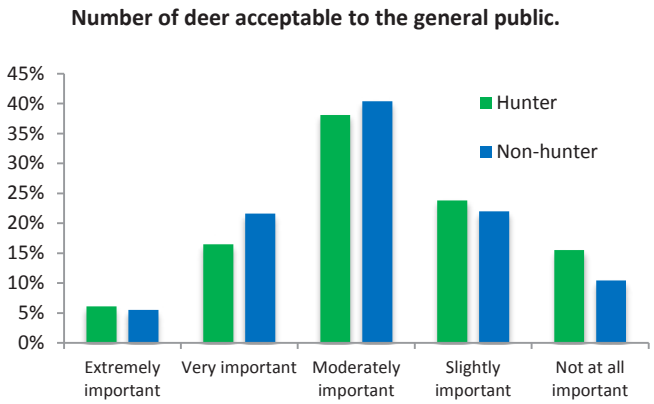


Figure 7-78. Hunter and non-hunter opinion about the importance of the number of deer acceptable to the general public for setting deer population goals in Indiana. There was a subtle (Cramer's V=0.060), but significant difference (p<0.001) between hunters (n=13,679) and non-hunters (n=1,713).

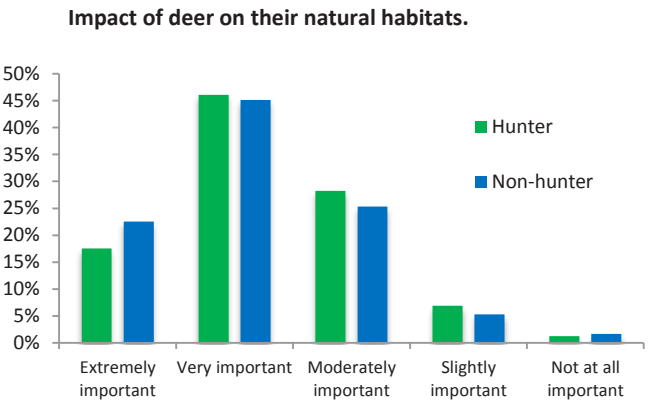


Figure 7-79. Hunter and non-hunter opinion about the importance of the impact of deer on their natural habitat is for setting deer population goals in Indiana. There was a very subtle (Cramer's V=0.046), but significant difference (p<0.001) between hunters (n=13,583) and non-hunters (n=1,671).

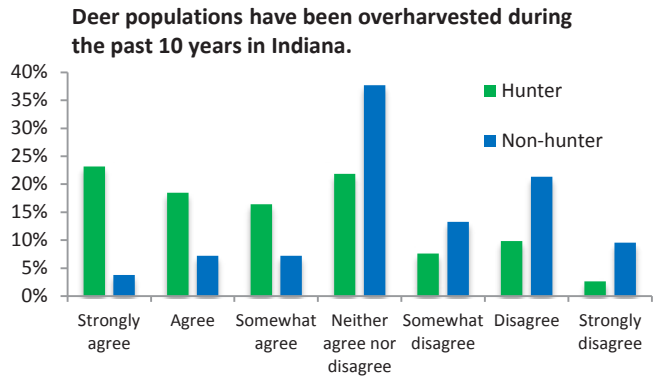


Figure 7-80. Hunter and non-hunter opinion about the if deer populations have been overharvested during the past 10 years. There was a subtle (Cramer's V=0.269), but significant difference (p<0.001) between hunters (n=13,825) and non-hunters (n=1,795).

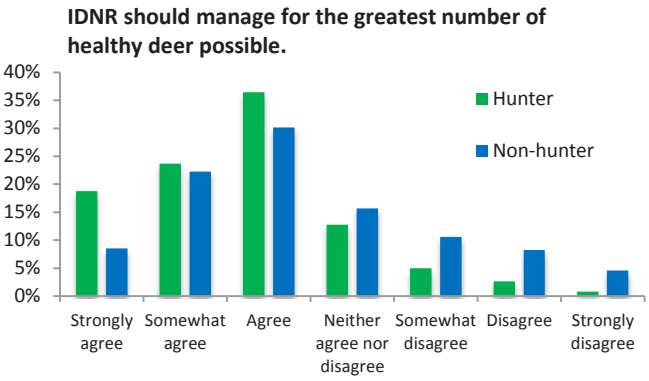


Figure 7-81. Hunter and non-hunter opinion about the if DNR should manage for the greatest number of healthy deer possible. There was a very subtle (Cramer's V=0.189), but significant difference (p<0.001) between hunters (n=13,819) and non-hunters (n=1,795).

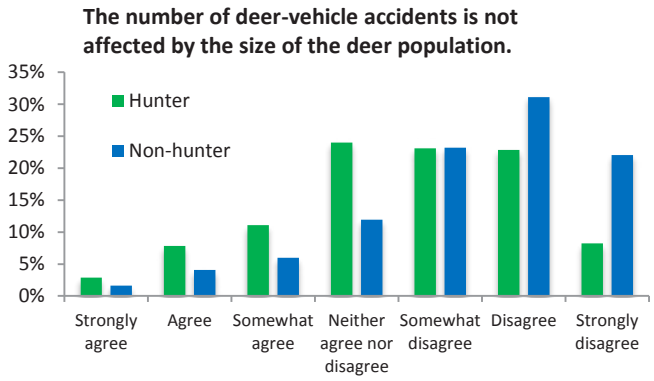


Figure 7-82. Hunter and non-hunter opinion about the relationship between the deer population and the number of deer vehicle collisions. There was a subtle (Cramer's V=0.185), but significant difference (p<0.001) between hunters (n=13,821) and non-hunters (n=1,794).

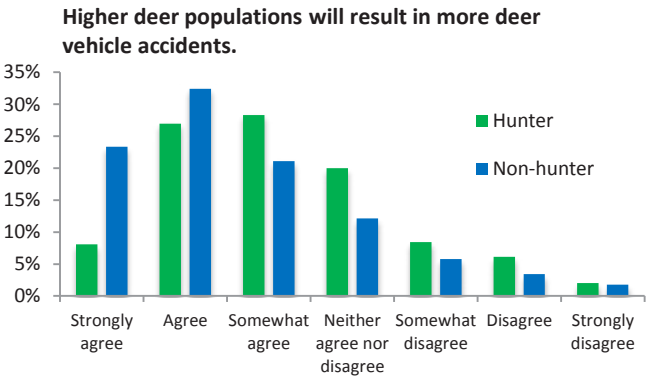


Figure 7-83. Hunter and non-hunter opinion about the relationship between higher deer population and the number of deer vehicle collisions. There was a subtle (Cramer's V=0.184), but significant difference (p<0.001) between hunters (n=14,102) and non-hunters (n=1,956).

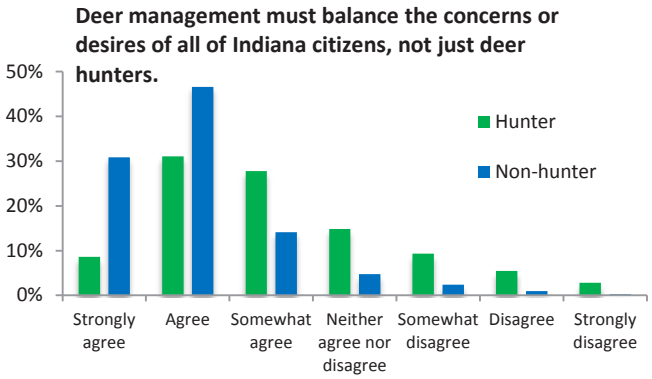


Figure 7-84. Hunter and non-hunter opinion about the balance in opinions between hunters and the general public for setting deer population goals in Indiana. There was a subtle (Cramer's V=0.287), but significant difference (p<0.001) between hunters (n=13,961) and non-hunters (n=1,888).

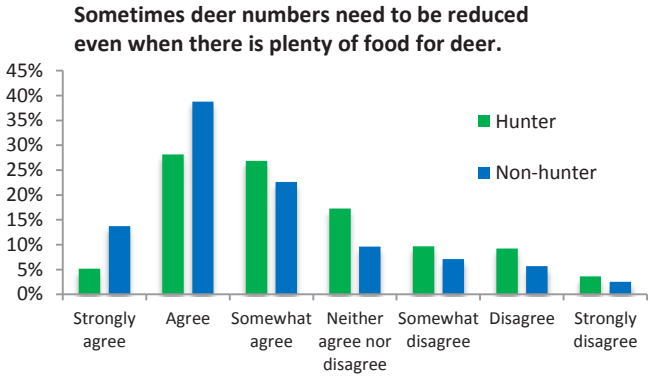


Figure 7-85. Hunter and non-hunter opinion about the need for reducing deer populations in Indiana, even when there is plenty of food for the deer. There was a subtle (Cramer's V=0.154), but significant difference (p<0.001) between hunters (n=13,974) and non-hunters (n=1,893).

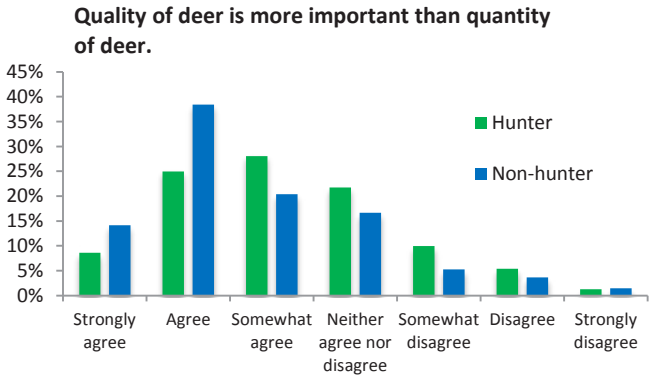


Figure 7-86. Hunter and non-hunter opinion about the importance of the quality of deer in Indiana. There was a subtle (Cramer's V=0.131), but significant difference (p<0.001) between hunters (n=13,964) and non-hunters (n=1,889).

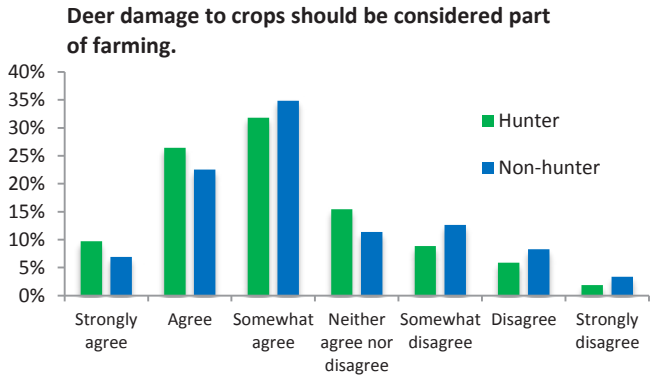


Figure 7-87. Hunter and non-hunter opinion about if deer damage to crops should be considered part of farming. There was a very subtle (Cramer's V=0.082), but significant difference (p<0.001) between hunters (n=13,963) and non-hunters (n=1,889).

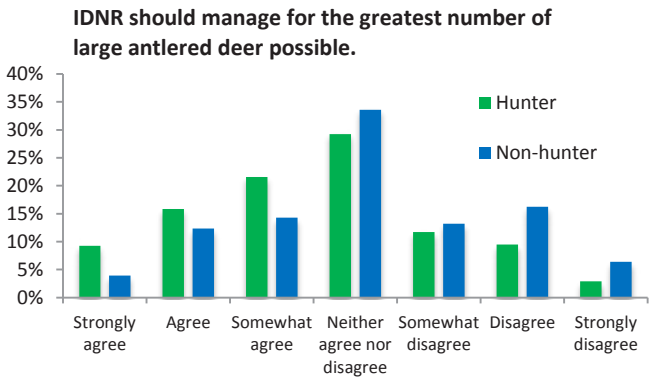


Figure 7-88. Hunter and non-hunter opinion about the importance of the number of deer vehicle collisions for setting deer population goals in Indiana There was a subtle (Cramer's V=0.126), but significant difference (p<0.001) between hunters (n=13,812) and non-hunters (n=1,794).

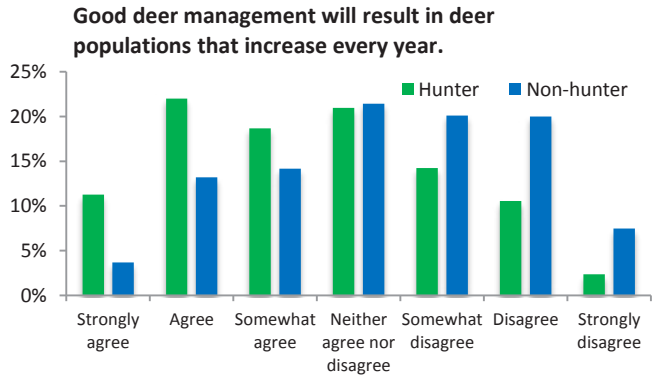


Figure 7-89. Hunter and non-hunter opinion about the if good deer management results in increases in the population every year. There was a subtle (Cramer's V=0.177), but significant difference (p<0.001) between hunters (n=14,110) and non-hunters (n=1,956).

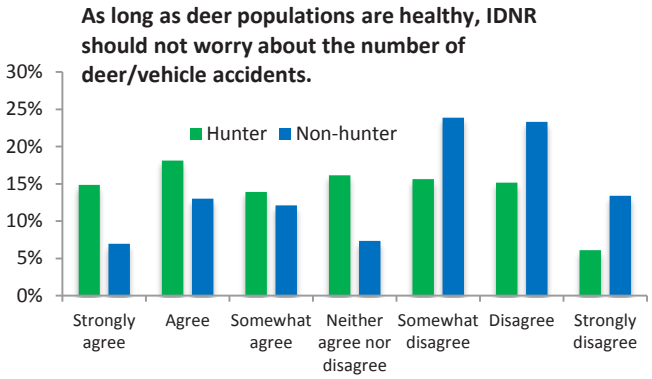


Figure 7-90. Hunter and non-hunter opinion about managing a healthy deer populations and the number of deer vehicle collisions. There was a subtle (Cramer's V=0.170), but significant difference (p<0.001) between hunters (n=14,122) and non-hunters (n=1,957).

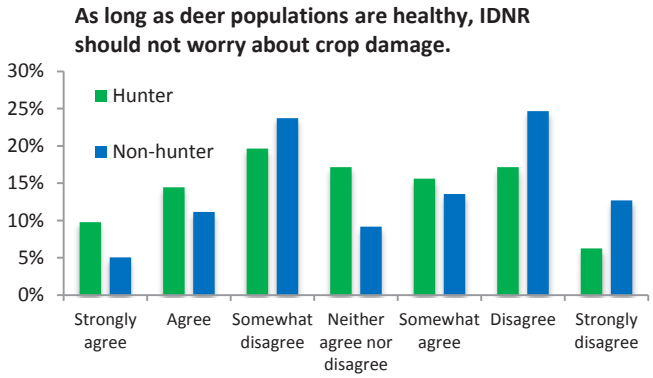


Figure 7-91. Hunter and non-hunter opinion about how crop damage should affect how DNR manages deer. There was a subtle (Cramer's V=0.136), but significant difference (p<0.001) between hunters (n=14,111) and non-hunters (n=1,955).

and disagreeing with this statement, and the difference was smaller between hunter and non-hunters (p<0.001; Cramer's V=0.136).

The Bundle License – Indiana DNR asked hunters to select their level of agreement with reasons why they might purchase the bundle license. Hunters agreed to some degree most with the statements The bundle is more convenient than purchasing three separate licenses (n=5,905 responses; 98.3% agreed to some degree), I usually hunt multiple seasons each year and thought the bundle would save me money (n=5,922 responses; 91.5% agreed to some degree); and the Bundle is a good deal (n=5,884 responses; 91.4% agreed to some degree; **Figure** 7-92). A large proportion of hunters chose Having the bundle allows me to hunt more seasons that I normally would (n=5,915 responses; 68.5% agreed to some degree; **Figure 7-92**), which can allow hunters to enjoy most of the various deer seasons without the need for additional licenses.

Most hunters were unsure about the statement Having a bundle allows me to harvest a doe with a rifle on State Fish and Wildlife Areas (n=5,841 responses; 56.1% of hunters neither agreed nor disagreed, 14.2% of hunters agreed to some degree with this statement; **Figure** 7-92). This was an intentionally false statement. In most cases, you cannot harvest a doe with a rifle on State Fish & Wildlife Areas because many FWAs do not allow the use of Bonus Antlerless Licenses on their property. There are a few properties that allow the use of Bonus Antlerless Licenses, but the vast majority do not. Indiana DNR had indications that many hunters were confused about this fact based on calls received about the bundle license. This seems to confirm confusion and emphasizes the need for better education about the relationship between the bundle license, the Bonus Antlerless License and quotas, and their use on State FWAs.

Conclusion for Deer Management Questions – About half of hunters exhibited a preference toward harvesting a buck. Those hunters who desired to harvest a buck tended to favor the management style for bucks that will produce either quality bucks or trophy bucks. While Indiana DNR's management goals are not specifically to produce higher-quality bucks, there are some regulations and policies in place that allow local land managers to emphasize the development of larger, higher-quality bucks. The one-buck rule encourages selectivity in the deer because most hunters can only harvest one buck. While controversial, the relatively liberal doe harvest allows for a smaller and more-balanced deer population (i.e., balanced sex ratios). A smaller deer herd ultimately means that fewer deer have to share the available food resources. Balanced sex ratios can cause bucks to exhibit normal breeding behaviors compared to populations that are skewed toward many does per buck. Ultimately, the management for higher-quality bucks stops at the landowner level. Landowners themselves must identify what might be the limiting factors for their local deer population (i.e., lack of fawning or escape cover, high-quality food during a specific season, etc.) and manage for what is lacking. Local land managers decide how many of what type of deer are harvested, which ultimately shapes the physical characteristics of the local deer herd.

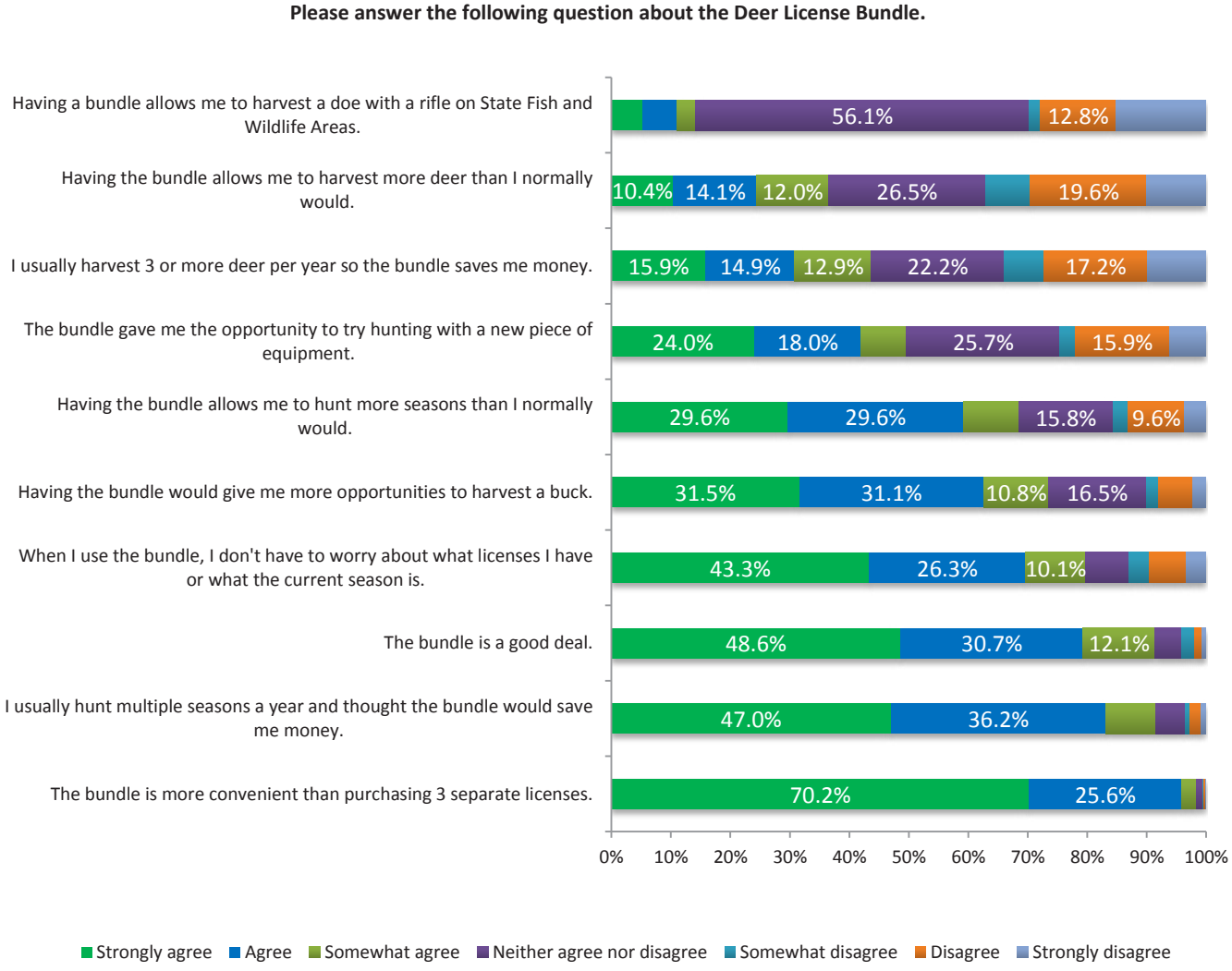


Figure 7-92. Reasons why hunters choose the Deer Licenses Bundle.

Literature Cited

Caudell, J. N., and O. D. L. Vaught. 2018. 2017 Indiana White-tailed Deer Report. Indiana Department of Natural Resources, Bloomington, Indiana, USA.

Dufford, D., and P. McDonald. 2018. Illinois Chronic Wasting Disease: 2017-2018 Surveillance and Management Report. Illinois Department of Natural Resources, Springfield, USA.

Gillin, C. M., and Mawdsley, J. R. Editors. 2018. AFWA Technical Report on Best Management Practices for Surveillance, Management and Control of Chronic Wasting Disease. Association of Fish and Wildlife Agencies, Washington, D. C. 111 pp.

Heberlein TA 2004. Fire in the Sistine chapel: how Wisconsin responded to Chronic Wasting Disease. Human Dimension of Wildlife 9:165-179.

Holsman, R. H., Petchenik, J., Cooney, E.E., 2010. CWD After the fire: six reasons why hunters resisted Wisconsin's eradication effort. Human Dimensions of Wildlife 15:180–193.

Kellert, S. R. 1980. American's attitudes and knowledge of animals. Transactions of the North American Wildlife and Natural Resources Conference 45:111-124. Cited in Peterson 2004.

Manjerovic, M. B., M. L. Green, N. Mateus-Pinilla, and J. Novakoski. 2014. The importance of localized culling in stabilizing chronic wasting disease prevalence in white-tailed deer populations. Preventative Veterinary Medicine 113:139-145.

Mateus-Pinilla, N., H. Y. Weng, M. O. Ruiz, P. Shelton, and J. Novakofski. 2013. Evaluation of a wild white-tailed deer population management program for controlling chronic wasting disease in Illinois, 2003-2013.

Miller, K. V., and R. L. Marchinton, editors. 1995. Quality Whitetails. The How and Why of Quality Deer Management. Stackpole Books, Mechanicsburg, Pennsylvania, USA.

Peterson, M. N. 2004. An approach for demonstrating the social legitimacy of hunting. Wildlife Society Bulletin 32:310-321.

Robinson, S. J., M. D. Samuel, K. I. O'Rourke, C. J. Johnson. 2012. The role of genetics in chronic wasting disease of North American cervids. Prion 6:153-162.

2019 DEER MANAGEMENT SURVEY

Joe Caudell and Olivia Vaught, *Indiana Department of Natural Resources*

As part of the 2017 Deer Management Review, hunters indicated they would like more input into deer management (Caudell and Vaught 2018). Other states such as Wisconsin (Wisconsin DNR 2016) and Pennsylvania (Fleegle et al. 2013) have used County Deer Advisory Councils in an attempt to obtain input from both hunters and non-hunters. Other states such as Indiana and Ohio have used random hunter surveys for years to obtain input on deer management. To increase participation from hunters and to make the survey available to any interested hunter or non-hunter, we initiated a survey program in 2018 using Qualtrics, an online survey tool, that was sent to any license holder (i.e., fishing, hunting, deer hunting, trapping, etc.), to successful deer hunters, or to anyone who signed up in the electronic system specifically to obtain the survey.

In the 2019 Deer Management Survey, the Indiana DNR asked several questions designed to assess opinions and/or gather data about hunting access, barriers to finding places to hunt, the use of guide services for hunting, the types of property ownership hunters use, and the one-buck rule. The inclusion of specific questions should not be interpreted as a change or a desire for a particular regulation by Indiana DNR or the public. The information gathered from these questions are often useful in answering questions from the public about Indiana DNR regulations, hunter behavior, and the need for programs designed to assist hunters (e.g., hunter access program). Some questions are useful for long-term trend studies in hunter opinion. An example is monitoring support or opposition for the one-buck rule. Here we report on the results of the 2019 Deer Management Survey on these topics. Other portions of the Deer Management Survey are referenced elsewhere in this report. For example, questions regarding the desires of hunters and non-hunters about the direction of the size of the deer herd, number of deer desired and taken, and other questions related to the deer population status are reported in the County and Deer Management Unit data sheets.

Methods

The 2019 Deer Management Survey was sent to individuals that the Division of Fish & Wildlife had prior contact with and had an email address for. Individuals included those who had purchased any type of hunting, trapping, or fishing license; anyone who checked in a deer; and anyone who created an electronic account with Indiana DNR for other reasons (such as obtaining the survey). Because lifetime license holders and hunters who use their property exemption do not have to purchase a yearly license, they can only be surveyed if they harvest a deer, purchase another license type (e.g., fishing, Deer Reduction Zone license, etc.), or sign up on Indiana DNR's electronic system specifically to receive the survey. Because of this, lifetime license holders and hunters who only use their landowner exemption and do not harvest a deer are likely not represented in the survey.

Survey invitations were distributed by Qualtrics using the email list generated by Indiana DNR on Feb. 5, 2019. A reminder was sent on Feb. 15, 2019, and the survey closed on March 4, 2019. Descriptive statistics were generated using StatsIQ, the integrated statistical package in Qualtrics. Cramer's V was calculated for effect size, and chi-squared tests were used to describe relationship between factors when appropriate.

Results and Discussion: 2019 Deer Management Survey

General Demographics of Respondents – The 2019 Deer Management Survey was sent to 398,102 individuals who purchased some type of license(s) through the Indiana DNR online point of sale system (i.e., hunting, fishing, and trapping), had signed up for an Indiana DNR account, or had checked in a white-tailed deer during the past season, all of which were dependent upon the individual providing a valid email. Duplicate emails were identified and removed before surveys were emailed. Of those sent, 28,999 emails bounced back as undeliverable, for an adjusted sample size of 369,013. Out of the 369,013 surveys successfully sent, 33,987 surveys were started, for a response rate of 9.2%; and 24,955 surveys were finished for a completion rate of approximately 73%.

Because much of the survey is dependent upon potential respondents being assigned to a county for reporting, survey respondents had to include a county they hunted in or lived in to be included in the final data. Respondents from 30,493 surveys included a county of residence. Of the non-residents who responded to the survey, 1,861 started the survey, and 1,536 non-residents self-identified as being a hunter (1,270 reported they hunted during the 2018-2019 deer hunting season), while 325 non-residents indicated they did not hunt. When resi-

dents of Indiana were asked ***Do you consider yourself a deer hunter even if you did not hunt during the 2018-2019 deer hunting season***, 25,613 residents indicated they were deer hunters while 2,895 residents indicated they were not deer hunters.

Indiana DNR asked hunters to choose which statement best describes where [they] live and hunt. Of the 22,300 respondents, 30.7% chose I hunt mostly in the county where I live, but I also occasionally hunt other counties; 28.9% chose I hunt only in the county where I live; 22.4% chose I never hunt in the county that I live in and I only hunt deer in a different county; and 18.0% choose I hunt occasionally in the county that I live in, but I mostly hunt in other counties. We asked hunters to select which license(s) type(s) [they] used in the 2018-2019 hunting season. The bundle license (41.9%; n=9,551) and lifetime license (25.9%; n=5,897) were the most used licenses. Landowner exemptions accounted for 14.5% (n=3,307) of the "licenses" used. The least used "license" was the military exemption (0.5%; n=119; **Figure** 7-93).

Indiana DNR asked hunters to choose a response for How many deer did [they] want to harvest in the 2017-2018 deer hunting season. Of the 22,543 hunters who responded, 31.1% wanted to harvest a buck and a doe, 21.3% of wanted to harvested a buck and two does, 17.1% wanted to harvest a buck only, and 8.0%% rs wanted to harvest two deer regardless of sex (**Figure 7-94**).

Indiana DNR asked hunters to select ***How many total years they had been a deer hunter*** and ***How many total years they have hunted deer in Indiana***. Of the 22,236 who responded, 62.9% reported they had hunted *more than 20 years total*, 55.0% reported that they had hunted *more than 20 years total in Indiana*, 18.8% reported they had hunted *10-20 years total [anywhere],* 20.1% reported they had hunted *10-20 years in Indiana*, 9.1% reported they had hunted *6-10 years total [anywhere],* 11.1% reported they had hunted *6-10 years in Indiana*, 7.6% reported they had hunted *2-5 years total [anywhere],* and 10.7% reported they had hunted *2-5 years in Indiana*. Of the first-time hunters, 1.5% of reported they were *first-time hunters anywhere* and 3.1% reported they were *first-time hunters in Indiana*.

Access to Areas for Hunting – Indiana DNR asked hunters several questions related to gaining access to private land for hunting. Of those hunters who responded (n=10,833), 81% responded that they had asked for permission to hunt on private land from someone who was not related to them while 19% responded that they did not ask for permission to hunt private land. Asked How often are you successful in obtaining permission to hunt on private land by someone not related to you, only a small percentage (4.3%; n=371) responded that they were Never successful (**Figure** 7-95). We asked hunters When you are denied access to hunting on private land, what do you do? Most (54.8%; n=10,408) responded that they Continue to ask for access to other parcels of private land while 32% (n=6,156) chose to Hunt public land (**Figure** 7-96).

Indiana DNR asked hunters to select What reasons have private landowners given to you when you have been denied access to private land. The most common two reasons selected were that The landowner only allows relatives to hunt their land (58%; n=11,057) and The landowner does not allow hunting on their land (57%; n=10,871; **Figure** 7-97). Hunters were also allowed to select Other reasons and provide a write-in response for reasons why they had been denied access. A total of 3,468 responded that they had been given other reasons they were not allowed to hunt on private land owned by a non-relative. Of those respondents, 29% (n=1,002) stated landowners were afraid of taking on the liability of allowing someone to hunt on their land, and 3% (n=111) stated landowners had safety concerns with individuals hunting on their land. A total of 0.6% reported that landowners had denied them access to private land because landowners were concerned with the law allowing high-powered rifles to be used on private land, a reason primarily related to beliefs of reduced safety.

Indiana DNR asked hunters Have you ever lost permission to hunt on private land where you previously had permission to hunt it, and 52% (n=5,601) responded that they had lost permission to hunt on private land while 48% of hunters (n=5,128) had not. Asked to select What were the reason(s) given to you by the landowner when you have lost permission to hunt on their private land, the most common reasons selected were that The land had been sold to a new owner (60%; n=3,361), The landowner was offered a lease agreement or money to allow another hunter exclusive access (44%; n=2,468), and that The land transferred ownership to another relative that does not allow hunting (31%; n=1,758; **Figure** 7-98). A total of 1,126 hunters provided written comments about Other reason not listed as to why they lost their hunting privileges on private land. The most common reasons listed were that some member of the landowner's family had begun hunting (36%) and new or growing concerns over liability (7.7%; n=87).

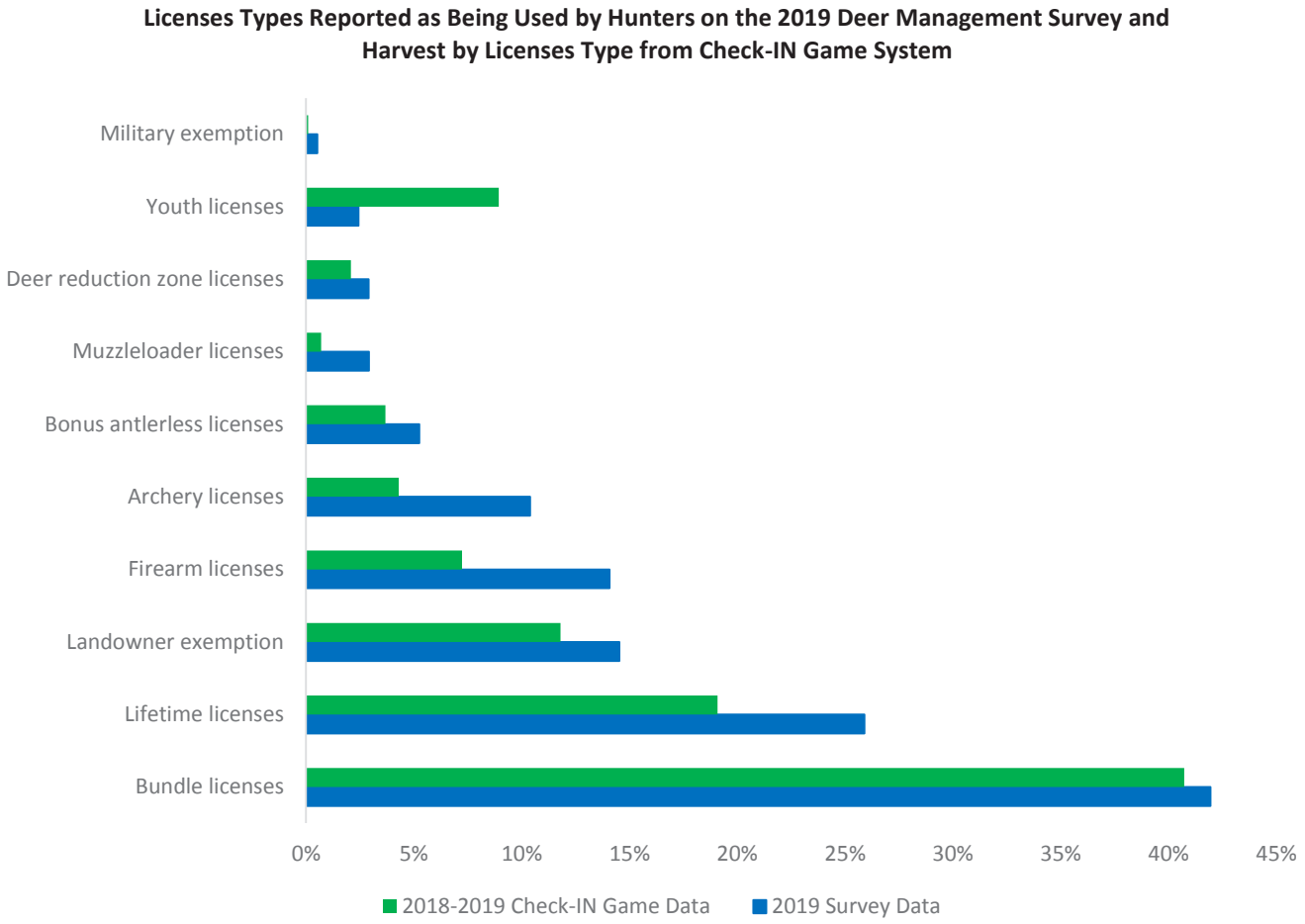


Figure 7-93. Percent of Deer Management Survey respondents that used each type of hunting license during the 2018-2019 deer hunting season.

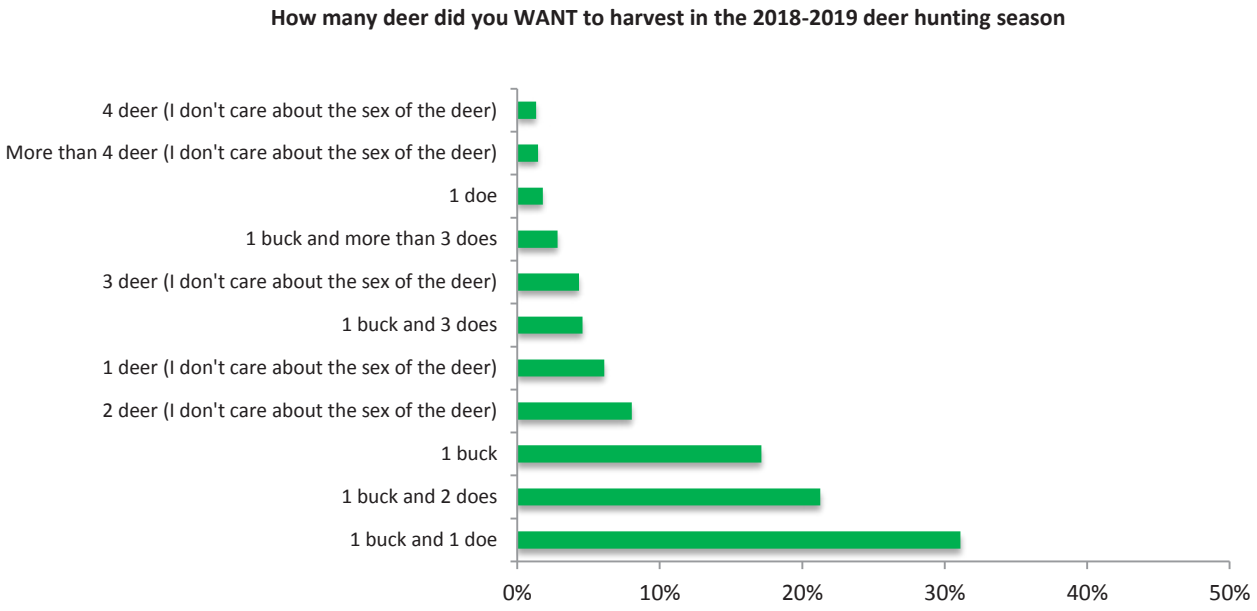


Figure 7-94. Number of deer desired to harvest in the 2018-2019 deer seasons by hunters (n=22,543).

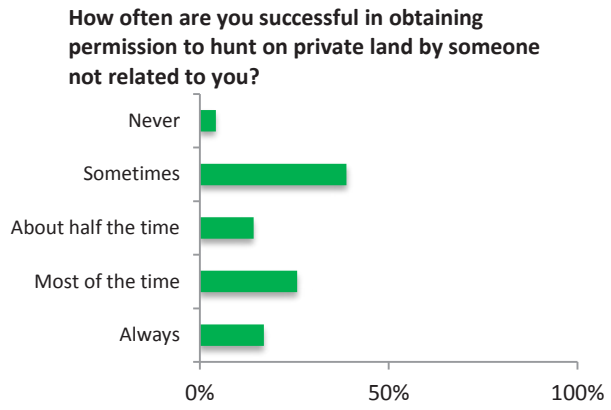


Figure 7-95. Hunters were asked to select the category that best reflects their success rate when asking to hunt on private land (n=8,726).

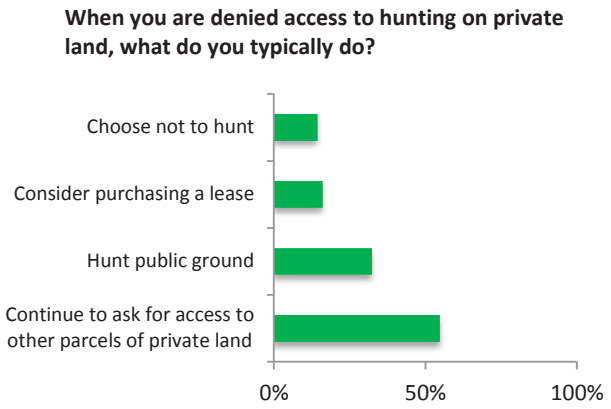


Figure 7-96. Hunters that had been denied access to hunt on a parcel of private land were asked what they do when they are denied access to private land (n=22,369).

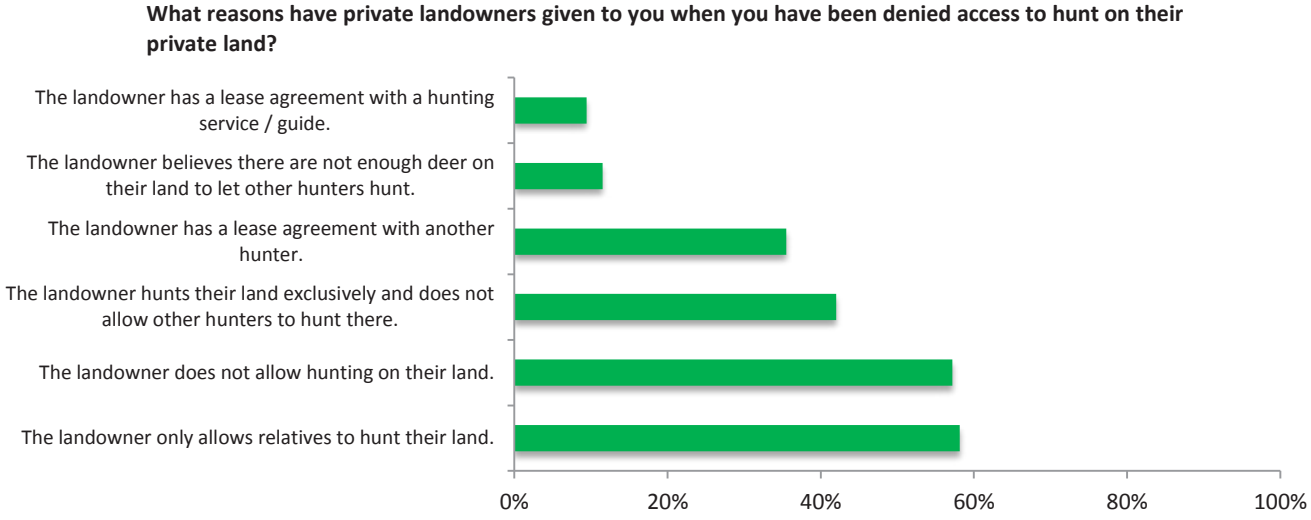


Figure 7-97. Hunters were asked to select any of the reasons they had been denied access to private land (n=19,011).

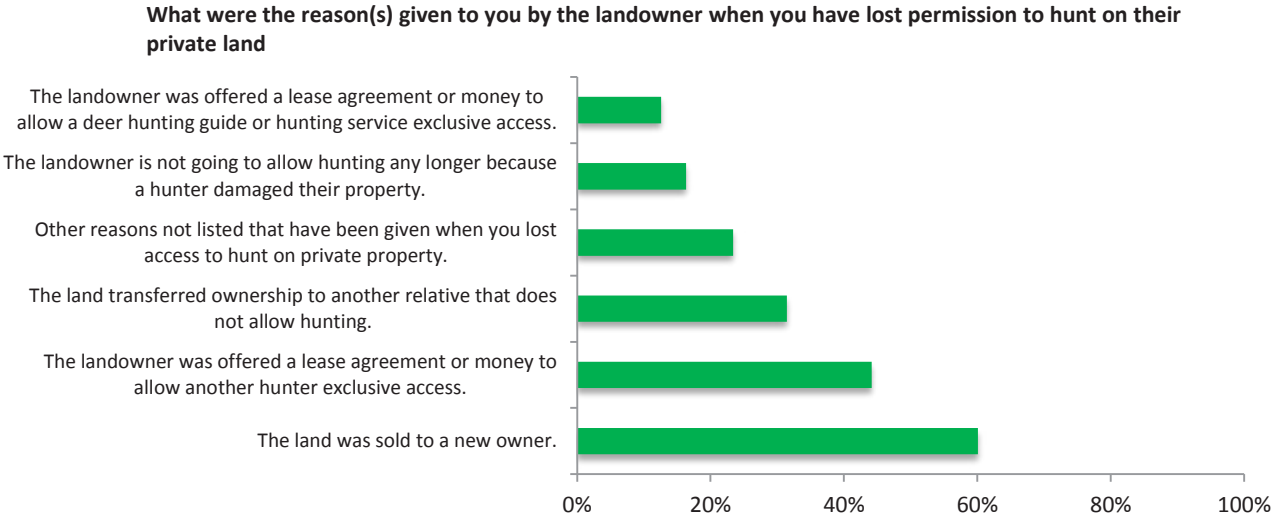


Figure 7-98. Hunters were asked to select any of the reasons they had lost access to private land (n=5,591).

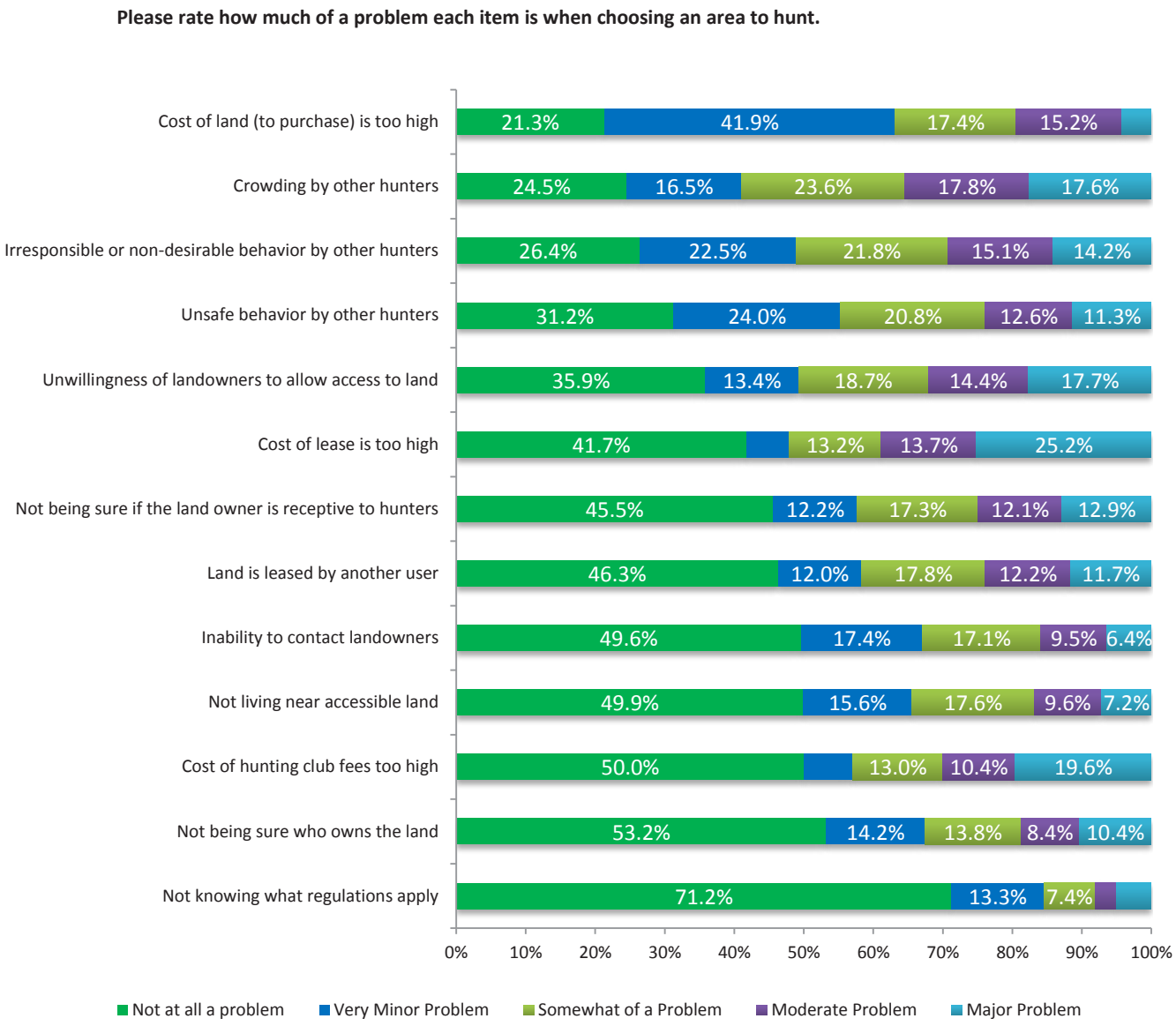


Figure 7-99. How much of a problem are each of these factors in deciding where to hunt (n=20,236).

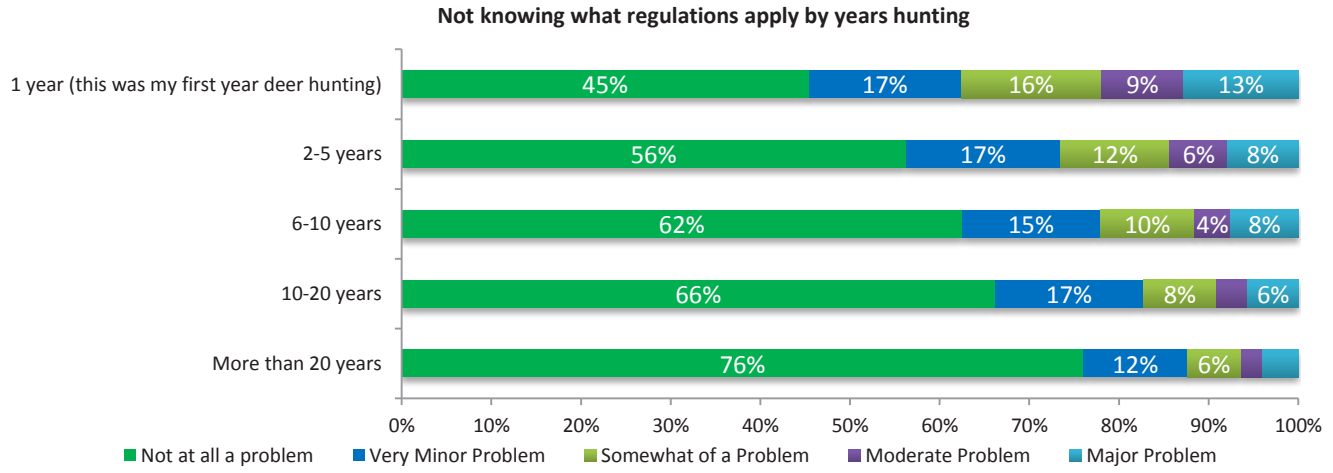


Figure 7-100. Analysis of how much of a problem it is not knowing what deer hunting regulations apply by years hunting (n=20,372).

Barriers to Finding a Place to Hunt – Indiana DNR asked hunters to Please rate how much of a problem each item is when choosing an area to hunt. None of the problems listed appeared to be a significant problem to most hunters (**Figure** 7-99). The cost of a lease is too high was selected as being a Major or Moderate problem by 38.9% of hunters, Crowding by other hunters was selected as being a Major or Moderate problem by 35.4% of hunters, Unwillingness of landowners to allow access to land was selected as being a Major or Moderate problem by 31.1% of hunters, and Cost of hunting club fees too high was selected as being a Major or Moderate problem by 30.0% of hunters (**Figure** 7-99). Not knowing what regulations apply was selected as Not a problem by 71.2% of hunters.

Because Indiana DNR perceives that complex regulations may act as a barrier for new hunters, we analyzed the issue of Not knowing what regulations apply by How many total years have you been a deer hunter (as self-reported by hunters). There was a subtle (Cramer's V=0.085) but significant difference ($p<0.001$) between the years that a hunter had been hunting and the degree to which not knowing the regulations acts as a barrier to hunting (n=20,237), with 22% of first-year hunters selecting this as a Major problem (13%) and a Moderate problem (9%; **Figure** 7-100).

Where Hunters Hunt – Indiana DNR asked hunters to Please describe the ownership of the land where you typically hunt in Indiana and received 20,817 responses to this question (**Figure** 7-101). Most hunters responded that they hunt with permission on land owned by people they were not related to without a paid lease (52.6%; n=10,956). The lowest selected response was that hunters hunt on land that they have leased for hunting (8.8%; n=1,830). Approximately 18% of hunters (n=3,682) chose to hunt on public land, although we did not ask about the ownership of that landholding (e.g., U.S. Forest Service, Indiana DNR Fish & Wildlife Area, military land, etc.).

Use of Guides for Hunting – Because of several recent questions related to the use of guide services for deer hunting, Indiana DNR was interested in the prevalence of the use of deer guides or paid services for hunting. This is a fairly common and well-organized practice in the western United States, but the extent of hunter use of deer guides in Indiana was unknown. To evaluate this, Indiana DNR asked hunters ***Did you use a paid hunting guide service or other type of deer hunting assistance that you paid for during the 2018-2019 deer hunting season***. Out of 21,261 responses from residents and non-residents only 0.8% (n=176) responded that they used a hunting guide for this season.

For those individuals who selected that they did use a guide, Indiana DNR asked ***Would you have hunted in Indiana without the assistance of a paid guide***. Of the 173 hunters who responded to this follow-up question, 44.5% selected *Definitely yes*, 17.9% selected *Probably yes*, 12.1% selected *Might or might not*, 16.8% selected *Probably not*, and only 8.7% selected *Definitely not*. Of those hunters who responded to the follow-up question, 69.0% were hunters who had hunted more than 20 years, 14.0% had hunted 10-20 years, 6.5% had hunted 6-10 years, 8.2% had hunted 2-5 years, and 2.3% reported this was their first year hunting. This indicates that hunters who use guide services tend to be long-time hunters who are

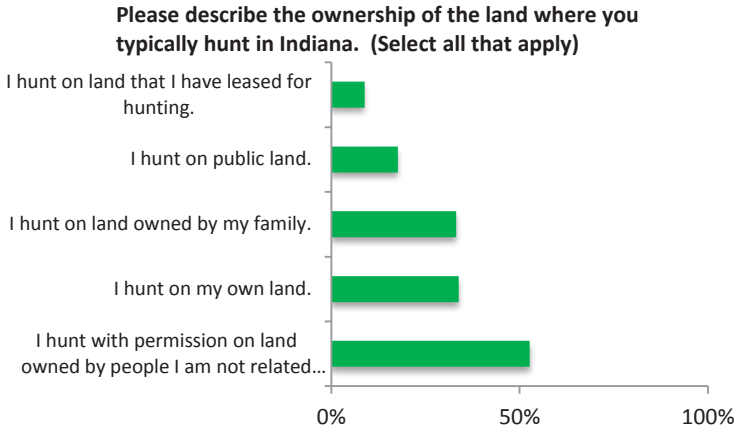


Figure 7-101. Hunters were asked to describe the land ownership where they typically hunt.

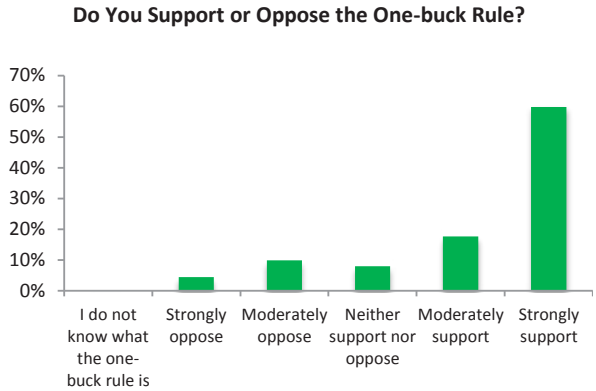


Figure 7-102. Hunters were asked to select their level of support for the one-buck rule in Indiana

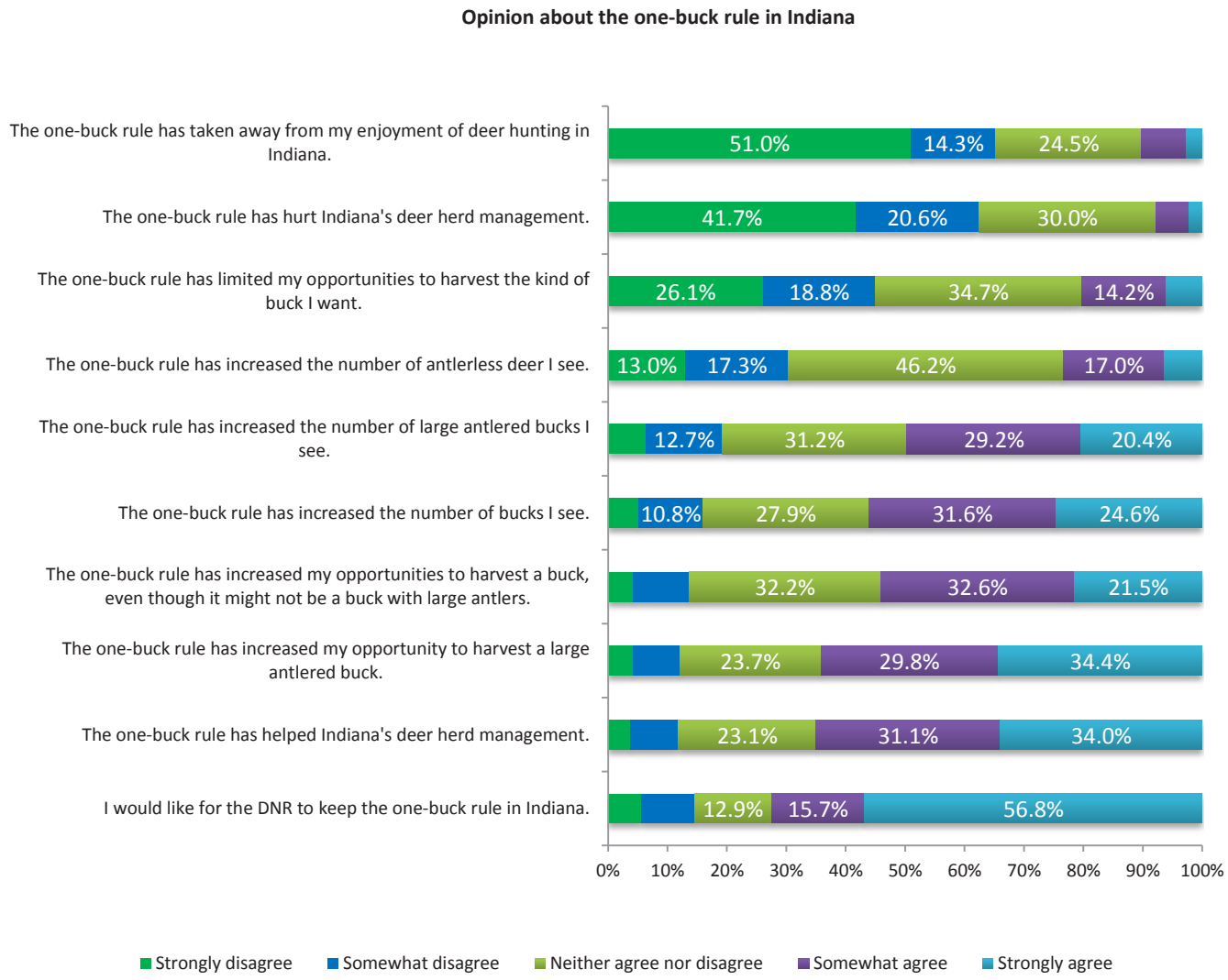


Figure 7-103. Hunters were asked to answer questions related to the one-buck rule in Indiana.

possibly looking for new places to hunt or new challenges.

We used a t-test to examine if hunters who use a guide and those who do not use a guide experience differences in their level of enjoyment in the hunt. Those who used a guide for hunting had a mean enjoyment score of 79.8 (out of 100) and a median score of 87. Those hunters who did not use a guide for hunting had a mean enjoyment score of 78.7 and a median score of 85. There was no statistical relationship between those who used a guide for hunting and those who did not in their level of enjoyment (P=.53; Cohen's d=0.46; difference between no and yes = -1.09; CI_{95} = -4.51 to 2.33).

As a measure of success, we used a ranked t-test and a t-test to examine the number of does and bucks, respectively, harvested between those who used a guide service and those who did not. On average, those who used a guide harvested fewer does (mean=0.36 does) when compared with those individuals who did not use a guide (0.47 does; P<0.001; Cohen's d=0.251). There was a slight difference between the number of bucks harvested between those individuals who used a guide (0.40 bucks) and those who did not use a guide (0.35 bucks) but it was not statistically different (P=0.165; Cohen's d=0.110; difference between no and yes = 0.056; CI_{95}= -0.02 to 0.136). Of those who used a guide and reported the number of does taken (n=176), 80% reported that they did not harvest a doe, 15% harvested one doe, 4% harvested two does, and 1% harvested four does. No hunter with a valid response reported harvesting more than four does.

Evaluation of the One-buck Rule – Currently in Indiana, only one buck can be harvested per hunter in most cases. Exceptions to this are for special management purposes, such as Deer Reduction Zones that allow hunters to harvest an additional buck in select areas after they harvest a doe, in state parks as part of reduction

hunts, or on military bases. This is typically known as the "one-buck rule." The one-buck rule was implemented in 2002. In 2011, Indiana evaluated the one-buck rule as part of the Indiana Deer Hunter Survey (Responsive Management 2011) that was conducted via a phone-based survey. Occasionally, Indiana DNR receives questions or comments about the one-buck rule for which we need to understand the opinions of hunters about this regulation. To update the data on the opinions about the one-buck rule, Indiana DNR asked similar or the same questions from the 2011 survey (Responsive Management 2011) in the 2019 Deer Management Survey.

Indiana DNR asked hunters Do you support or oppose the one-buck rule. We found that 77.5% supported the one-buck rule to some degree with 59.8% (n=12,659) of hunters selecting Strongly support and 17.7% (n=3,751) of hunters selecting Moderately support the one-buck rule (**Figure** 7-102). This was an increase in support from the 2011 survey in which 65% reported they supported the one-buck rule with Strongly support being the most selected option. Only a small portion opposed the one-buck rule with 4.5% (n=942) selecting Strongly oppose and 9.9% (n=2,085) selecting Moderately oppose the one-buck rule. This was a decrease in opposition from 2011 when 23% opposed the one-buck rule (approximately evenly divided between Strongly oppose and Moderately oppose; Responsive Management 2011). The remaining 8% Neither supported nor opposed the one-buck rule, and only 0.1% (n=30) Did not know what the one-buck rule was.

Indiana DNR asked hunters how much they agreed or disagreed with several statements related to the one-buck rule (**Figure** 7-103). There was strong disagreement regarding the statements The one-buck rule has taken away from my enjoyment of deer hunting in Indiana (65.3% disagreed to some degree) and The one-buck rule has hurt Indiana's deer herd management (62.3% disagreed to some degree; **Figure** 7-103). There was strong agreement with the statements The one-buck rule has helped Indiana's deer herd management (65.1% of hunters agreed to some degree), The one-buck rule has increased my opportunity to harvest a large-antlered buck (64.2% agreed to some degree), and I would like for the DNR to keep the one-buck rule in Indiana (72.5% agreed to some degree; **Figure** 7-103). Only 14.5% disagreed with the statement I would like for the Indiana DNR to keep the one-buck rule in Indiana (**Figure** 7-103). Responsive Management (2011: page 131) reported that hunters agreed to some degree with the statements The one buck rule has increased opportunities to harvest a big buck (54%); The one-buck rule has increased opportunity to harvest a buck, even though it might not be a buck with large antlers (54%); The one-buck rule has helped Indiana's deer herd management (52%); and The one-buck rule has increased the number of bucks seen (no data provided). Only 47% agreed to some degree that The one-buck rule has increased the number of big bucks seen, and 38% agreed to some degree that The one-buck rule has increased the number of antlerless deer seen. Responsive Management (2011: page 131) also reported that hunters disagreed to some degree with the statements The one-buck rule has taken away from the enjoyment of deer hunting in Indiana (63%); The one-buck rule has hurt Indiana's deer management (54%); and The one-buck rule has limited their opportunities to harvest the kinds of bucks they want (48%).

In general, hunters consistently support the one-buck rule, and support appears to have increased over time. In the 2018 survey, Indiana DNR asked a question related to the one-buck rule. Hunters were asked to express their desire for a change to The number of antlered bucks that a hunter can legally harvest, and 70.8% selected No change (**Figure** 7-70. This is further evidence for retaining the one-buck rule. Part of this support is likely due to the perception of an increase in higher-quality bucks over time. The one-buck rule has coincided with an increase in the age structure of harvested bucks in Indiana (unpublished data). Older deer generally result in deer with larger antlers with all other factors being held constant (i.e., similar food resources, deer density, and genetics). We speculate that the one-buck rule also leads to higher-quality deer because it requires greater selectively by hunters because hunters can only harvest one buck, and there is no second chance to harvest a better deer later in the season. There is no evidence to suggest that this trend in hunters desiring better-quality deer will wane over time and, therefore, support for the one-buck rule in Indiana is likely to remain high.

Literature Cited

Fleegle, J. T., C. S. Rosenberry, and B. D. Wallingford. 2013. Use of citizen advisory committees to direct deer management in Pennsylvania. Wildlife Society Bulletin 37:129-136.

Johnson, K. N., R. L. Johnson, D. K. Edwards, and C. A. Wheaton. 1993. Public participation in wildlife management: opinions from public meetings and random surveys. Wildlife Society Bulletin 21:218-225.

Responsive Management. 2011. Deer Management and Deer Hunting in Indiana. Conducted for the Indiana DNR by Responsive Management. Responsive Management, Harrisonburg, Virginia, USA.

Wisconsin DNR. 2016. County Deer Advisory Councils Governance of Operations. Wisconsin DNR, Madison, Wisconsin, USA.

CHAPTER 8. CITIZEN SCIENCE

Citizen science is public participation in data collection and analysis of natural resources. The Indiana Department of Natural Resources (DNR) seeks assistance from citizen scientists as an alternative way to collect data traditionally obtained by biologists. Citizen science provides the public an opportunity to participate in resource management and allows for collection of a wider set of data from a broader scale, thus saving Indiana DNR time and resources. Currently, the Deer Research Program relies on citizen scientists for three projects: Snapshot Indiana, the Archer's Index, and the After Hunt Survey.

SNAPSHOT INDIANA

Joe Caudell, Olivia Vaught, Emily McCallen, and Gerianne Albers, *Indiana Department of Natural Resources*

Snapshot Indiana is a citizen science project that uses trail cameras to collect data on a variety of wildlife species in Indiana. Remote-trigger cameras, aka trail cameras, can be a useful tool for DNR wildlife managers because data can be collected with only a moderate amount of effort, and photos allow for easier identification than other types of surveys. Photos can provide a variety of data, including whether a species is expanding into new counties, long-term population trends, activity patterns, or documentation of uncommon species (e.g., American badger, ***Taxidea taxus***). The Deer Research Program is working on analyzing these data as a measure of doe:buck ratios and fawn:doe ratios.

A doe:buck ratio measures the number of does relative to the number of bucks in an adult deer population. In general, a deer population with a balanced ratio of males to females is characteristic of an unhunted population and is generally considered a desirable trait for deer management. A fawn:doe ratio is the number of fawns present per adult doe. Fawn:doe ratios have several management implications, depending on the time of year the ratios are measured. Fawn:doe ratios measured just before birth (i.e., the number of fawns counted in the uterus of road-killed or selectively shot deer) are useful for estimating birth rate. Fawn:doe ratios observed in the fall, just prior to deer hunting season and/or in early archery season, are a measure of recruitment, or the number of new deer that will enter the hunting population.

Each year, trail cameras are sent to volunteers who meet certain criteria. They must have at least 10 acres and cannot have bait or feeders for wildlife near where the camera is set. Volunteers receive training on how to set up and use cameras. Cameras are set for at least 30 consecutive days during October and November. Biologists review the photos and record the number of bucks, does, and fawns seen in each photograph. Photographs are then reviewed for duplicates in a short period of time (i.e., when individual deer continually walk in front of cameras). Such photos are removed before analysis for fawn:doe ratios, resulting in a total count of only unique events. A minimum number of individuals (MNI) is calculated for each camera, based on what appear to be unique individuals for each camera. The MNI value is likely more conservative than total counts for unique events. The analysis is conducted on statewide observations and regional deer management units. Finally, 95% confidence intervals (CI_{95}) are calculated for statewide and regional means.

In the 2017 Indiana White-tailed Deer Report, we reported fawn:doe and buck:doe ratios by region (Caudell and Vaught 2018) based on approximately 75% of the completed data. Final 2017 data revealed a total of 37,080 photos taken on 75 cameras during 2,435 camera trap nights. White-tailed deer were the most commonly detected species, with 2,753 detection events and 113.1 detections/100 camera trap nights.

The 2018 photos are still being processed. Thus far, approximately 80% of more than 39,000 photos have been analyzed. Of those photos, just over 19,000 were of white-tailed deer. Final analyses, fawn:doe ratio calculations, and buck:doe ratio calculations will be completed and reported in the 2019 Indiana White-tailed Deer Report.

Currently, there are plans to expand the Snapshot Indiana program to new volunteers, state lands, and other underrepresented areas. Photographic data have the potential to serve as a method for developing long-term datasets for a variety of metrics, such as recruitment, buck quality, age ratios, and sex ratios. Individuals desiring to volunteer can sign up for the Snapshot Indiana program at on.IN.gov/snapshotindiana.

Literature Cited

Caudell, J.N. and O.D.L. Vaught. 2018. 2017 Indiana White-tailed Deer Report. Indiana Department of Natural Resources, Bloomington, Indiana.

ARCHER'S INDEX

Joe Caudell, Olivia Vaught, Emily McCallen, and Gerian Albers, *Indiana Department of Natural Resources*

Archery hunters play an important role in monitoring the abundance of furbearer and other wildlife species in Indiana. Since the early 1990s, Indiana archery hunters have voluntarily shared their wildlife observations with DNR as a way to monitor trends in statewide wildlife populations. The partnership between archery hunters and DNR has provided a consistent and inexpensive method for monitoring many wildlife species. The Division of Fish & Wildlife (DFW) Furbearer Program currently manages the Archer's Index, and has shared their data on deer observations for analysis in the White-tailed Deer Report. The complete Archer's Index report is available on a yearly basis and contains indices for a number of furbearer species. See previous Archer's Index reports by typing "Archer's Index" in the search box at wildlife.IN.gov/3352.htm. Volunteers may sign up to participate in the Archer's Index online at on.IN.gov/archersindex.

Methods

Prior to the archery hunting season, hunters who volunteered to participate in the survey were sent a standardized survey form and directions for recording wildlife observations. Hunters were asked to record the number of hours spent hunting each day, noting either morning or evening hunts, and the total number of each wildlife species observed daily.

Historically, the survey ended on the same day as the early archery season, typically in late November. However, regulation changes were implemented in 2012 that extended the Archery season to one continuous season that ended in early January. Since then, the Archer's Index has ended one day prior to the opening of firearms season to ensure an unbiased and standard survey period. After the end of the survey period, participants returned their completed survey form to DNR.

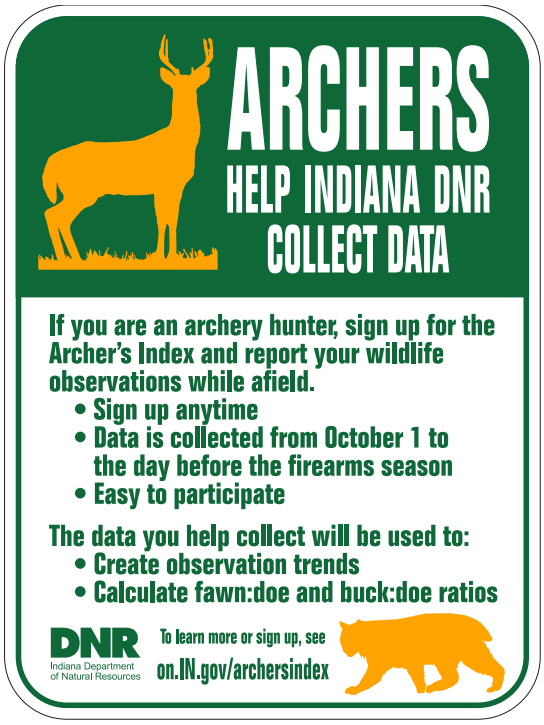
Population indices were tabulated by dividing the total number of each wildlife species sighted by the total number of hours hunted. Observations per hour, fawn:doe ratios, and doe:buck ratios were calculated statewide and at a regional level based on the ten deer manage-

ment units (DMU) the Deer Research Program created, in partnership with Purdue University, to better understand deer trends across broad habitats (**Figure** 8-1). Statewide results are reported in this section and regional results are reported in the DMU Data Sheets section. Confidence intervals (CI95) were calculated for observations per hour each year.

Results and Discussion

In 2018, 243 hunters in 86 counties reported deer observations in the Archer's Index. Hunters observed a total of 10,442 deer in 12,325 hours during 3,822 observational periods ranging from 0.5 to 10 hours. Hunters observed an average of 0.86 deer per hour (n= 3,822, SD=1.20, CI95=0.04; **Figure 8-2**). A total of 2,666 bucks, 4,346 does, 2,381 fawns, and 1,049 deer of an undetermined age and sex were observed. From the Archer's Index, the statewide fawn:doe ratio was 0.54:1 (SD= 0.014, CI95=0.027) and the buck:doe ratio was 1.63:1 (SD=0.040, CI95=0.079). Comparatively, the harvest doe:buck ratio was 0.89:1 (SD=0.005, CI95=0.011; **Figure** 8-3).

The Archer's Index provides several measures or indices of the size, composition, and recruitment of the deer population and may be useful for monitoring its trends. However, because these values have not been measured against a known population, it is unclear how closely the values from these indices reflect true population values. Therefore, the results of the Archer's Index can only be used to monitor trends of deer population and not the actual size. One potential bias proposed by critics of citizen science observer indices is that fawn observations may be underrepresented. Older fawns can look similar to young does, especially if the fawns are not traveling with their doe. Thus, fawn:doe ratios and recruitment data may become skewed. However, the period when the Archer's Index occurs (October to mid-November) is considered an ideal time, because bias from fawns not traveling with their mother is minimized. Fawns are likely at their smallest body size, routinely traveling with their mother, and loss of the parent is minimized prior to gun season. Furthermore, if the fawn:doe ratios are biased in favor of does, due to misidentified fawns, then the doe:buck ratio would likewise be skewed toward does. This does not appear to be the case for our data, as



doe:buck ratios appear to be between 1.4:1 and 2:1 in most areas (see DMU sheets in the Appendices).

Fawn recruitment is the number of fawns that are born and survive to join the huntable population in the fall. The recruitment value is lower than the total number of fawns born each spring. Fawns die or are killed between birth and the hunting season due to predation, disease, exposure, abandonment, deer-vehicle collisions, haying operations, and other reasons. Therefore, the recruitment rate is almost always lower than the birth rate. For example, the reproductive characteristics of does were recently studied in Illinois. Green et al. (2017) found an average of 20.5% of recruited fawns and 85.5% of adult does were bred by the end of the breeding season. Their average litter size was 1.9 $\pm$ 0.54 fawns. In 2015, Illinois reported their statewide recruitment, based on their fawn:doe ratio, was 0.5:1 (QDMA 2016). Even though a large proportion of deer were bred, resulting in a high rate of births, fawns experienced a high rate of mortality. Fawn recruitment values can be used for several different purposes, including modeling for allowable buck and/or doe harvest and as an indicator of potential problems with a deer herd, such a slow growth rate.

Initially, it may appear that fawn:doe ratios are low for many of the DMUs and statewide. However, Indiana has similar fawn:doe ratios compared to nearby states, ac-

cording to the 2015 recruitment data reported to QDMA (2019): Ohio (0.60:1), Illinois (1.18:1), Michigan (0.47:1; QDMA 2015), or the Midwest average (0.81; QDMA 2019). Although these reported ratios are similar, caution should be taken when directly comparing fawn:doe ratios across states, because the methodology used to calculate the fawn:doe ratios are different. These differences are often based on how the data have been historically collected. For example, Ohio uses the ratio of fawns to does in the harvest, whereas Wisconsin calculates their fawn:doe ratios on a regional basis, using the total number of biologist observations of fawns and does (0.90:1 in 2017; QDMA 2019). It may seem that all states should use the same system, but for each state's deer management program, the long-term trend (i.e., index) is more important than a comparison with neighboring states. Therefore, readers must understand how the data are collected in other states prior to comparing to Indiana's fawn:doe ratios.

Currently, Indiana has an approximately balanced pre-hunt sex ratio (1.63:1). Balanced doe:buck ratios are generally considered to be desirable, because they increase the likelihood of all does being bred during the period when they are most receptive, a more condensed rut, and an earlier fawning season (Guynn and Hamilton 1986; Neuman et al. 2017).

Observations per hour is an index that can be used to examine long-term trends in the deer population. It is important to understand that this is an index of the population and does not represent population numbers or an expectation for hunters (i.e., if the average reported observation per hour is 1.1, hunters should not expect to see a deer every hour they are in the woods). The trend over the past 10 years apparently reflects the previous management strategy, with a decrease in observations that corresponds to a general management goal of decreasing the deer population by increasing harvest of does. Observations per hour have leveled off since 2013 (**Figure** 8-2), with only minor fluctuations since then.

Literature Cited

Guynn, D. C., and R. J. Hamilton. 1986. The effects of adult sex ratio on reproduction in white-tailed deer. Proceedings of the International Ranchers Roundup 1986:233-240.

Green, M. L., A. C. Kelly, D. Satterthwaite-Phillips, M. B. Manjerovic, P. Shelton, J. Novakofski, and N. Mateus-Pinilla. 2017. Reproductive characteristics of female white-tailed deer (Odocoileus virginianus) in the Midwestern USA. Theriogenology 94:71-78.

Neuman, T. J., C. H. Newbolt, and S. S. Ditchkoff. 2017. The influence of population demographics on white-tailed deer fawning season. Journal of the Southeastern Association of Fish and Wildlife Agencies 4:115-120.

QDMA. 2015. QDMA's Whitetail Report 2015: An Annual Report on the Status of White-tailed deer. Quality Deer Management Association, Bogart, Georgia, USA.

QDMA. 2019. QDMA's Whitetail Report 2019: An Annual Report on the Status of White-tailed deer. Quality Deer Management Association, Bogart, Georgia, USA.

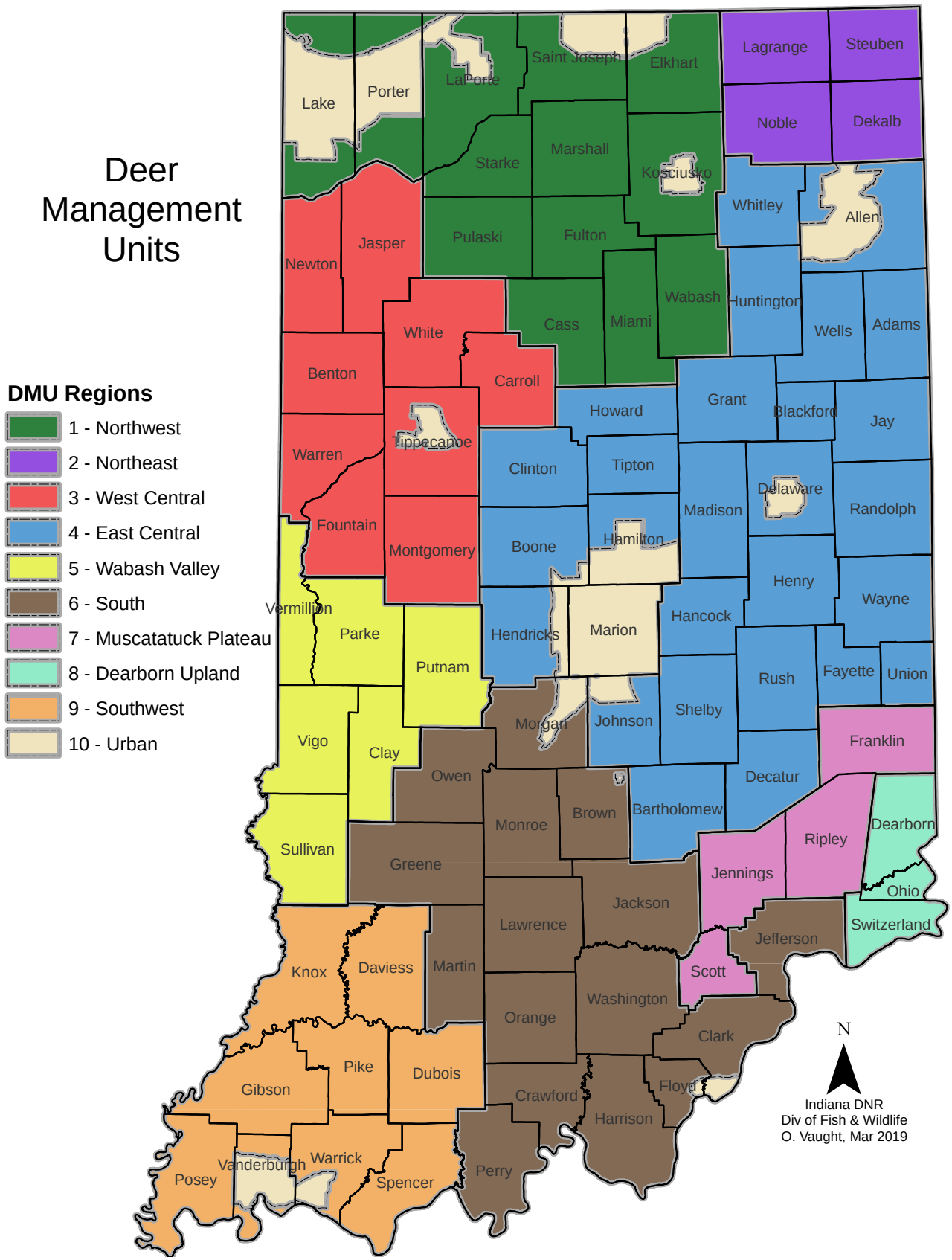


Figure 8-1. Deer management units (DMUs) created by DNR and Purdue University to better understand survey data trends regionally.

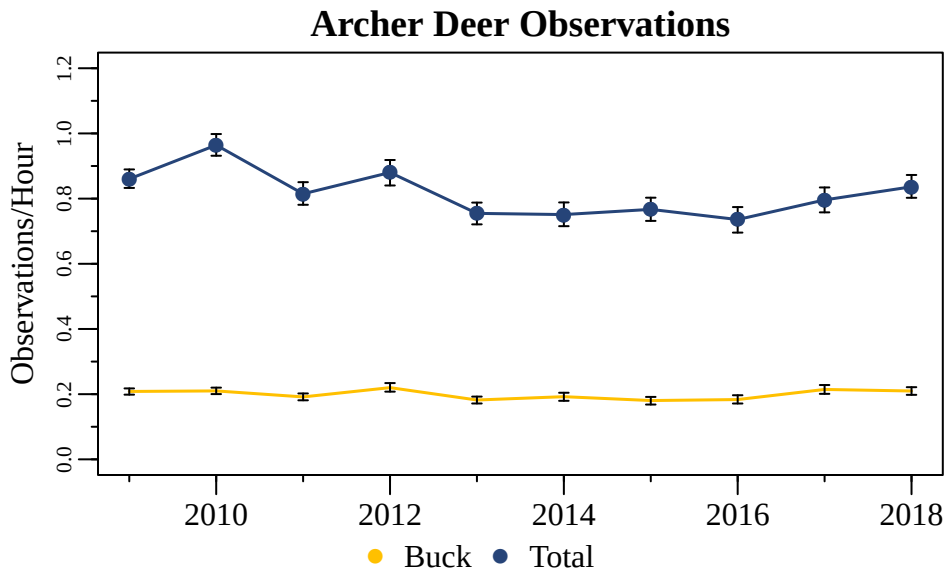


Figure 8-2. Statewide observations of bucks and total deer reported in the Archer's Index.

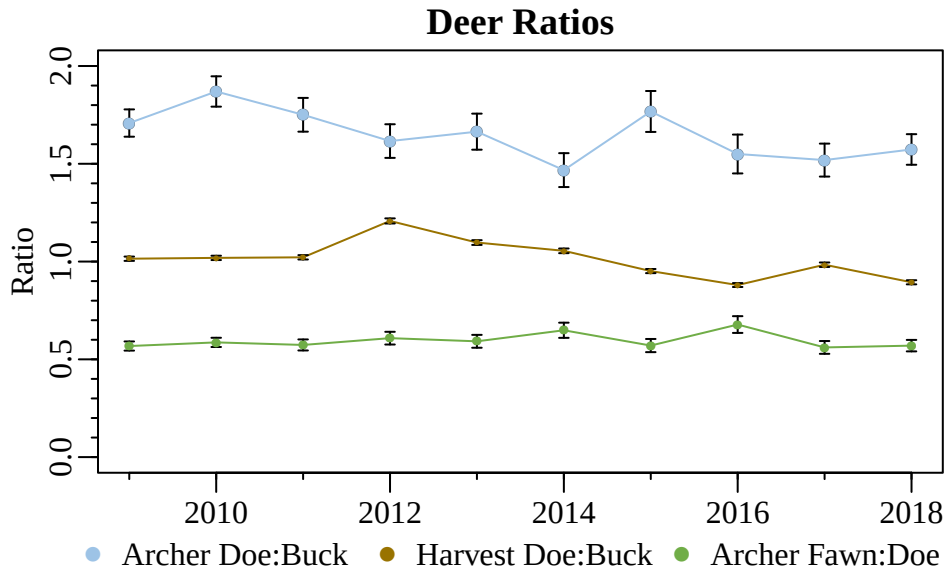


Figure 8-3. Statewide observation of doe:buck and fawn:doe ratios reported in the Archer's Index and the reported doe:buck harvest ratio from CheckIN Game data.

AFTER HUNT SURVEY

Joe Caudell, Olivia Vaught, and Emily McCallen, *Indiana Department of Natural Resources*

For many years, DNR biologists examined deer at physical check stations where hunters came to record their harvest. Biologists typically recorded age, sex, and other biological information that was useful for managing the deer herd. In 2015, Indiana moved to a completely online game check-in system to make the check-in process more convenient for hunters. In an effort to recapture this data, the Deer Research Program created the After Hunt Survey to allow successful hunters the opportunity to provide biological information about their deer. The goal of the After Hunt Survey is for hunters to self-report on a sufficient number of deer, so that both hunters and managers can better understand deer population biology, ecology, and demographics at the county level. The 2018-2019 deer season was the second year the survey was available to hunters. The sample size for most counties was not large enough to report survey results to the county level; therefore, results are reported at the regional and state levels.

Methods

The After Hunt Survey was administered using Qualtrics, an electronic survey system. When hunters completed the electronic check-in process for their deer, they were asked to participate in the survey. Hunters could also access the survey at a later time by visiting www.in.gov/dnr/fishwild/9813.htm and clicking on the link at the bottom of the page. Hunters were asked about the equipment used to harvest the deer, the location of harvest, the number of hours spent hunting for that deer, their opinion of that particular hunt, and biological information for that deer.

Results and Discussion

A total of 1,805 hunters responded to the survey, with at least one survey response from each county, which was a 6.5% decrease in responses from 2017-2018. County responses ranged from two to 49. Of these, 82.5% of responses were completed, while 17.5% were partially completed. To appropriately assess data at the county level, approximately 80-120 samples are needed from each county, depending upon the number of response categories for each question. However, survey data can be analyzed at a regional level based on DMUs (**Figure** 8-1). Regional sample sizes ranged from 80 responses (Muscatauck Plateau unit) to 488 responses (South unit; **Table** 8-1).

Hunters were asked to age their deer using tooth wear and replacement patterns. Hunters reported on the age of 375 does and 502 bucks; 329 does and 518 bucks were not aged. Sixty-one bucks were not aged, because they were going to be mounted and the hunters did not want to damage the skin. Statewide, most of the deer with reported ages were 2.5 years old (**Figure** 8-4). There were not enough ages reported to summarize the age structure by county. Age structures by region were similar to the statewide distribution, except for in the Northwest region where most of the aged does (31.3%) were 1.5 years old (**Figure** 8-5). Although the northeast had a much higher percentage of bucks 2.5 years old, the structure of age classes followed the same curve as other regions. The curve for does in the northwest was shifted forward, to a younger age class compared to all other regions. To verify reported ages and develop an error rate for the aged deer, hunters were asked to submit a photo of the jaw. Photos of only 19 jaws were submitted, and hunters provided ages for 12 of them. Half of the deer photos were aged correctly and the other half were aged to be younger than what the tooth wear indicated. Of those incorrectly aged, 11 were reported as being 1 year younger and 1 was reported as being more than 2 years younger than how they were aged by wildlife biologists. This indicates the age structure may be slightly older than what is indicated by the results. However, not enough photos were submitted to develop an error rate for the ages.

When used in conjunction with fawn:doe ratios, lactation rates can provide another point for estimating fawn recruitment. Estimating recruitment is especially useful for managers when setting harvest rates. Low fawn recruitment can indicate a need to change harvest quotas to account for fewer deer entering into next year's population. Hunters were asked to report on the lactation status of their harvested does, and 679 hunters responded with 161 lactating, 362 not lactating, and 156 not checked. From Oct. 1, 2018 to Jan. 6, 2019, 70 does > 2.5 years old were lactating, and 111 > 2.5

years old were not lactating (**Figure** 8-6). Very few does were reported during the first ten weeks of the season (mean=44.1) and the last five weeks of the season (mean = 30.8). During firearms season, hunters reported lactation rates for an average of 13 does per day. In order to report lactation rates at the county or regional level, the number of responses needs to increase considerably in future years. Current small sample sizes cause considerable variation in the data, making it difficult to analyze trends and to use in recruitment estimations.

Hunters were asked several opinion questions related to their hunting experience. On a scale of 0 (poor) to 100 (excellent), respondents were asked to rate their overall enjoyment of the hunt, the number of does they saw on the hunt, the number of bucks they saw on the hunt, the quality of bucks on the hunt, and how well DNR was managing deer in the county where they hunt. Responses from quality of bucks (n=1,561), quantity of bucks (n=1,590), and quantity of does (n=1,635) were bimodal (**Figure** 8-7). Responses about how well DNR was managing deer in the county where they hunt (n=1,550) and how much they enjoyed their hunt (n=1,685) were skewed toward the right, indicating a greater enjoyment of the hunt (**Figure 8-8**).

Hunters were asked to report on several characteristics of their harvested buck, including if the rack was typical or non-typical, the number of antler points, and the inside spread of the antler beams. Hunters reported 90% of the bucks that were harvested had a typical rack, while the other 10% were reported as being non-typical. The total number of points on harvested bucks was approximately normally distributed with an average of 7.6 points (n=826, SD=2.8, $CI_{95}\pm0.2$) and a median of eight points. The average inside spread of harvested bucks was 13.1 inches (n=681, SD=5.1, $CI_{95}\pm0.4$), with a median measurement of 14 inches.

In this survey, hunters were asked to report the weights of their deer. Hunters (n=494) reported the field-dressed weight of their deer only if it had been weighed on a scale. All the weights were converted to live weights by multiplying field dressed weight by 1.26 (**Figure 8-9**), which is the approximate difference between the live weight and field-dressed weight of a deer (Smart et al. 1973). There were not enough survey responses by county for each age class of deer to include in the County Deer Data section, nor were there enough responses for each age class by region to report. Deer weights can provide valuable information about the quality of deer and the relationship of deer recruitment to nutrition if the data is reported with a high enough frequency on a small scale (such as at the county or 16 square mile grid level). Reporting of weights by hunters needs to be significantly higher for this statistic to inform management.

Hunters were asked to report the number of hours they hunted for bucks and does separately. Hunters were also asked to report the number of bucks and does they observed while hunting during this time. The number of hours it took to harvest deer will eventually be used to calculate trends in harvest per effort, which can be used as an index for deer population size. These trends demonstrate there is a selective component in hunting, and any index should take into account these factors, especially when harvesting bucks, where the hours spent hunting per harvest may be higher than required to harvest does.

Hunters reported that they hunted for an average of 23.7 hours (n=1,001, SD=30.0, CI95+1.9) and a median of 12 hours before they shot their buck (**Figure** 8-10). During this time, hunters saw an average of 2.6 bucks (n=1,000, SD=3.1, CI95+0.2), with a median of two bucks, and an average of 4.9 does (n=997, SD=7.9, CI95+0.5), with a median of three does. Hunters reported that they hunted for an average of 16.7 hours (n=691, SD=23.1, CI95+1.8) and a median of eight hours before they shot their doe (**Figure** 8-10). During this time, hunters saw an average of 1.3 bucks (n=688, SD=4.2, CI95+0.3), with a median of zero bucks, and an average of 4.7 does (n=691, SD=6.4, CI95+0.5), with a median of three does. For this trend to be useful at the county and regional levels, a much higher level of reporting is required.

Hunters (n=697) who saw more than one buck when hunting were asked why they waited to harvest the buck they harvested. Approximately 25.8% (n=180) of hunters were waiting for a buck with larger antlers, 25.7% (n=179) of hunters were waiting for an older buck, 20.1% (n=140) of hunters reported that the other bucks were out of the range of their equipment, 8.2% (n=57) were waiting for a specific buck, and 7.7% (n=54) reported that the location where the buck was standing would not have been a safe shot. The remaining 12.5% (n=87) reported that it was another reason than those listed. Hunters

(n=673) who saw more than one doe while hunting were asked why they waited to harvest the doe they harvested. Approximately 32.2% (n=217) of hunters reported that they were waiting for a bigger, older doe, 25.7% (n=173) of hunters reported that the other does were out of range, 9.5% (n=64) of hunters passed up on does that had fawns with them, 8.9% (n=60) of hunters reported that the location where the doe was standing would not have been a safe shot, 6.2% (n=42) reported that they did not want to disturb the buck that was with the doe, and 2.7% (n=18) reported they were looking for a smaller, younger doe. The remaining 14.7% (n=99) of hunters reported that there was another reason why they passed on does that was not listed.

Hunters were asked to select a category of distance that best reflected the maximum range they would expect to kill a deer (either buck or doe) with one shot. As expected, high-powered rifles were reported as the equipment with the greatest range, with 77% of hunters selecting the maximum range being 150, 200, or >200 yards (**Table** 8-2). Shotguns, modern muzzleloaders, pistol caliber rifles, and traditional muzzleloaders were reported as having the second greatest range, with the majority of maximum ranges being 50 yards to 150 yards in over 80% of responses for each of these categories (Table 8-2). Crossbows and compound bows fell into similar categories, with maximum range being from 30 to 50 yards for over 93% of respondents. The maximum range for 95% of the respondents for traditional archery was 30 yards. Pistol and handguns had responses ranging from 30 yards to 200 yards, with 76% of the responses being 30 and 50 yards as the maximum.

Using a ranked ANOVA, we examined the relationship between how many hours hunters hunted before they shot their deer and the type of equipment used. There was no statistical relationship between equipment used and the time spent to shoot a buck ($P=0.107$; effect size=0.127; **Table** 8-3; **Figure** 8-11). There was a subtle, but statistically significant, relationship between the equipment used and time spent to shoot a doe ($P<0.001$; effect size=0.158; **Table** 8-4; **Figure** 8-11). The reported time spent to shoot a doe with a rifle and a compound bow and arrow was statistically less than was spent to shoot a buck with the same equipment (**Figure** 8-11). This is likely due to hunters being selective for the type of buck they were interested in harvesting. While equipment does affect the time spent to shoot a deer, there is such a large variation in hours spent hunting that it appears that the skill, selectivity, experience, and other characteristics of the hunter, as well as the weather conditions and other extrinsic factors, significantly affect the time to harvest a deer.

Conclusion

The After Hunt Survey shows potential for providing valuable biological data such as age, sex, and reproductive data. It may also serve as a mechanism for developing an index based on harvest per effort, which may be related to population size. However, this use of harvest per effort will need to be examined further. Reporting will need to significantly increase before it can be reliably used at the regional, county, or sub-county level. Advertising of this survey, such as in the hunt guide, through media outlets, and on social media, will need to increase to ensure a sufficient number of responses are obtained in order for this information to be used for management purposes.

Literature Cited

Smart, C. W., R. H. Giles, Jr., and D. C. Guynn, Jr. 1973. Weight tape for white-tailed deer in Virginia. Journal of Wildlife Management 34:53-555.

Table 8-1. Number of After Hunt Survey responses reported per deer management unit, 2018-19.

Management Unit	Responses	Number of Counties	% of Total Responses
1 Northwest	273	13	15.1%
2 Northeast	98	4	5.4%
3 West Central	141	9	7.8%
4 East Central	350	28	19.4%
5 Wabash Valley	149	6	8.3%
6 South	488	16	27.0%
7 Muscatatuck Plateau	80	4	4.4%
8 Dearborn Upland	85	3	4.7%
9 Southwest	141	9	7.8%
Total	1,805	92	

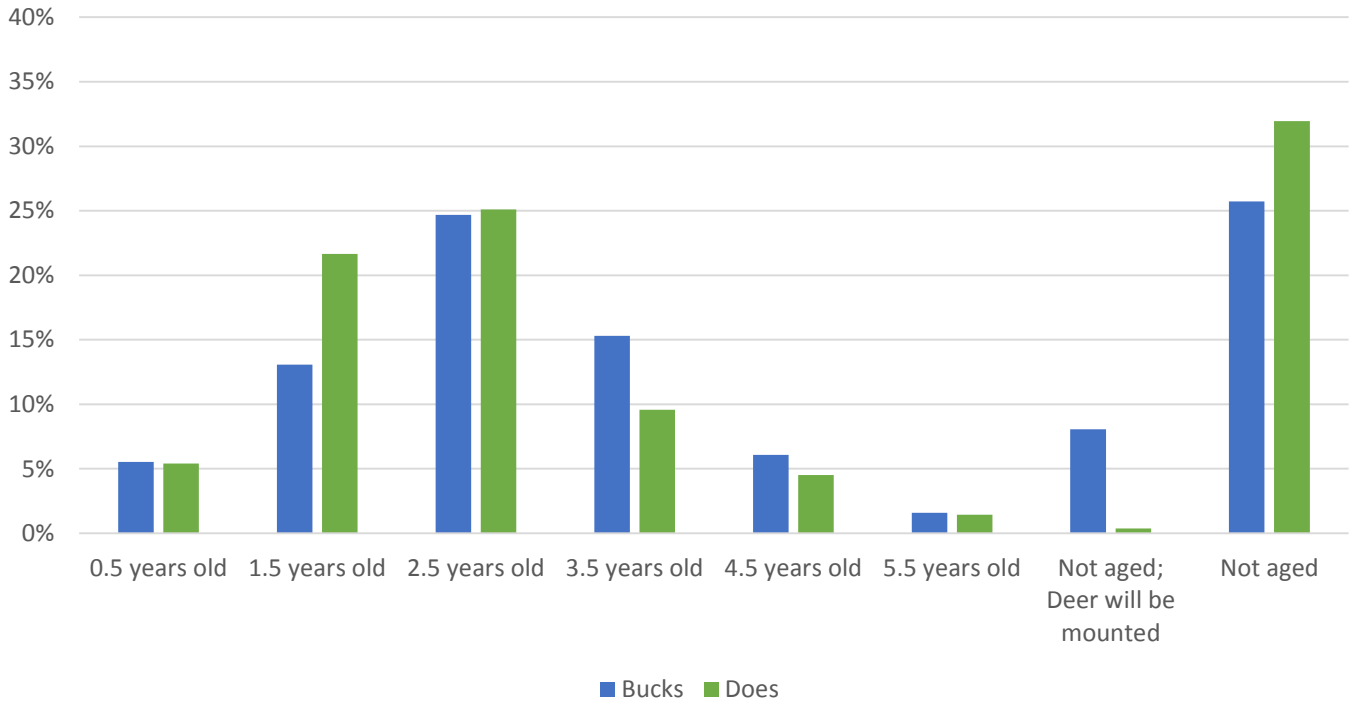


Figure 8-4. Statewide age distribution of harvested deer reported by hunters in the 2018-19 After Hunt Survey.

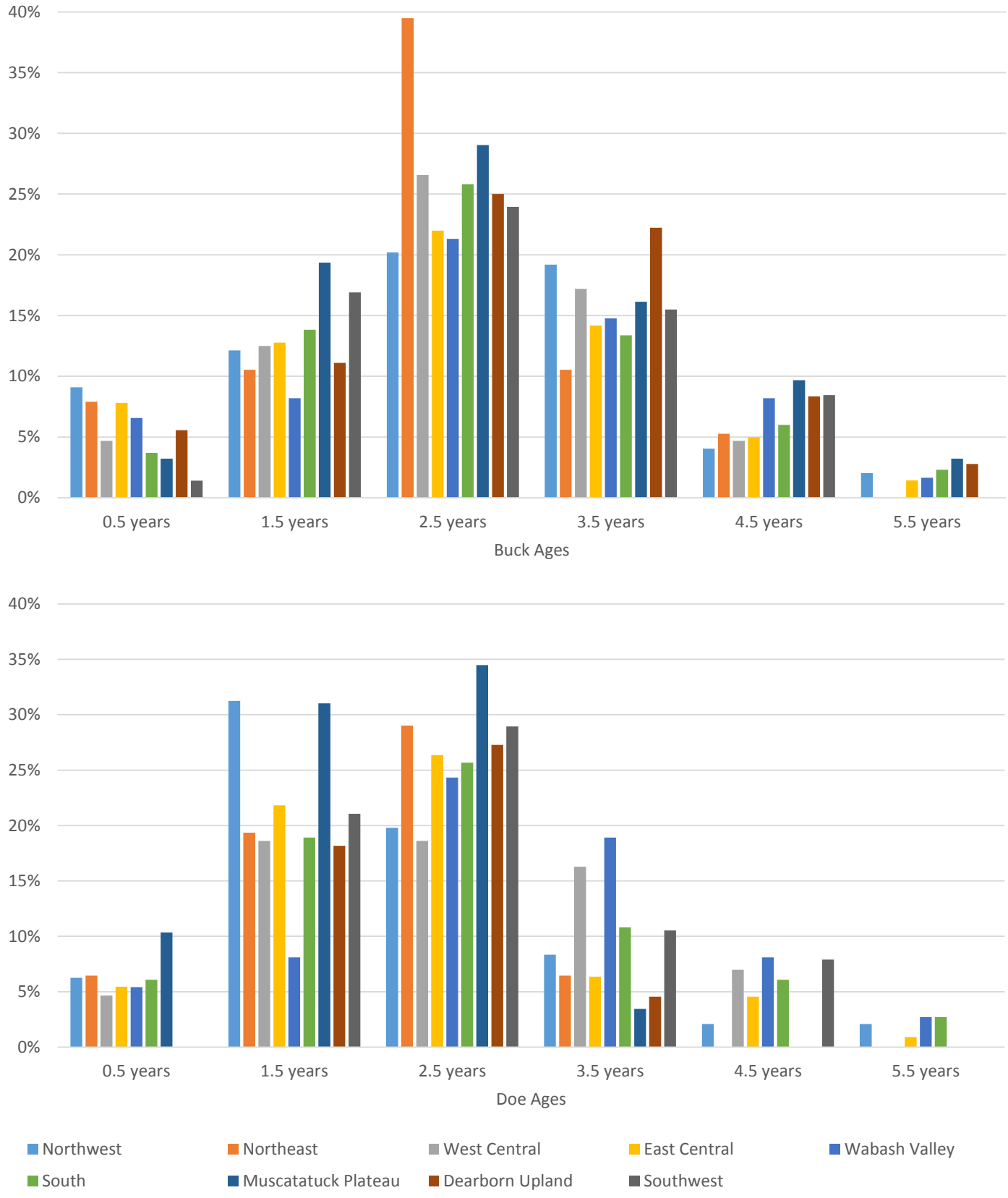


Figure 8-5. Regional age distributions of harvested bucks (upper graph) and does (lower graph) reported by hunters in the 2018-19 After Hunt Survey.

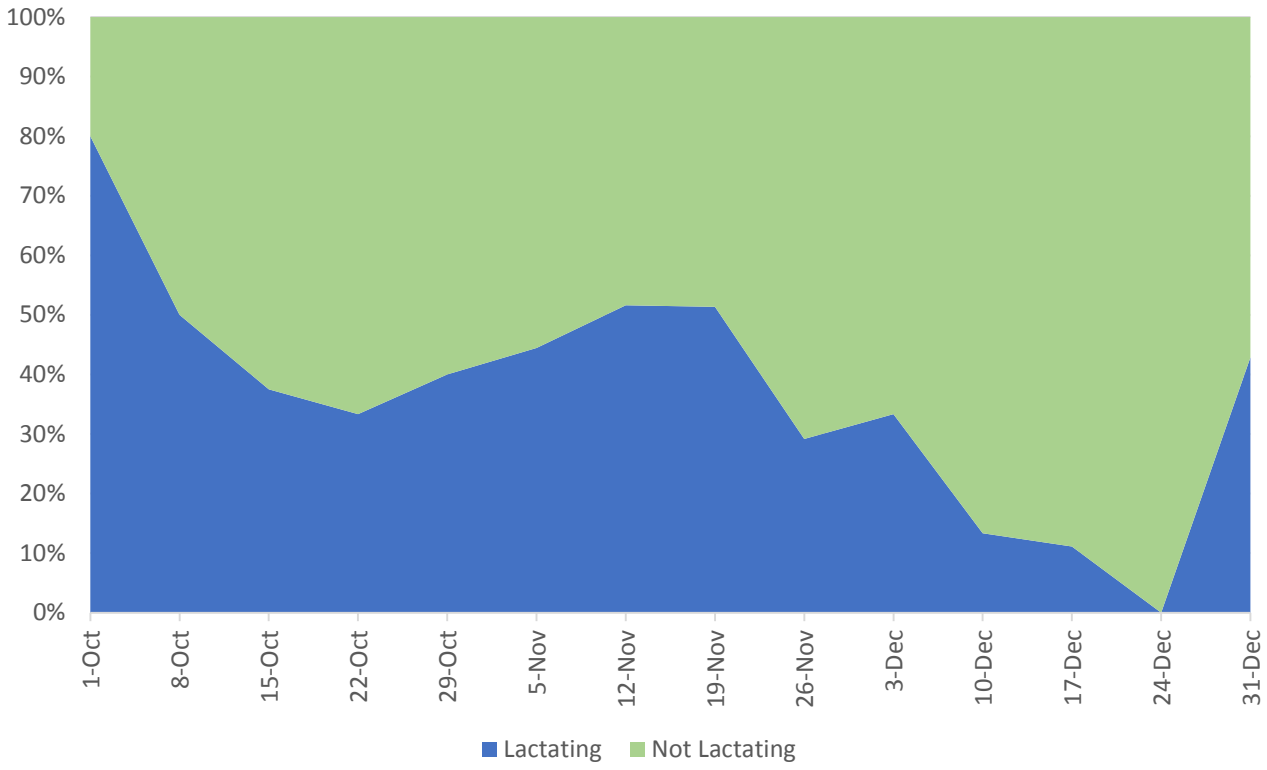


Figure 8-6. Percent of lactating and non-lactating does ≥2.5 years old reported in the 2018-19 After Hunt Survey for each week of the deer hunting season.

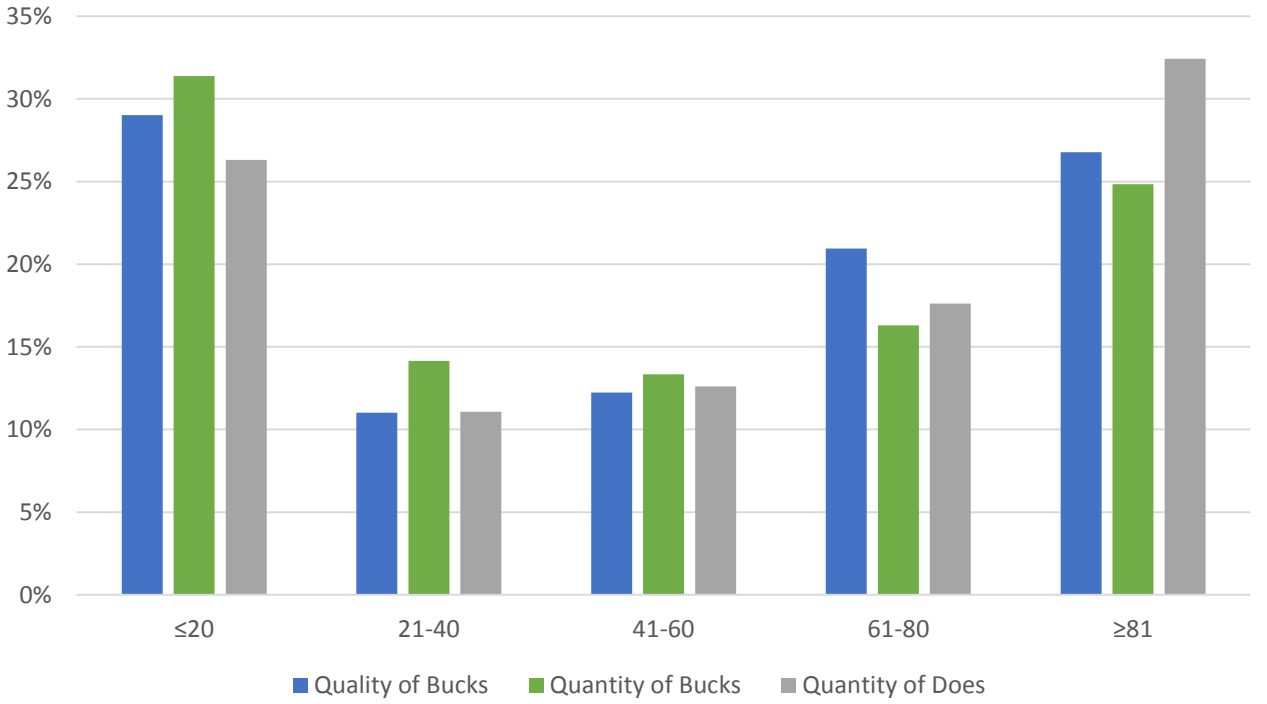


Figure 8-7. Hunter opinion about the quality of bucks, number of bucks, and number of does observed while hunting during the 2018-19 deer hunting season. Scores range from 0 (poor) to 100 (excellent).

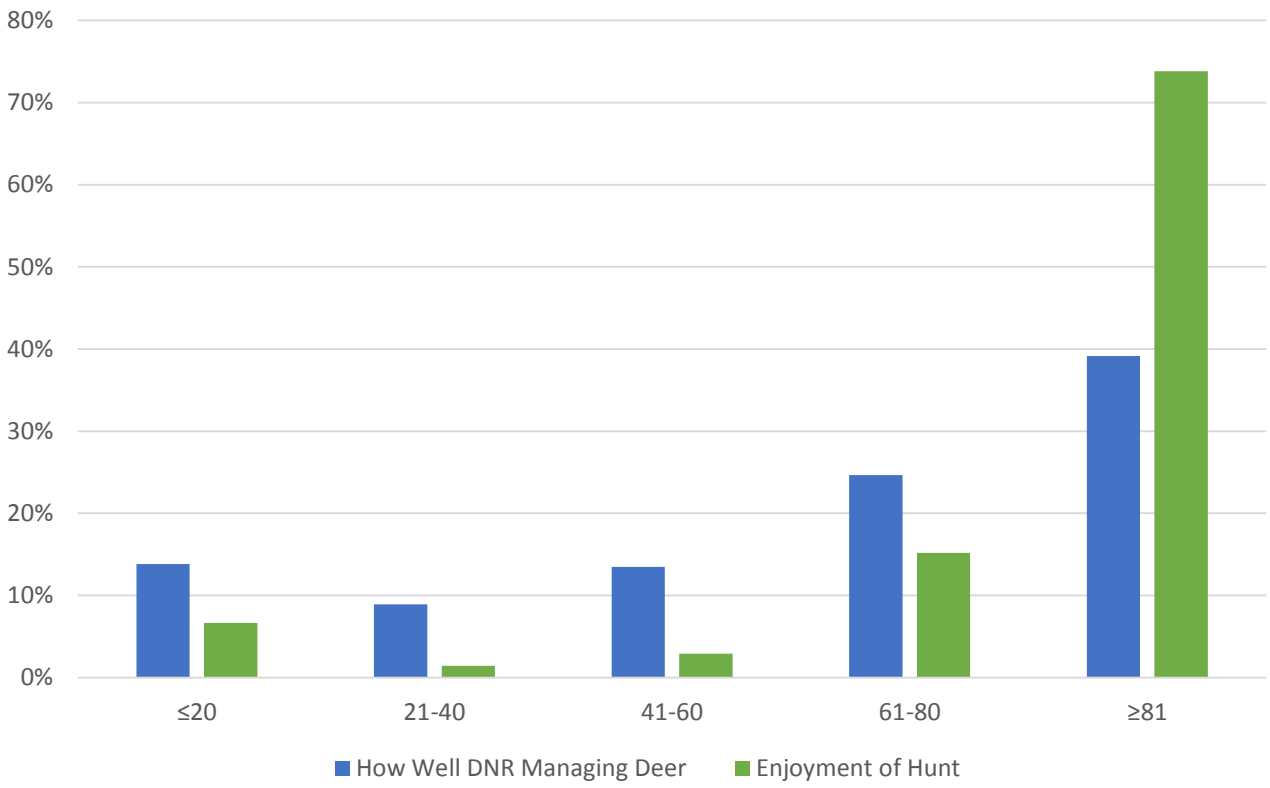


Figure 8-8. Hunter opinion about how well DNR is managing the deer in the county where they hunt and their enjoyment of the hunt during the 2018-19 deer hunting season. Scores range from 0 (poor) to 100 (excellent).

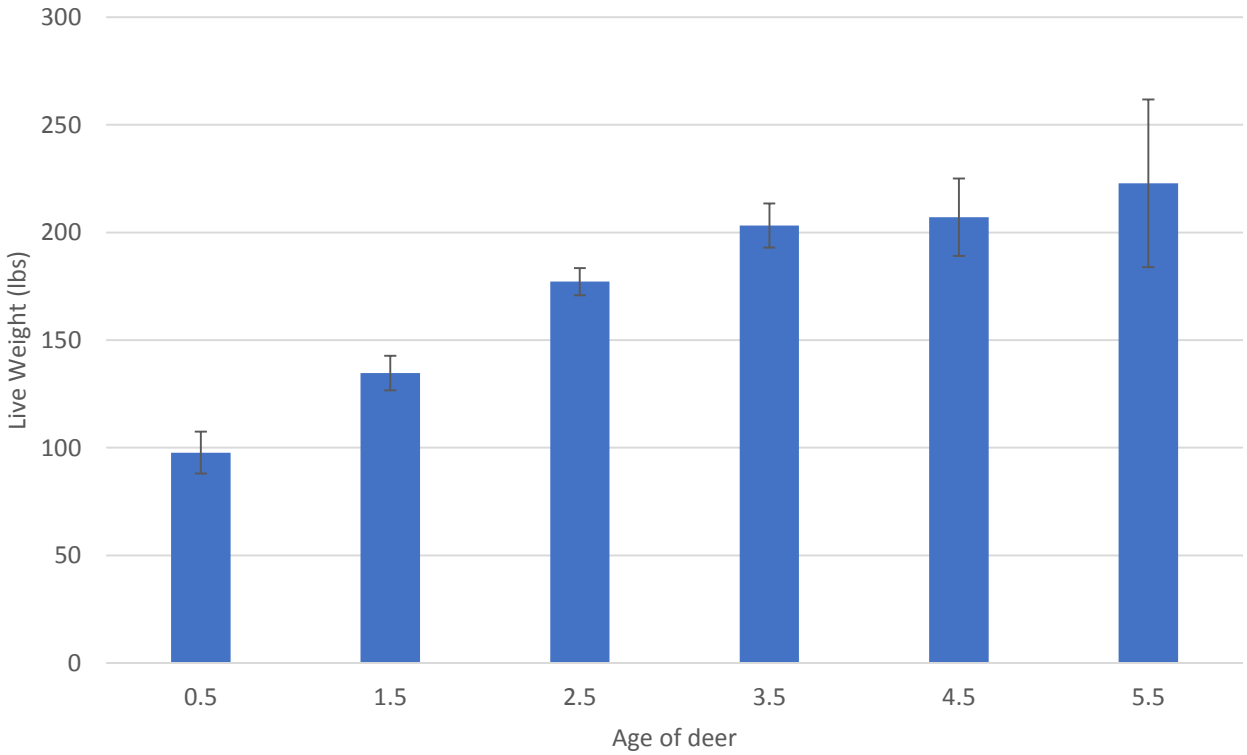


Figure 8-9. Live weights of deer by age class reported by hunters in the 201-19 After Hunt Survey. Of the 494 hunters that reported a weight, only 310 of them also reported the age of their deer.

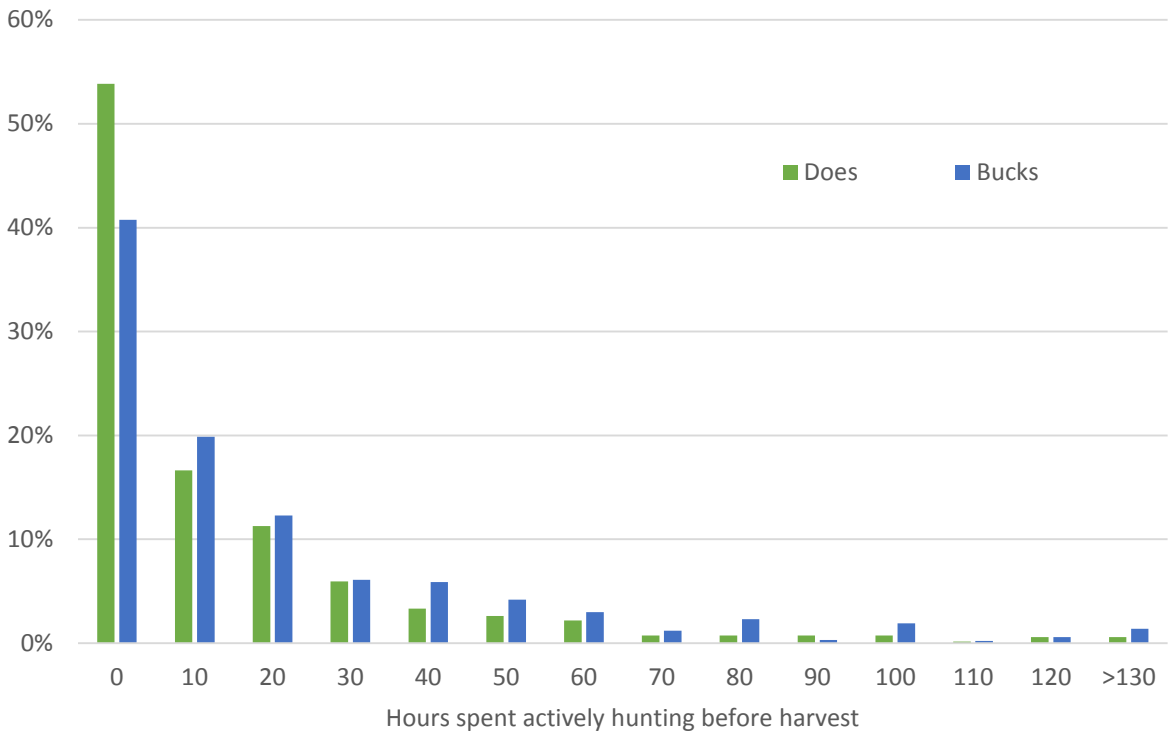


Figure 8-10. The number of hours hunters spent actively hunting before harvesting a buck or a doe during the 2018-19 deer hunting season, as reported in the 2018-19 After Hunt Survey.

Table 8-2. Estimated maximum distance by hunters that an equipment type can be used to kill a deer with one shot, as reported in the 2018-19 After Hunt Survey.

	n	Less than 10 yards	0 - 30 yards	0 - 50 yards	0 - 75 yards	0 - 100 yards	0 - 150 yards	0 - 200 yards	0 to more than 200 yards
High-powered Rifle	511	0.0%	2.5%	2.7%	5.1%	12.1%	24.9%	29.5%	23.1%
Shotgun	249	1.2%	7.6%	18.5%	26.1%	35.3%	9.6%	1.2%	0.4%
Modern Muzzleloader	220	0.0%	3.6%	4.1%	10.0%	34.1%	34.1%	10.5%	3.6%
Pistol-caliber Rifle	129	0.0%	1.6%	13.2%	13.2%	39.5%	26.4%	4.7%	1.6%
Traditional muzzleloader	22	0.0%	0.0%	13.6%	18.2%	45.5%	13.6%	0.0%	9.1%
Crossbow	294	0.7%	34.7%	58.5%	5.8%	0.3%	0.0%	0.0%	0.0%
Compound Bow	242	2.1%	47.5%	47.1%	2.9%	0.4%	0.0%	0.0%	0.0%
Traditional archery	12	8.3%	91.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pistol or handgun	8	0.0%	37.5%	37.5%	0.0%	12.5%	0.0%	12.5%	0.0%

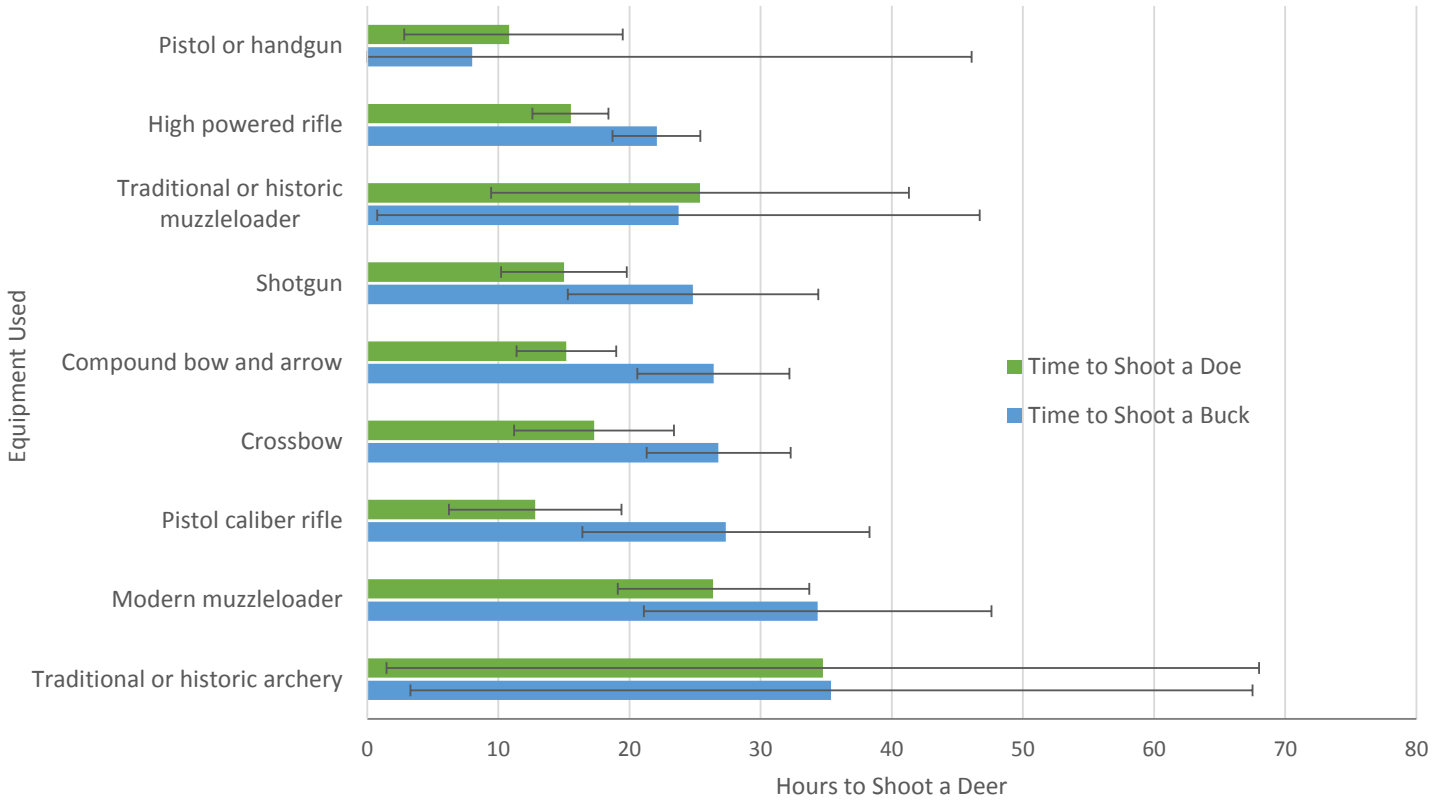
Table 8-3. Time spent to shoot a buck by equipment type, as reported by hunters in the 2018-2019 After Hunt Survey.

Group	Average	Median	Sum	Sample Size	95% CI	Standard Deviation
Traditional or historic archery	35.4	20.0	283.0	8	3.30 to 67.5	38.4
Modern muzzleloader	34.3	19.0	3,400.6	99	21.1 to 47.6	66.3
Pistol caliber rifle	27.3	14.0	2,160.0	79	16.4 to 38.3	48.8
Crossbow	26.8	15.0	4,417.5	165	21.3 to 32.3	35.7
Compound bow and arrow	26.4	15.0	3,514.5	133	20.6 to 32.2	33.7
Shotgun	24.8	10.0	4,422.0	178	15.3 to 34.4	64.4
Traditional or historic muzzleloader	23.8	11.5	237.5	10	0.757 to 46.7	32.1
High powered rifle	22.1	11.0	7,134.6	323	18.7 to 25.4	30.6
Pistol or handgun	8.0	8.0	16.0	2	-30.1 to 46.1	4.2

Table 8-4. Time spent to shoot a doe by equipment type, as reported by hunters in the 2018-2019 After Hunt Survey.

Group	Average	Median	Sum	Sample Size	95% CI	Standard Deviation
Traditional or historic archery	34.8	30.5	139.0	4	1.49 to 68.0	20.9
Modern muzzleloader	26.4	10.0	3,139.3	119	19.1 to 33.7	40.1
Traditional or historic muzzleloader	25.4	22.0	304.5	12	9.45 to 41.3	25.1
Crossbow	17.3	6.0	2,232.7	129	11.2 to 23.4	35.0
High powered rifle	15.5	8.0	2,905.8	187	12.6 to 18.4	20.1
Compound bow and arrow	15.2	10.0	1,653.5	109	11.4 to 19.0	20.0
Shotgun	15.0	6.0	1,066.5	71	10.2 to 19.8	20.3
Pistol caliber rifle	12.8	6.0	627.8	49	6.24 to 19.4	22.9
Pistol or handgun	10.8	10.5	65.0	6	2.19 to 19.5	8.2

Figure 8-11. Graphical representation of time spent to shoot a deer by equipment type, as reported by hunters in the 2018-2019 After Hunt Survey.



CHAPTER 9. DNR DEER RESEARCH

EVALUATING THE EFFECTIVENESS OF DRZ CORRIDORS ON DEER-VEHICLE COLLISION HOTSPOTS

Joe Caudell and Olivia Vaught, *Indiana Department of Natural Resources*

Since 2012, Deer Reduction Zones (DRZs) have been established in localized areas across more than a dozen counties. DRZs mitigate deer-related problems faced by communities while allowing hunters additional opportunities to harvest deer. In 2018, Indiana DNR established new DRZ corridors along segments of major roadways that had high rates of deer-vehicle collisions (DVCs). We analyzed the 2012-2017 DVC data reported to INDOT using a hotspot analysis technique in the ArcGIS mapping software to identify road segments with DVC rates statistically higher than what would be expected if the collisions occurred by random chance.

DVC hotspots were identified along several sections of major roads in Brown, Dearborn, Dekalb, Fulton, LaGrange, Madison, Monroe, Steuben, and Wabash counties (see wildlife.IN.gov/8534.htm for more details). In order to mitigate this conflict, Indiana DNR designated a DRZ corridor extending ½ mile to either side of the centerline of the identified road segments in these counties. Hunting was allowable on the entirety of any parcel of land that was intersected by the DRZ corridor.

The goal of the DRZ corridors is to target localized deer-human conflicts along roads and to evaluate the effectiveness of DRZs as a tool to mitigate DVCs. When selecting a segment of road for a DRZ corridor, we also selected a non-included segment of road to serve as a control. After the DRZ corridors have been in place for a few hunting seasons, we will evaluate the number and rates of DVCs along these segments of road compared to those of the previous years and to the control segments of road outside of the DRZ. This will help us determine if the number or rates of DVCs decreased as a result of the DRZ corridor. Analyses will begin after the 2019-2020 hunting season.

DRZ harvest numbers can be found in Chapter 3 of this report. DVC data can be found in Chapter 5 of this report.

EFFECTS OF HIGH-POWERED RIFLE LAW

Joe Caudell and Olivia Vaught, *Indiana Department of Natural Resources*

The Indiana State Legislature passed House Enrolled Act 1231 in early 2016. It allowed additional rifle options for deer hunting on private land only. The new rifle options required a barrel length of at least 16 inches, cartridge case length of at least 1.16 inches, and cartridges that fired bullets with a diameter of .243 inches or .308 inches only. Previous rifle restrictions still applied for deer hunting on public land. The new law also approved the use of handguns that fire the 10mm Automatic or .40 Smith & Wesson cartridges for deer hunting wherever firearms are legal to use. House Enrolled Act 1231 requires Indiana DNR to analyze the effects of the law on the deer population, harvest numbers, and public safety.

In 2017, Indiana Legislature passed House Enrolled Act 1415 that amended the size of rifle cartridges legal for deer hunting on private lands. Legal rifle cartridges must have a case length with a minimum 1.16 inches and a maximum 3 inches, and must fire a bullet with a diameter that is .243 inches (same as 6mm) or larger.

During the first year of the new legislation, hunters made a shift in the type of equipment used to harvest deer. Of those who hunted deer in 2015 using equipment types other than a rifle, 8,399 used a rifle to harvest at least one deer in 2016. By specific equipment type, more than 20% of the hunters who used a bow, crossbow, handgun, or muzzleloader in 2015 used a rifle in 2016, either in place of or in combination with non-rifle equipment (see 2016 Indiana White-tailed Deer Summary; deer.dnr.IN.gov).

In 2015, the number of hunters who harvested at least one deer using a rifle was 17,918 (**Figure 9-1**). That number increased by 92% in 2016 (n=34,347), and by an additional 2% in 2017 (n=35,025). In 2018, the number of hunters who harvested at least one deer using a rifle increased 5.5% (n=36,951) from 2017. Approximately 3,000 hunters in 2016 and just under 2,400 hunters in 2017 purchased a license for the first time and harvested at least one deer using a rifle. That number increased slightly in 2018, to 2,455 hunters. Hunters took 105% more antlered bucks with a rifle in 2016 than in 2015,

but 8% fewer in 2017 than in 2016 (**Figure 9-2**). In 2018, hunters harvested 12.4% more antlered deer with a rifle than in 2017. The shed buck, button buck, and doe harvests using a rifle in 2016 increased from 2015 by 49%, 76%, and 83%, respectively, but only button buck (13%) and doe (12%) harvests using a rifle increased in 2017. Antlerless harvest using a rifle decreased by 3.8% in 2018.

In 2016, the total number of antlered deer harvested across all equipment types was only 1% higher than 2015. Additionally, the 2016 total harvest was 4% lower than 2015, indicating a shift in equipment type used to harvest deer rather than the number of deer harvested. Harvests using muzzleloaders, shotguns, and handguns saw the largest declines in both 2016 and 2017 (Figure 9-2). In 2018, the number of deer harvested using a shotgun decreased by 11.9% compared to 2017.

Indiana DNR, Indiana DNR Law Enforcement, and Indiana Hunter Education keep a close eye on hunting-related incidents. During the 2016, 2017, and 2018 deer hunting seasons, there were no confirmed reports of injury or damage to property as a result of high-powered rifles.

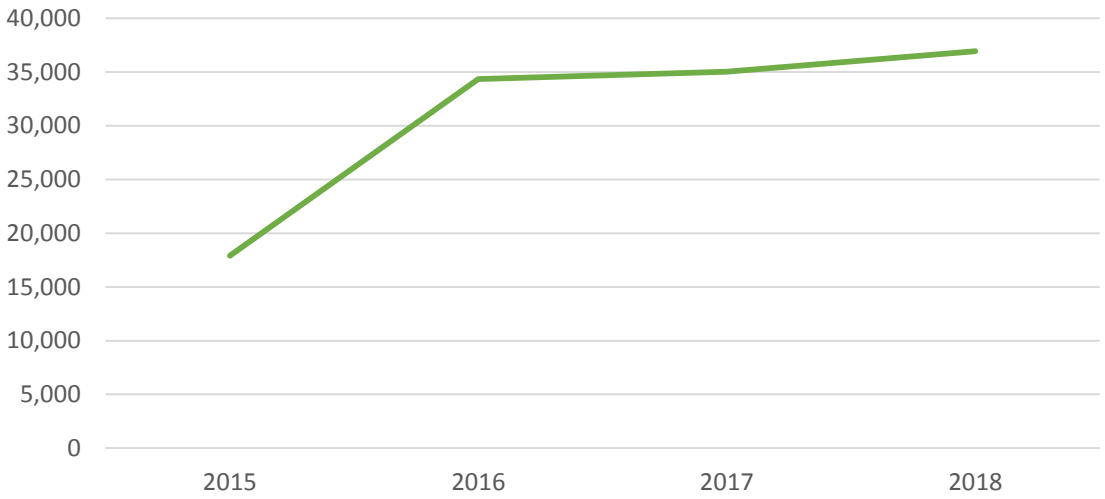


Figure 9-1. Number of hunters who used a rifle to harvest at least one deer during the hunting season, 2015-2018. Reporting error rates: ±0.61% (2018), ±1.44% (2017), ±0.73% (2016), and ±0.95% (2015).

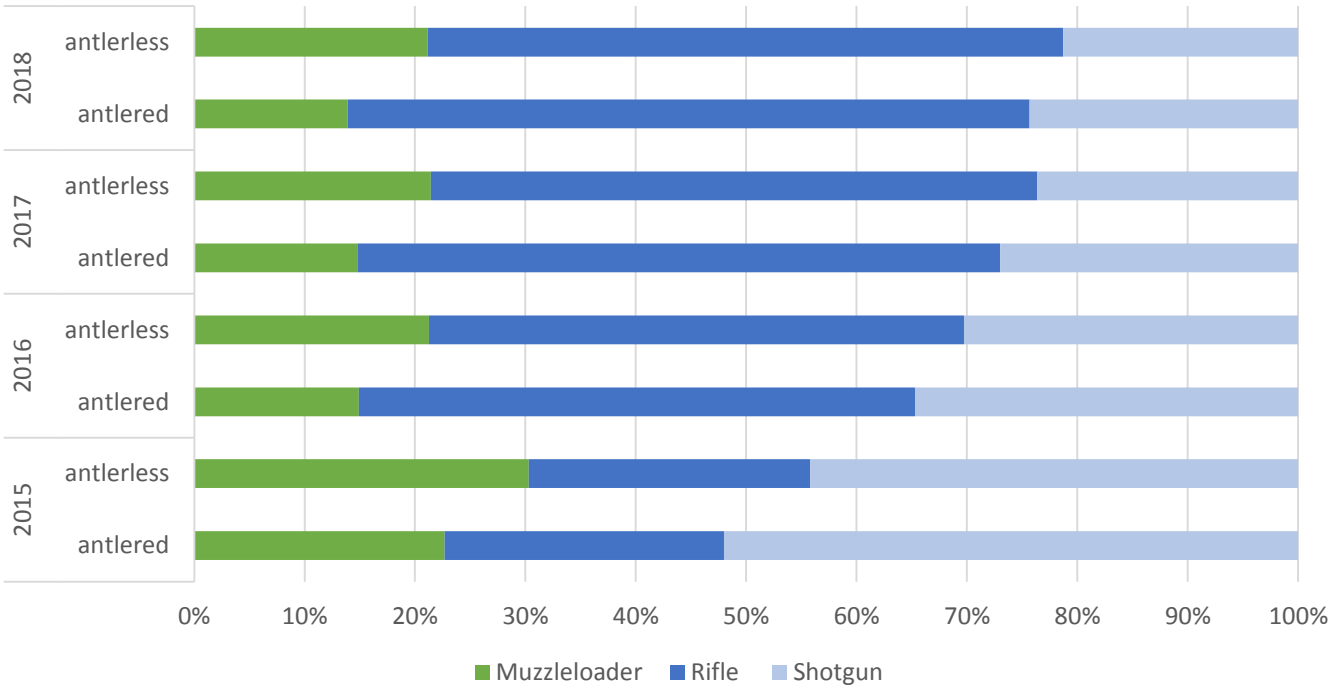


Figure 9-**2**. Proportions of antlered and antlerless deer harvested using a muzzleloader, rifle, and shotgun during the 2015, 2016, 2017, and 2018 deer hunting seasons. Reporting error rates: ±0.61% (2018), ±1.44% (2017), ±0.73% (2016), and ±0.95% (2015).

OBTAINING CITIZEN INPUT ON A LOCAL SCALE FOR DEER MANAGEMENT IN INDIANA

Joe Caudell and Olivia Vaught, *Indiana Department of Natural Resources*

The responsibility for managing white-tailed deer in Indiana lies with the Indiana DNR Division of Fish & Wildlife (DFW). The statewide goal is to manage the deer herd in a manner that adequately balances the ecological, recreational, and economic needs of the citizens of Indiana. Deer are managed at the county level, to account for local differences in the desires and needs of the citizens, recreational opportunities, and ecological relationships between the deer herd and available habitat. Citizens' desires must be constrained by biological factors of white-tailed deer and ecological considerations of that region, yet citizens still must be provided a minimum level of recreational opportunity. This concept is shown in **Figure 9-3** with a theoretical deer management model that integrates the three tiers of biological carrying capacity, a minimum hunting opportunity, and the desires of citizens.

In theory, the acceptance of any public input recommendations on deer management would fall between a Lower Population Limit Desired and an Upper Population Limit Desired. The Lower Population Limit Desired would include a minimum population or management sideboard with the intent to provide a specific hunting experience and to maintain a perpetual deer population. The Upper Population Limit Desired would account for the constraints imposed by the biological carrying capacity of the environment or a management sideboard. Population numbers beyond the Upper Population Limit Desired would experience negative impacts to both deer and habitat (**Figure 9-3**). Definition and metrics for determining these limits must be defined and evaluated through acceptable scientific processes.

Traditionally, when planning management strategies and actions, Indiana DNR has taken into account local differences through random surveys of hunters and landowners every three years, as well as reviewing annual input from Indiana DNR conservation officers and biologists. During the 2017 Deer Management Review, participants of that review process identified the need for greater public input (Caudell and Vaught 2018). As a result, Indiana DNR re-evaluated how it was collect-

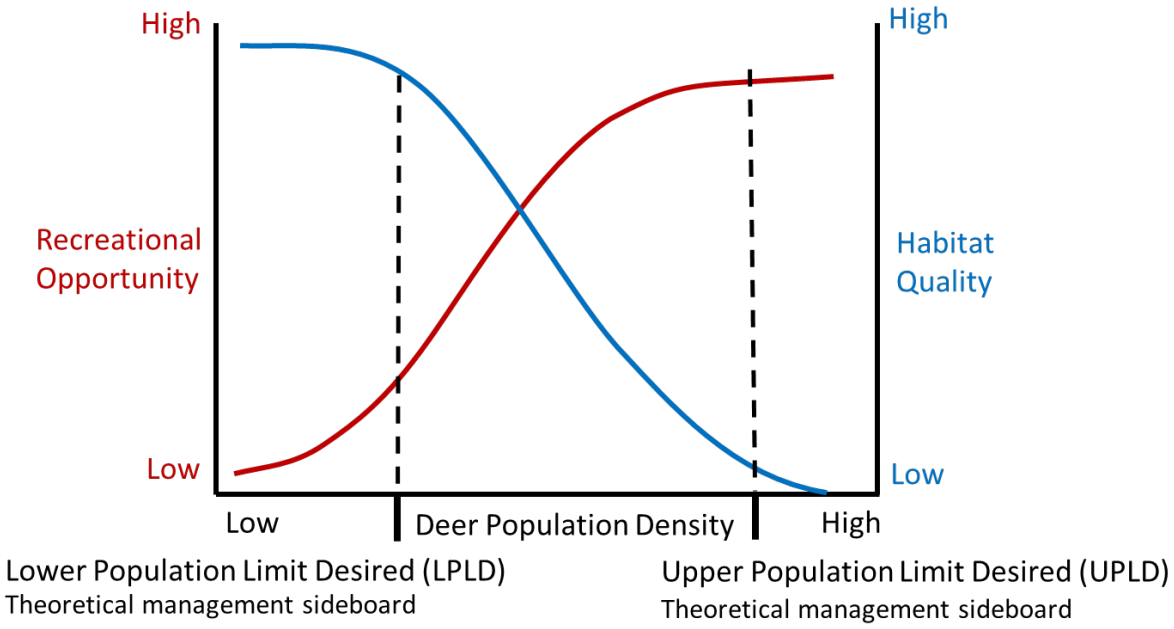


Figure 9-3. Conceptual model integrating recreational opportunity for deer hunting, ecology, and human dimensions.

ing public input data and examined an expansion of the methods currently in use, considering the possibility of incorporating new survey techniques and other direct public input methods.

In 2015, Indiana DNR administrators were asked to obtain county-level public input using the model of Wisconsin's County Deer Advisory Councils (CDACs), in which one Council was created in each of 72 counties (WDNR 2013). In 2016, Indiana DNR agreed to a limited trial of a modified version of the Wisconsin CDAC model, resulting in the formation of 10 CDACs through grassroots efforts within those counties. The Wisconsin CDAC model is similar to the Deer Advisory Councils that were used in Pennsylvania in 2006 (Fleegle et al. 2013). Indiana's modified version was a 100% grassroots variation, in which local CDAC coordinators were responsible for recruiting representative members, contacting Indiana DNR to obtain deer management data, conducting their own surveys, arranging meetings, and reporting back to Indiana DNR. The input provided by CDACs was then incorporated into the deer management model as a type of public input for the desired change in direction of the deer herd in conjunction with input from biologists, conservation officers, and an online survey.

The effectiveness of these different public input methods had not been previously compared to determine which provides the most high-quality data at a cost reasonably assumed by Indiana DNR. We examined four options to achieve the goal of increasing the quantity and quality of public input: 1) replace existing paper surveys with an internet-based approach that would increase the frequency and scope of data collected and ensure their applicability as a reliable index for deer populations (termed citizen surveys); 2) a direct interface, county-based deer advisory committee based on the Wisconsin model, using Indiana DNR staff as liaisons to each council (termed the county-based Indiana DNR-facilitated CDAC model); 3) a direct interface, region-based model that retains most of the functionality of the Wisconsin model, but creates conglomerates of counties for representation by each CDAC (termed the regional Indiana DNR-facilitated CDAC model); and 4) a grassroots-facilitated CDAC model that allows citizens to set up a CDAC with minimal guidance and input from Indiana DNR (termed the county-based grassroots-facilitated CDAC Model). The grassroots model was piloted in 10 Indiana counties in 2016. We evaluated each model for their estimated ability to obtain unbiased and representative public input data and for their cost (e.g., time, resources, etc.) to Indiana DNR for obtaining those data.

Wisconsin CDAC Model

To estimate the costs associated with creating a Wisconsin-style CDAC model in Indiana in which each county has representation, we estimated the time necessary for Wisconsin DNR to implement its CDAC program, and applied that to Indiana's wildlife management, specifically the DFW Private Lands Program and the DFW Wildlife Science Program. Wisconsin DNR has pre-designated CDAC board positions to provide for representation of various stakeholder groups within a county, including hunter, agriculture, forestry, and tourism interests (WDNR 2013). Interested members of the public apply to fill board positions. Those with proper backgrounds to represent each seat are selected to serve. Invitations are also sent to various agencies and organizations requesting nominations to fill seats, such as from a county sportsman's alliance or county forest association. Each CDAC is chaired by a member of the Wisconsin Conservation Congress. CDACs meet every three years to develop county-based deer population objective recommendations (increase, decrease, or maintain the herd) that will guide deer herd management over the next three years. To form these recommendations, CDACs review current county-specific data on hunter harvest, fawn:doe ratios, antler development, herd health, deer impacts to agriculture, forest health, economics, vehicular collisions, and the deer-hunter experience. CDACs also welcome public input at every stage of the meeting cycle. Doing so is particularly important before and after preliminary recommendations are released for public review and feedback.

Wisconsin DNR uses the CDACs to assist in developing county population objective recommendations for its long-term deer population goals. This process occurs every three years based on the following schedule of input from the CDACs:

- September: CDAC board members review and discuss deer herd metrics and receive public comments.
- October: CDAC board members receive public comments and develop preliminary recommendations for a three-year deer population objective.
- November: CDAC board members release preliminary recommendations for public comment.

- December: CDAC board members receive public comments and the results of the public comment period. They vote on a final three-year population recommendation. Final recommendations are sent to the Wisconsin DNR Deer Advisory Committee for review and possible further discussion with CDACs.
- February: Final population objective recommendations are sent to the Natural Resources Board (NRB) for approval.

All CDAC meetings are open to the public. If an attendee wishes to provide written or spoken comments, they must complete a comment card upon arrival at the meeting. Additionally, members of the public may contact local CDAC members to provide comments or submit feedback during the online public comment period, which is provided between the first meeting (when preliminary recommendations are made) and the final meeting. Online surveys occur every three years in November during the development of three-year population objectives as well as each year in early April, when establishing annual antlerless quota, permit, and season-structure recommendations. The CDAC board members are expected to attend all meetings, reflect the interests of the stakeholder group they represent, and network with stakeholders in the community. Failure to do so may result in dismissal.

To work toward achieving their three-year population objectives, CDACs meet twice each spring to discuss and develop antlerless harvest quotas, permits, and deer-season framework recommendations. Because these recommendations are reviewed annually, they can be adjusted as needed in response to the previous year's deer harvest, winter severity, and other factors. As with population objective recommendations, councils receive public feedback as they develop preliminary and final recommendations. These recommendations go into effect for the upcoming deer hunting season. This annual process occurs based on the following schedule:

- March: CDAC board members review and discuss the previous year's hunting season results and long-term harvest trends relative to the three-year population objective, accept public comments, develop preliminary antlerless quotas, and make permit and season-structure recommendations.
- Early April: CDAC board members release preliminary recommendations for public comment. Online surveys customized for each individual county are available to gather public feedback.
- Late April: CDAC board members receive public comments and results from the online survey, then formulate (sometimes by voting) the final recommendations that will advance to the Wisconsin DNR Deer Advisory Committee for review.
- May: Final CDAC recommendations are sent to the NRB for approval. Wisconsin DNR may make its own recommendations to the NRB to alter CDAC recommendations.
- Summer - Autumn: The NRB-approved quota, permit, and season-structure recommendations are put into action for the fall hunting seasons.

In order to meet the needs for information and oversight of the CDAC, Wisconsin DNR uses a combination of state-level and county-level biologists and research staff to provide population modeling and harvest expectations for the next year. The big-game ecologist, two additional full-time big-game staff, and research staff (for both population modeling and development of surveys) spend approximately 50% of their time on CDACs each year (K. Wallenfang, WDNR, personal communication). Other staff, such as communications and social science staff, also contribute significantly to this effort. The time commitment increases temporarily every three years, as all of the CDAC members reapply to their positions and/or new ones are added. Every three years, they also oversee the logistics of holding additional meetings to allow CDACs to set population objectives for their county. This likely adds another 25% to the staff time estimate.

Wisconsin DNR has approximately one biologist and at least one conservation officer per county and one forester per approximately two counties. Each wildlife biologist serves as the primary liaison to their CDAC, and is responsible for providing an extensive presentation about the local deer herd during the annual spring meeting. Each wildlife biologist also answers routine questions from CDAC members and the public. This amounts to about 40 hours per county biologist per year; foresters and law enforcement officers account for approximately eight hours per county per year. When added up to determine the full-time equivalent (FTE) positions necessary to implement a CDAC program, Wisconsin's county-level biologists spend a total of approximately 10 weeks per year, or 2,880 total hours. Law Enforcement spends approximately eight hours per person per year, or 1,152

total hours. Foresters spend approximately 576 total hours per year on CDAC related duties.

Methods

Using estimates based on Wisconsin's CDAC program of 40 hours per county biologist per year, eight hours per year for foresters, and eight hours per year for law enforcement officers, we calculated the number of full-time equivalent (FTE) positions that would be needed to emulate a CDAC program for Indiana. We estimate that it would require 3,680 total hours for biologists, 1,472 hours for law enforcement officers, and 736 for foresters on CDAC-related duties. The total approximate time in FTEs spent on CDAC duties in Wisconsin used in our calculations for Indiana is:

- Statewide Big Game Management/Science Staff – 1.9 FTE (rounded off to 2 FTEs)
- County Biologists – 1.9 FTE (rounded off to 2 FTEs)
- Law Enforcement - .75 FTEs
- Forestry - .38 FTEs
- Administration staff – undetermined in Wisconsin

Because Wisconsin's wildlife management system is fundamentally different from Indiana's, significant modifications to its CDAC structure would be needed if applied to Indiana. The FTEs should only be looked at as absolute minimum time required for implementation. The biggest fundamental difference is that Wisconsin has county-level wildlife biologists, whereas Indiana has district-level biologists, each covering approximately nine counties. To implement a Wisconsin-type CDAC, staffing would need to increase past the minimum FTEs listed to account for working with multiple counties on a regular basis. We calculated the financial cost of additional time, personnel, and equipment needed for each proposed method for increasing public input in deer management. We estimated full-time equivalents (FTE) based on prior experience with an input method or communication with other states that had initiated similar programs.

Salary and benefits were estimated based on the average salaries of existing Indiana DNR district biologists ($62,050 per year). Management positions were estimated based on an average cost of a higher level biologist ($77,816 per year). Associated costs for vehicles ($4,000 in use per year) and technology and support equipment ($3,000 per year) were also estimated. Office space was not included, as it was assumed that new personnel would be housed in existing space. Cost of administrative time was based on the current salaries of Indiana DNR administrators, rounded to the nearest $1,000 in their respective roles, with a decreasing amount of time needed for the CDAC program as administrative level increased (i.e., the director of DFW would spend less time on CDAC than would the wildlife chief). One-time start-up costs were also included as necessary.

We estimated the cost effectiveness of each method by using an estimate of the population of Indiana and an estimated number of hunters for Indiana to create a measure of cost per person and a cost per hunter, respectively. We also used an estimate of the number of participants for public meetings, based on past experience with other public meetings and data from attendance at the Wisconsin CDAC meetings, to create a cost per participant for the public meeting model. Response rates were used to create a cost per participant for the citizen survey methods.

Citizen Survey Method. – Surveys have been used to collect less-biased public input compared to data obtained from public meetings (Johnson et al. 1993, Marshall and Jones 2005, Fleegle et al. 2013). Indiana DNR has been conducting surveys of hunters and landowners since the early 1990s to obtain opinion data about deer management. Surveys have been paper-based, and were distributed to a random sample of approximately 15,000 Indiana hunters and landowners who obtained at least 50% of their income from their land. Citizens or municipalities who obtain damage control permits have also been considered in this public input process. However, the opinions of other citizens who have an interest in deer management (e.g., commuters, gardeners, nature enthusiasts, wildlife watchers) have not formally been incorporated into the development of deer management strategies.

To better represent all Indiana citizens who may have a stake in deer management, Indiana DNR proposed to expand the citizen survey method to allow more hunters, income-based landowners, and previously unsampled segments of society to participate. These data would be obtained annually so that deer management strategies could be based on current conditions, opinions, and desires.

Each paper-based deer-related survey used in the past cost the Indiana DNR approximately $10,000 to implement using current methodology. The surveys were sent to a random sample of approximately 15,000 landowners

and hunters every three years. In general, paper-based surveys are being used less often by Indiana DNR and expanding them to obtain more-frequent and timely data would be cost and time prohibitive. It is difficult to implement a timely paper-based survey because such surveys would need to be sent out in early February each year (as soon as the deer season ends). Surveys would also need to be received and the data entered and evaluated by the end of March to meet deadlines for incorporating results into the emergency rulemaking process that is used for setting the County Bonus Antlerless Quotas in Indiana.

A more efficient system would be internet-based surveys. This would potentially allow most citizens of Indiana to provide input, regardless of their interest or stake in deer management. The only limitation would be internet access. While the internet is usually available at public libraries for free, some communities in Indiana are underserved by the public library system. Therefore, initial research would need to be undertaken to ensure that stakeholders with limited internet access, or those who do not desire to use the internet to participate, are adequately represented. Indiana DNR identified four types of potential internet-based surveys and a new reporting system that would provide avenues to capture the type of data needed to ensure proper representation of Indiana citizens:

- After Hunt Survey (AHS) – An online survey used to collect biological and sociological data from successful hunters immediately after they check in harvested deer online.
- Deer Management Survey – An annual online survey through which all Indiana residents can share their opinions about deer management where they live and/or hunt.
- Landowner Opinion Survey – An annual online survey for landowners who generate at least 50% of their income from their land to share their opinions on deer management.
- Public Opinion Survey: An online survey specifically for the non-hunting and non-farming public to determine their preferences for deer management.
- Damage Complaint Tracking – An online system by which the general public can report deer damage.

Because the citizen survey method would replace the existing system of periodic paper surveys, it would likely involve a relatively low level of routine input and oversight, up through the director of DFW. It should require no more oversight than is typically used for the current survey system. No additional FTEs should be required to develop and administer the new online surveys. Deer research program staff are already tasked with developing, administering, and analyzing paper surveys. The time necessary to implement the new citizen survey method would replace the time spent distributing existing paper surveys.

County-based Indiana DNR-Facilitated CDAC Model – The county-based, Indiana DNR-facilitated CDAC model would implement a Wisconsin-style CDAC program in Indiana; however, there are fundamental differences in the structures of Wisconsin and Indiana's wildlife management programs, especially for managing wildlife on private lands. In Wisconsin, CDACs are supported by, on average, a single wildlife biologist assigned to each county. Indiana's Private Lands Program is based on a district system, with eight district wildlife biologists and two urban wildlife biologists who support counties with large urban/suburban areas. On average, the urban and district wildlife biologists are each responsible for nine to 10 counties. These biologists are already working full time on existing Indiana DNR priority projects and programs. Therefore, additional personnel would be needed to meet the new workload necessitated by implementing a Wisconsin-based CDAC system. Wisconsin CDACs were also built around the Conservation Congress, which is a wildlife management/public interface model. The Conservation Congress provides additional leadership for CDACs at the county level. Without this system, additional time would likely be required by Indiana DNR to establish leadership at the county level.

It is proposed that the CDACs would interface with eight district deer specialists (new FTE positions), resulting in multiple county meetings per biologist rather than the single meeting per biologist that occurs in Wisconsin. The Indiana CDAC meetings may align with the existing districts, or with the Deer Management Units (DMU). It is likely that this would require more than the minimum two FTEs estimated based on the Wisconsin model because those duties would not be spread out over as many biologists in Indiana.

Providing and explaining data, attending meetings, evaluating potential CDAC board member applications, and providing recommendations to the deer program would occur in a relatively short time frame (i.e., between Feb. 1, when the deer season ends, and early April, when recommendations are provided for the upcoming

deer season). Therefore, it is likely that additional personnel, either current employees assigned to assist with this task or new hires, would be necessary to meet these deadlines. These new district deer specialists would be the direct interface for the Indiana DNR at the county level on all deer issues. Each one would be responsible for approximately 11 to 12 counties, with approximately 0.50 - 0.75 FTE needed for each position. Each one would also do other duties, as assigned, to support the goals of the deer management or private lands programs.

An FTE management position would be required to supervise both the district deer specialists and an FTE deer research position, which would provide the necessary data and reports to the district deer specialists. Because this would be a high-profile program, a relatively high level of administrative input and oversight, up through the director of DFW, would likely occur on a routine basis. Communication is also a major part of the CDAC program, through the use of the Indiana DNR website. The website would need to be updated and managed on a regular basis for all 92 counties.

Another issue with the Wisconsin CDAC model is the process of distributing information and gathering feedback. In Wisconsin, the county-level biologist is primarily responsible for explaining biological and sociological data provided by the Wisconsin DNR staff at a public meeting. Immediately after the biologist's explanation, the public provides input on the data, and the CDAC then reaches a decision on its objective recommendation. This procedure is quick, and it does not give the CDAC members a chance to process the information provided by the Wisconsin DNR prior to meeting with the public. It also provides the opportunity for the public's opinion to sway the opinion of the CDAC without full consideration of the presentation.

Regional Indiana DNR-Facilitated CDAC Model – The county-based CDAC system, as implemented in Wisconsin, is likely not practical for Indiana. Indiana DNR has fewer existing staff available because they are already committed to other agency priorities. In Wisconsin, there was already one biologist in each county who was able to assume the CDAC responsibilities. In Indiana, those duties are handled at the district level. These biologists are already working full-time on existing Indiana DNR priority projects and programs; therefore, additional personnel would be needed to meet the new workload necessitated by implementing a CDAC system.

This system also encounters the same issue as the county-based Indiana DNR-facilitated CDAC model, regarding the distribution of information and gathering feedback. The county-level biologist is primarily responsible for explaining biological and sociological data provided by DNR staff at public meetings. After the biologist's explanation, the public provides input on the data, and the CDAC then reaches a decision on its objective recommendation. This procedure is quick and does not give the CDAC members a chance to fully process the information provided by the DNR prior to meeting with the public. It also provides the opportunity for the public's opinion to sway the opinion of the CDAC without full consideration of the presentation.

To address the issues of fewer Indiana DNR staff and to provide information to the CDAC board members in advance of public meetings, we propose that the CDACs be supported by two regional deer biologists (i.e., one for northern counties and one for southern counties). These regional biologists would only associate with the CDAC board members, serving as their primary contact within Indiana DNR. Regional deer biologists would be responsible for developing the CDAC implementation plan, which outlines how CDACs would operate (similar to Wisconsin); reviewing applications for CDAC board positions from interested county residents; preparing data and reports for CDACs; communicating with CDAC members; and providing oversight for data collection in their regional area.

The CDACs would participate in three meetings: one with the Indiana DNR, in which data are shared; a second in which public input is solicited; and a third that would be a closed meeting of the CDAC board members to make final decisions. This would give the CDACs a better opportunity to receive and consider both information from the Indiana DNR and public opinion with less outward pressure.

The first meeting would be a regional meeting based on deer management unit (DMUs) (Figure 8-1). Two regional deer biologists would hold eight or nine CDAC meetings across the DMU regions (one meeting per region), to share and explain deer harvest data and opinion-related survey results. Active participation in this information exchange meeting would be restricted to the CDAC board members from the counties within that region; however, the public would be able to attend the meeting as observers or view the meeting via the internet. The Indiana DNR regional biologist would provide county-specific data for that area, including trends occurring in the area's deer population, survey results from hunters and the public, and biological data collected in

that region. The CDAC board members would have the opportunity to ask questions about the data, data collection methods, or data interpretation, to understand what is happening with their local deer herd. It would be the CDACs' responsibility to use these data in their decision-making process.

The second meeting would be held by the CDACs in their respective counties and would be open to the public, allowing attendees to voice their opinion about deer management. Hunters, income-driven landowners, property owners, commuters, and other self-identified groups would be able to provide input. The CDAC would incorporate these opinions in their deliberation about the goals for their deer population.

The third meeting would be a closed meeting in which the CDACs evaluate the biological and sociological information together. They would provide a published, guided opinion for the factors they considered in their decision-making process. For example, the CDAC may conclude that biological indicators such as spotlight counts, data from the Archer's Index survey, deer-vehicle collisions, and forest-regeneration indices indicate the population is growing. The CDAC may also conclude that the sociological indices indicate that the social carrying capacity has been exceeded by income-driven landowners, property owners, and commuters, but it may not have been reached by hunters. Based on these conclusions, each CDAC would make an informed decision on deer management goals for their county and publicize their rationale.

A recommendation from a CDAC under which all the members voted, followed the instructions provided, and did not appear to have been unduly influenced by special interest(s) would be accepted as is. Indiana DNR would be able to verify adherence to the criteria through modeling expected outcomes. For example, if the biological data presented to and examined by a CDAC board clearly indicate that a reduction in the deer population is warranted, but the CDAC recommends increasing the population through a reduction in the antlerless harvest, this would be an indicator that the CDAC board is not incorporating the biological data into its decisions. If a recommendation is provided by a CDAC that does not meet the criteria set by the Indiana DNR (i.e., incorporating the results of data with the desires of citizens), it would be used by Indiana DNR only as public input and incorporated into the existing decision-making process for the antlerless harvest.

County-based Grassroots-Facilitated CDAC Model – The desire for CDACs in Indiana originated as a grassroots movement by several hunters concerned with a lack of representation at the county level. As mentioned previously, the county-based CDAC system, as implemented in Wisconsin, is likely not practical for Indiana, because Indiana DNR has fewer existing staff available because they are already committed to other Agency priorities. To address the issue of fewer Indiana DNR staff and the desire to provide direction on deer management at the local level, a potential option is a county-based, grassroots-facilitated CDAC model. This is functionally the type of model that was tested in Indiana in 2016.

The county-based, grassroots-facilitated CDAC model would likely result in the formation of CDACs in counties where there are significant concerns from a particular stakeholder (e.g., hunters, farmers, land/homeowners). CDACs would not be required for any county, and they may not form in every county. In a county where hunters are most concerned about the deer population, the CDAC would likely be formed by hunters. If deer damage is the primary concern in a county, the CDAC would likely be formed by individuals who are interested in reducing damage. The CDACs would be managed at the local level, with little input from Indiana DNR other than to provide data on a yearly basis and/or attend meetings as time permits.

Indiana DNR would provide CDACs with biological and sociological data in limited meetings (one per region), published reports, and through remote explanation using internet-based media. Indiana DNR would also create a framework of recommendations and policies by which CDACs would operate; however, their use would be at the discretion of the local organizers. The model framework would suggest basic meeting procedures, proportional representation on the council by varying interests within the county, timing of meetings to provide harvest recommendations, and acceptable recommendations for input into deer management goals. Recommendations provided by CDACs that follow the model framework would be fully considered in the decisions to set county bonus antlerless harvest limits.

Because grassroots-facilitated CDACs would be less organized, CDAC chairs and members would likely demand additional contact with Indiana DNR and deer-related data. To serve this model, two additional deer research biologists would be tasked with interfacing with the CDACs and collecting data. One would serve the northern regions, and the other would serve the southern regions. The regional biologist would be the primary contact for CDACs in their area of responsibility, and they

would be responsible for developing an operation plan for CDACs, reviewing applications for board positions, preparing data and reports, communicating with CDAC members, and providing oversight for data collection in their respective region.

In 2016, county-based, grassroots-facilitated CDACs were piloted in 10 Indiana counties. Each county selected representatives, held a meeting, and provided recommendations to Indiana DNR for their county bonus antlerless quota. This was a completely grassroots-facilitated effort. Indiana DNR provided county deer harvest data and other data for the CDACs to evaluate.

Results

Citizen Survey Method – The citizen survey method would not result in additional staff, office space, vehicles, or other expenses, as the Indiana DNR already has time and personnel designated to conducting surveys. The online software program Qualtrics would be used to administer the surveys via email. The Qualtrics package was quoted to cost $32,000 per year in the first five years. The funds previously used for paper surveys would not be used to offset this cost, as additional follow-up surveys using a paper-based survey would likely be required to assess bias.

Surveys can be a useful tool for assessing public opinion toward various topics (Johnson et al. 1993); however, care must be taken to ensure the sample is representative of the target population. With Indiana DNR's citizen survey method for deer management, all hunters and a sample of non-hunters would have the opportunity to provide input. Obtaining a representative sample from Indiana's non-hunters may require additional research efforts to ensure each group is adequately represented.

In 2018, Deer Management Surveys were sent to 269,389 individuals who had purchased some type of hunting, fishing, or trapping license from Indiana DNR in the last five years. We received survey responses from 23,283 individuals, which included resident hunters (n=17,614), non-resident hunters (n=795), and residents who indicated they did not hunt (n=2,550). Based on a cost of $32,000 for the survey tool, and assuming the survey tool is only used for this one purpose, it cost $1.37 to survey each individual about deer management.

In 2019, we sent the Deer Management Survey to 398,102 individuals who had purchased some type of license from Indiana DNR. We received survey responses from 33,987 individuals, which included resident hunters (n=25,613), non-resident hunters (n=1,536), and residents who indicated they did not hunt (n=2,895). Based on a cost of $32,000 for the survey tool, and assuming the survey tool is only used for one purpose, it cost $0.94 to survey each individual about deer management.

County-based Indiana DNR-Facilitated CDAC Model – The Wisconsin-style CDAC model, if implemented in Indiana, would result in the creation of an additional biologist position within the Indiana Deer Research Program with an estimated $62,050 in personnel cost and $46,000 for expenses (i.e., travel, survey materials, and technology). Each of the eight districts would need to hire a district deer specialist to serve as the primary interface for the CDACs, which would be an estimated $496,400 in personnel costs, $77,816 for a CDAC program manager, $36,000 per year in vehicle expenses, and $28,000 in technology expenses. Administrative cost was estimated at $175,000 using 0.1 FTE for DFW director, 0.2 FTE for the chief of wildlife, 0.4 FTE for the private lands and science program managers (each), 0.8 FTE for state deer research biologist, and 0.25 FTE for Division of Communications. The total annual cost to implement a county-based, Indiana DNR-facilitated CDAC model would be an estimated $921,266. An additional one-time cost for 10 vehicles would be $250,000.

A benefit of the county approach is that it would result in the least amount of burden on county citizens because Indiana counties are relatively small. Thus, a centralized meeting would be no more than a 30-minute drive for most residents.

A disadvantage of the county approach is that participation and representation is typically low in public meeting models (Johnson et al. 1993, Fleegle et al 2013), especially when compared to surveys. Public participation models often result in biased data, with a higher proportion of hunters attending meetings who are more dissatisfied with deer management and often desire more or better deer. Some public participation models afford wildlife agencies a chance to interact and educate hunters on deer and deer management. However, the county-based Indiana DNR-facilitated CDAC model is designed so the CDAC board members lead the meetings, with Indiana DNR present to provide data and input as needed. Based on the experiences of Wisconsin CDACs, public participation outside of hunters is low, and many CDAC board positions that are intended to be filled with community representatives are left unfilled.

Indiana DNR has invited county residents to public meetings on bovine tuberculosis in recent years. Meeting

attendance ranged from approximately 10 to 60 individuals, with interest being highest when the disease was first found. Wisconsin DNR estimated that attendance at its CDAC meetings ranged from 0 to 30 individuals, with a typical attendance of 5 to 20 individuals, and an estimated average of 10 individuals (K. Wallenfang, WI DNR, personal communication). However, when a controversial proposal is suggested (i.e., an antlerless only season), attendance can increase to several hundred, filling up the entire meeting venue.

Assuming an average attendance of 50 individuals in each of Indiana's 92 counties, 4,600 individuals statewide would attend these meetings, resulting in a total cost of $200.28 per individual for the purpose of obtaining public input. Based on an average of 10 attendees in Indiana's 92 counties, the total statewide participation would be approximately 920 individuals. The cost per individual would increase to $1,001.38 per year. In addition to public meetings, Wisconsin uses an online process to receive feedback on preliminary CDAC recommendations, which gives individuals an opportunity to react to and comment on those recommendations. Through this process, Wisconsin DNR hears from approximately 5,000-7,000 individuals. In total, less than 2% of Wisconsin's deer hunters likely participate in the overall process. The need for an additional survey for the CDAC method would further increase the cost per person by approximately $1 per person per year (see estimate for Citizen Survey Method above).

Regional Indiana DNR-Facilitated CDAC Model – The regional CDAC model implemented in Indiana would result in the creation of an additional biologist position within the Indiana Deer Research Program, with an estimated $62,050 in personnel cost and $46,000 for expenses (i.e., travel, survey materials, and technology). Using the regional approach (i.e., a north and south region), only two regional deer specialists would be needed to serve as the primary interface for the CDACs, resulting in an estimated $124,100 in personnel cost, $8,000 per year in vehicle expenses, and $6,000 in technology expenses. Administrative cost was estimated at $103,000, using 0.1 FTE for DFW director, 0.1 FTE for the chief of wildlife, 0.2 FTE for the private lands and science program managers, 0.4 FTE for state deer research biologist, and 0.25 FTE for Division of Communications. The total annual cost to implement a regional Indiana DNR-facilitated regional CDAC model would be an estimated $349,150. An additional one-time cost of three vehicles would be $75,000. Using the same estimates for public participation as in the county-based Indiana DNR-facilitated CDAC model, the cost per individual would range from $75.90 (4,600 participants statewide) to $379.51 (920 participants) per year.

The regional approach would result in a greater burden on county residents, as regional meetings may require more travel time to attend. As with the county-based CDAC model, participation and representation in the regional public meetings would be low (Johnson et al. 1993, Fleegle et al 2013). With the additional barrier of a potentially higher time commitment, representation and participation is likely to be even less than in the county-based CDAC model. In addition, Indiana hunters typically associate management and hunting with their county, which may cause conflict between hunters in different counties when the regional data do not align with what they believe is best for their county.

County-based Grassroots-Facilitated CDAC Model – The grassroots-based CDAC model, if implemented in Indiana, would result in the creation of two additional biologist positions within the Indiana Deer Research Program, with an estimated $124,100 in personnel cost and $52,000 for expenses (i.e., travel, survey materials, and technology). Administrative cost was estimated at $103,000, using 0.1 FTE for DFW director, 0.1 FTE for the chief of wildlife, 0.2 FTE for the private lands and science program managers, 0.4 FTE for state deer research biologist, and 0.25 FTE for Division of Communications. The total annual cost to implement a county-based, grassroots-facilitated CDAC model in Indiana would be an estimated $279,100. An additional one-time cost for two vehicles would be $50,000.

As this model would be optional and would not reach a representative number of citizens, it would need to be implemented in conjunction with the citizen survey method to ensure proper representation of counties that do not have a CDAC. Using the same estimates for participation, as in the county-based, Indiana DNR-facilitated CDAC model, the cost per individual would range from $60.67 (4,600 participants statewide) to $303.37 (920 participations) per year. The cost of adding a countywide survey to this model to offset the low participation at public meetings, as Wisconsin has done, would add approximately $1 per person to the cost (see cost estimate in Citizen Survey Method).

In 2016, all 10 of the trial CDACs held meetings and provided a county bonus antlerless quota recommendation based on public meetings and local surveys conducted by the local CDAC organizer in each county.

While some Indiana DNR conservation officers were in attendance at the meeting, the primary role of Indiana DNR was to provide county-level data about the harvest. In response to this need, Indiana DNR added the county-level data to the annual White-tailed Deer Report so that anyone interested would have access to the same data. In 2017, three of the 10 CDAC counties contacted Indiana DNR to provide harvest recommendations. In 2018, only one county provided harvest recommendations based on a survey of their CDAC members but it was unclear if a meeting was held or if only surveys were used. All recommendations received from the CDACs were included as a sociological data point for that county in the annual Indiana DNR meeting to set the county bonus antlerless quota recommendations.

Discussion

The county-based, grassroots-facilitated CDAC model would have the lowest cost for a CDAC; however, because the representation of citizens participating in the CDAC would likely be skewed toward a single stakeholder, surveys would also have to be conducted by Indiana DNR using the citizen survey method. This is also likely to be true of other CDAC options, and other states have faced similar issues. In 2006, the Pennsylvania Game Commission implemented a pilot program for a citizen advisory committee (CAC) to obtain citizen input on deer management (Fleegle et al. 2013). In 2009, the Pennsylvania Legislative Budget and Finance Committee contracted with the Wildlife Management Institute (WMI) to evaluate the Game Commission's deer management program. One of the conclusions made by WMI was that the CAC was grounded in social science but it was not a fully objective method to assess the desires of citizens. Consequently, Pennsylvania discontinued this method in 2011 in favor of a Citizen Survey to specifically address the issue of a lack of representation (Fleegle et al. 2013).

In addition to under-representing stakeholder groups, the county-based, grassroots-facilitated CDAC model may be the most problematic due to a lack of direct oversight and regular input by Indiana DNR. Because these CDACs would form when a segment of the public is displeased with deer management, they are likely to be skewed toward even more extreme views. These grassroots-facilitated CDACs may form both for the purpose of increasing deer populations as well as for decreasing populations, especially in farming areas where farmers experience high levels of damage. It is also possible that competing CDACs could form in a single county—one as a result of extreme damage, centered around urban or suburban areas, and another in response to small deer populations elsewhere in the county. Additionally, it does not appear that the grassroots-facilitated model can sustain itself over a long period of time. Having these groups persist at the county level would likely require organized input from Indiana DNR or a non-governmental organization. The grassroots-facilitated CDAC model is therefore not a recommended option for Indiana

The citizen survey method appears to be the most cost-effective method for obtaining quality, well-represented public input data for a low price. Indiana DNR has been conducting hunter surveys for more than 25 years at approximately three-year intervals using a combination of paper and phone surveys. Current technology allows agency staff to successfully implement a comprehensive, electronic-based citizen survey at a significantly smaller per-response cost. Electronic survey systems are also convenient for the public, as they allow input from individuals on their own timeframe (as opposed to attending a meeting at a time set by Indiana DNR). The only cost to the individual is the time it takes to complete the survey. Electronic survey systems also allow agencies to rapidly gather public input and incorporate that into management decisions in a timely manner.

An advantage of electronic surveys is that they allow for potential bias to be measured and adjusted to more accurately reflect the opinions of all citizens of a county, especially when compared with public input meetings. Responses under CDAC models would be expected to be biased toward individuals who are hunters. Fleegle et al. (2013) reported that nearly all members of the CAC were hunters, regardless of which stakeholder group they represented, even though less than 10% of Pennsylvania residents hunt. Johnson et al. (1993) found hunters attending public meetings had a more negative perception of deer hunting and management and held more polarized opinions than randomly selected hunters. Hunters who attended meetings also had fewer neutral opinions, which suggests hunters that serve on CDACs may not necessarily represent all hunters of the county. To determine if CDACs are representative of the populations they represent, Indiana DNR would need to routinely survey those groups, in addition to soliciting information via public input.

An advantage of CDAC models over the online citizen surveys would be direct interactions between biologists and the public, which is a true value of the public input process (Fleegle et al. 2013). This was previ-

ously achieved by Indiana DNR employees working at deer check stations, typically during the first weekend of firearms season. However, since Indiana DNR went strictly to an online check-in system for deer, this valuable contact has been lost. If the internet-based method is adopted as the primary method for public input, a town meeting or other communication opportunities should be considered to allow for this direct contact with the public but not for obtaining attitudes for management action.

Biological data should be considered separately from sociological data but integrated into a comprehensive model. Recommendations provided by CDACs that can arrange for the collection of biological data through citizen science will carry a greater weight than those that rely only on sociological data. These data may include operating county deer check stations, collecting data on deer damage, conducting vegetation surveys to assess quality of habitat, picking up roadkill to assess birth rates and condition, spotlight counts, or other recognized indices used to assess deer populations. Data collection will have to be supervised by Indiana DNR biological staff or contracted biological staff to ensure valid methods and study designs are used. Biological data collected by CDACs or local organized deer groups such as hunting clubs can be used to supplement or verify data collected through the After Hunt Survey and other Indiana DNR data-collection methods.

Finally, if the implementation of CDACs is under consideration, the citizens of Indiana, which the CDACs represent, should determine if this system is desirable. Those considering a change to a new system should be educated as to how the CDAC models would potentially be implemented, as well as any proposed alternatives (i.e., citizen surveys), costs, potential fee increases, and projected decreases in other services offered by Indiana DNR to offset the cost of the CDAC program. Research on public preference should be undertaken by outside entities, using several data collection techniques, to ensure the public's true preferences are determined.

Management Implications and Final Result of the Study

After a review of the data and the results of this report, Indiana DNR chose to go with the Citizen Survey Method for obtaining citizen input. The high cost of operating a CDAC and concerns over obtaining representative data were potentially the largest constraints for implementing any of the CDAC-type models for Indiana. As a result of this research, Indiana DNR implemented an annual Deer Management Survey (see Chapter 7) starting in 2016. This survey is distributed after the deer hunting season has concluded to both hunters and non-hunters who have had contact with the Division of Fish and Wildlife for checking in game; purchasing hunting, fishing, or trapping licenses; or who have opened an account for the purpose of obtaining the survey.

These data on public preference for deer management is currently used as a human dimension component for setting the County Bonus Antlerless Quotas (see Appendix which describes how the data are integrated into setting the yearly harvest). The overall results of the survey are reported in the annual Indiana White-tailed Deer Report. The survey results associated with the management of deer from the individual counties are found in the County Deer Data Sheets associated with that report (Appendix C).

Literature Cited

Caudell, J. N., and O. D. L. Vaught. 2018. 2017 Indiana White-tailed Deer Report. Indiana Department of Natural Resources, Bloomington, Indiana, USA.

Fleegle, J. T., C. S. Rosenberry, B. D. Wallingford. 2013. Use of citizen advisory committees to direct deer management in Pennsylvania. Wildlife Society Bulletin 37:129-136.

Johnson, K. N., R. L. Johnson, D. K. Edwards, and C. A. Wheaton. 1993. Public participation in wildlife management: opinions from public meetings and random surveys. Wildlife Society Bulletin 21:218-225.

Marshall, B. K., and R. E. Jones. 2005. Citizen participation in natural resources management: does representation matter? Sociological Spectrum 25:715-737.

Wisconsin Department of Natural Resources [WDNR]. 2016. County Deer Advisory Councils Governance of Operations. Wisconsin Department of Natural Resources, Madison, Wisconsin.

CHAPTER 10. EXTERNAL DEER RESEARCH

A FLEXIBLE MODEL-BASED APPROACH TO DELINEATE WILDLIFE MANAGEMENT UNITS

Robert K. Swihart, *Purdue University*
Joe N. Caudell, *Indiana Department of Natural Resources*
Jarred M. Brooke and Zhao Ma, *Purdue University*
Emily McCallen, *Indiana Department of Natural Resources*

In order to optimally manage harvested species, agencies often divide states into spatially identifiable management units to define and regulate populations. Unfortunately, management units are often chosen arbitrarily or defined solely by political boundaries (e.g., Bischof et al. 2016, Scarlett and McKinney 2017). In contrast to this approach, Ohio used county-level data to model spatial differences in the doe harvest of white-tailed deer as a function of biological, ecological, and sociocultural explanatory variables (Karns et al. 2016). Important explanatory variables from the resulting harvest model were used to cluster neighboring counties into prospective deer management units. This objective approach allowed Ohio to replace 88 county-level management units with six multi-county management units with similar underlying deer harvest characteristics.

In Indiana, much of the data that the Indiana DNR collect on deer populations is too sparse to be reliably reported at the county level. This factor drove agency desire for more robust management units. To achieve this goal, we worked with researchers at Purdue University who used a similar approach in Ohio (Karns et al. 2016). These researchers expanded the approach to include four types of documented deer mortality: 1) antlerless deer harvested; 2) antlered deer harvested; 3) reported deer-vehicle collisions; and 4) deaths due to take from deer control permits. The researchers then worked closely with agency biologists and conservation officers to develop the final deer management units.

Hunter harvest of antlerless and antlered white-tailed deer (2012-2017) was estimated by the Indiana DNR, through check stations and an online reporting system. Deer-vehicle collisions and the average daily vehicle miles traveled within each county were estimated by the Indiana Department of Transportation (Caudell and Vaught 2017). Mortality from deer control permits was also estimated by Indiana DNR.

Researchers gathered county-level data on hunter effort, land use, land cover, and human density from a variety of sources (**Table 10-1**) for the analysis. Each of these variables was chosen because of its ability to directly or indirectly influence deer mortality. Hunter density was calculated by dividing the number of successful hunters in each county by the statewide success rate (successful hunters/total licensed hunters) and county-level success rate (reported through a hunter survey), averaging the two values, and expressing per 10 km^2. Researchers obtained land-cover variables through the 2015 USDA National Agricultural Statistics Service Report (percent cropland, percent developed land) and the 2017 USDA Farm Service Agency Conservation Reserve Program (hereafter, CRP) Statistics Report (fraction of cropland enrolled in CRP). The "deer habitat" variable was calculated by determining the fraction of each county's land area (ha) in permanent cover. Permanent cover included forest, shrubland, grassland, pasture/hayland, and woody wetlands cover types, and excluded cropland, water, and developed cover types. Road density was obtained from the USDA Geospatial Data Gateway and was calculated by dividing distance of roads (km) in each county by the county area (km^2). Human population density was obtained from the 2010 U.S. Census Bureau and was calculated by dividing the human population in each county by the county area (km^2).

Researchers used multivariate regression to simultaneously model variation in the four sources of deer mortality among counties (Warton et al. 2012). Response variables were the mean numbers of antlerless and antlered deer harvested, reported deer deaths in collisions with vehicles, and reported deaths from deer control permits. These were computed for each county from 2012-2017 and expressed as mortalities per 1,000 km^2 (roughly the average size (1018 km^2) of Indiana counties). Counties were placed into various-sized clusters based on similarities in important explanatory variables (e.g., variables measuring land use, land cover, hunter density or human development) related to deer mortality, as well as geographical proximity.

Researchers assessed the results of each optimal clustering solution for five to 15 different-sized management units, and selected four candidate clusters for further consideration (six, seven, nine, and 12 clusters; **Figure 10-1**). Using these four candidate solutions, researchers sought input from 12 agency biologists and district conservation officer supervisors via online survey, to i) solicit their ideas on how they would group counties into management units, ii) rank the model-derived maps, and iii) rate the suitability of the model-based solutions for use in deer management. Each respondent was asked to use an interactive map to group counties into management units with the possible number of units corresponding to the size range for the four candidate solutions. After constructing their own maps, respondents were asked to rank the four candidate solutions (1 = best) and rate each of them on a five-point scale, in terms of how well the model conformed to their own perceptions for management units in Indiana (1 = not well at all, 5 = extremely well). To assess agreement with candidate solutions, each respondent's map was compared with an optimized model-derived map containing the same number of groups.

The best multivariate regression models identified four explanatory variables associated with deer mortality (deer habitat, hunter density, fraction of cropland in CRP, and general development) in addition to geographical location. Independently derived maps by biologists corresponded reasonably well with maps containing the same number of groups and derived objectively from the clustering of predictors of deer mortality with partial contiguity constraints. The average fraction of pairs of counties that were classified the same by both agency personnel and model-derived maps was 0.852 (with a standard deviation of 0.034). On average, respondents ranked the nine-cluster map as best, and it was the only map to avoid being ranked as worst by at least one individual.

Ratings of model conformity with personal perceptions were highest for the seven- and nine-unit solutions. Three respondents commented specifically that urban areas warranted consideration when forming management units, and one of these respondents noted that some heavily urbanized counties still contained areas of good deer habitat. Based on expert assessment, researchers selected the nine-cluster solution and modified it at the sub-county level to define a 10th urban zone (**Figure 10-2**) that incorporated existing urban deer reduction zones. Ultimately, Indiana DNR biologists found the non-contiguous maps to be impractical for regular use and modified final units slightly to maintain spatial congruity (**Figure 10-3**). Although we acknowledge that having spatially contiguous units decreases the amount of variation explained by the final models, the increase in ease of use for managers and citizens was judged to be a worthwhile tradeoff.

The density of deer habitat and hunters exhibited much greater effects on annual harvest mortality than other variables. The strong association between higher relative availability of habitat and harvest mortality is not surprising because deer abundance is linked to the amount and quality of habitat (Roseberry and Woolf 1998, Miranda and Porter 2003), and greater deer abundance leads to more harvest opportunities. Similarly, harvest levels are also affected by hunter effort (Skalski et al. 2007). In Indiana, hunter density was greater in counties with greater fractions of deer habitat. To a lesser degree, harvest was influenced positively by the relative amount of cropland in CRP. This may demonstrate the value of CRP to deer, especially in counties with adequate food resources and relatively low amounts of cover (Gould and Jenkins 1993, Grovenburg et al. 2010, Grovenburg et al. 2012). Because traffic volume and road density in habitable areas should lead to increased risk (McShea et al. 2008, Sudharsan et al. 2009), we saw an expected pattern of increased deer mortality from vehicular accidents in areas with greater human development and road density.

A limitation of this county-level clustering was its inability to incorporate variation within counties because data at this scale are unavailable. In the absence of such data, expert assessment provided a valuable addition to the county-level analysis. Specifically, as multiple experts identified the ignoring of urban areas as a weakness of the solutions offered, researchers amended the model-based solution to incorporate Indiana's deer reduction zones as a separate management unit. Indiana DNR had already created urban deer reduction zones to reduce human-wildlife conflicts in urban areas (Caudell and Vaught 2017), and these zones served as boundaries for the additional urban management unit. Expert assessment was also valuable as a means of validating model-based results. This project represents a valuable collaboration between researchers and agency experts for the science-based management of deer populations in Indiana.

Literature cited

Bischof, R., H. Brøseth, and O. Gimenez. 2016. Wildlife in a politically divided world: Insularism inflates estimates of brown bear abundance. Conservation Letters 9:122-130.

Caudell, J. N., and O. D. L. Vaught. 2018. 2017 Indiana white-tailed deer report. Indiana Department of Natural Resources, Bloomington, Indiana.

Gould, J. H., and K. J. Jenkins. 1993. Seasonal use of Conservation Reserve Program lands by white-tailed Deer in east-central South Dakota. Wildlife Society Bulletin 21:250–255.

Grovenburg, T. W., C. N. Jacques, R. W. Klaver, and J. A. Jenks. 2010. Bed site selection by neonate deer in grassland habitats on the northern Great Plains. The Journal of Wildlife Management 74:1250–1256.

Grovenburg, T. W., R. W. Klaver, and J. A. Jenks. 2012. Spatial ecology of white-tailed deer fawns in the northern Great Plains: Implications of loss of conservation reserve program grasslands. The Journal of Wildlife Management 76:632–644.

Karns, G. R., R. J. Gates, S. N. Matthews, J. T. Bruskotter, J. C. McCoy, and M. J. Tonkovich. 2016. Factors influencing spatial heterogeneity of female white-tailed deer harvest dynamics. Wildlife Society Bulletin 40:758-763.

McShea, W. J., C. M. Stewart, L. J. Kearns, S. Licciol, and D. Kocka. 2008. Factors affecting autumn deer–vehicle collisions in a rural Virginia county. Human-Wildlife Conflicts 2:110–121.

Miranda, B. R., and W. F. Porter. 2003. Statewide habitat assessment for white-tailed deer in Arkansas using satellite imagery. Wildlife Society Bulletin (1973-2006) 31:715–726.

Roseberry, J. L., and A. Woolf. 1998. Habitat-population density relationships for white-tailed deer in Illinois. Wildlife Society Bulletin 26:252–258.

Scarlett, L., and M. McKinney. 2017. Connecting people and places: the emerging role of network governance in large landscape conservation. Frontiers in Ecology and the Environment 14:116-125.

Skalski, J. R., R. L. Townsend, and B. A. Gilbert. 2007. Calibrating statistical population reconstruction models using catch-effort and index data. Journal of Wildlife Management 71:1309–1316.

Sudharsan, K., S. J. Riley, and H. C. III. 2009. Relative risks of deer–vehicle collisions along road types in southeast Michigan. Human Dimensions of Wildlife 14:341–352.

Warton D. I., S. Wright, and Y. Wang. 2012. Distance-based multivariate analyses confound location and dispersion effects. Methods in Ecology and Evolution 3:89-101.

Table 10-1. Summary statistics by county for explanatory variables considered in multivariate regression analysis of county-level deer mortality in Indiana, 2012-2017.

Variable name	Source	Median	Range (min.-max.)
Deer habitat[a]	USDA, National Agricultural Statistics Service (2015)	0.31	0.04–0.94
Cropland[a]	USDA, National Agricultural Statistics Service (2015)	0.52	0.02–0.91
CRP[b]	USDA, Farm Services Agency (2017)	0.02	0.00–0.21
Hunter density[c] (10 km^{-2})	Indiana Department of Natural Resources (2017)	25.3	5.4 – 90.8
Development			
Developed land[a]	USDA, National Agriculture Statistics Service (2015)	0.08	0.02–0.78
Vehicle travel (km day^{-1})	Indiana Department of Transportation (2012-2017)	1831.3	678.6 –47843.3
Road density (km^{-1})	TIGER 2015 Roads, US Department of Commerce	2.86	1.64–8.17
Human population density (km^{-2})	US Census Bureau (2012-2015)	31.2	8.3 – 891.8

[a]Fraction of county.

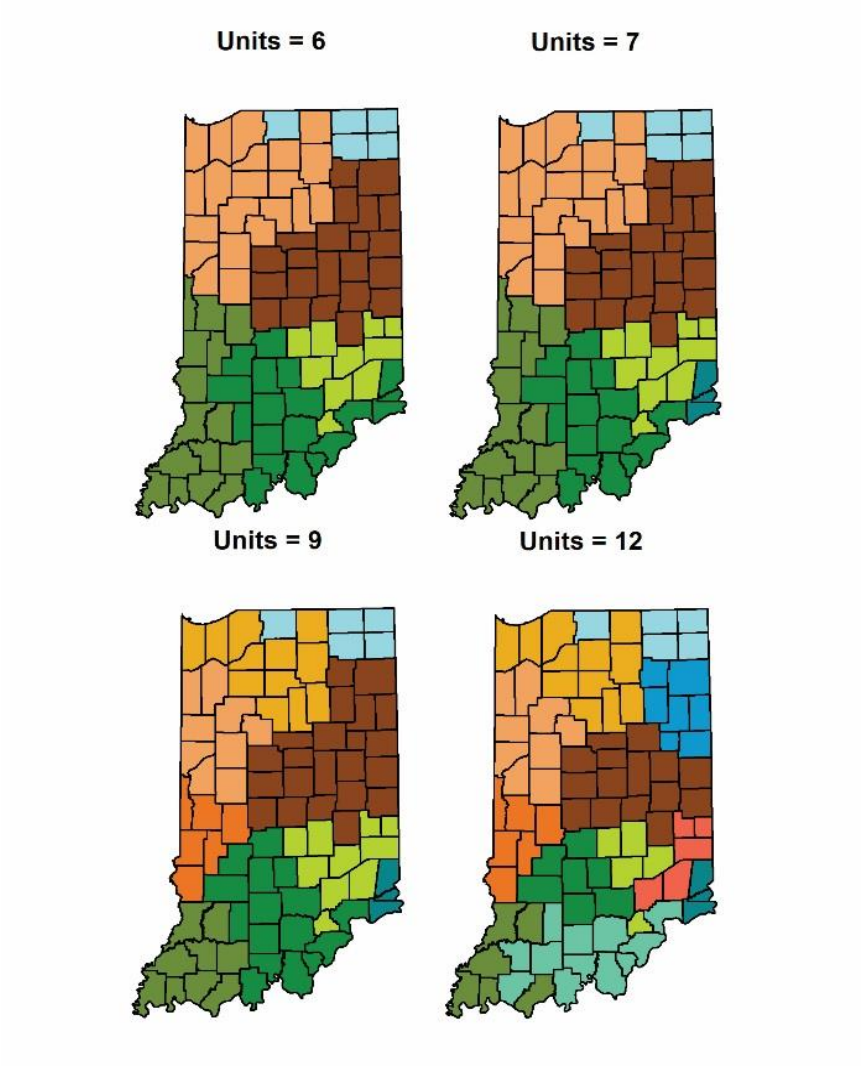


Figure 10-1. Maps of model-based solutions with partial contiguity constraints for six, seven, nine, and 12 deer management units in Indiana. These maps were presented to experts in an online survey designed to rank them and rate their suitability.

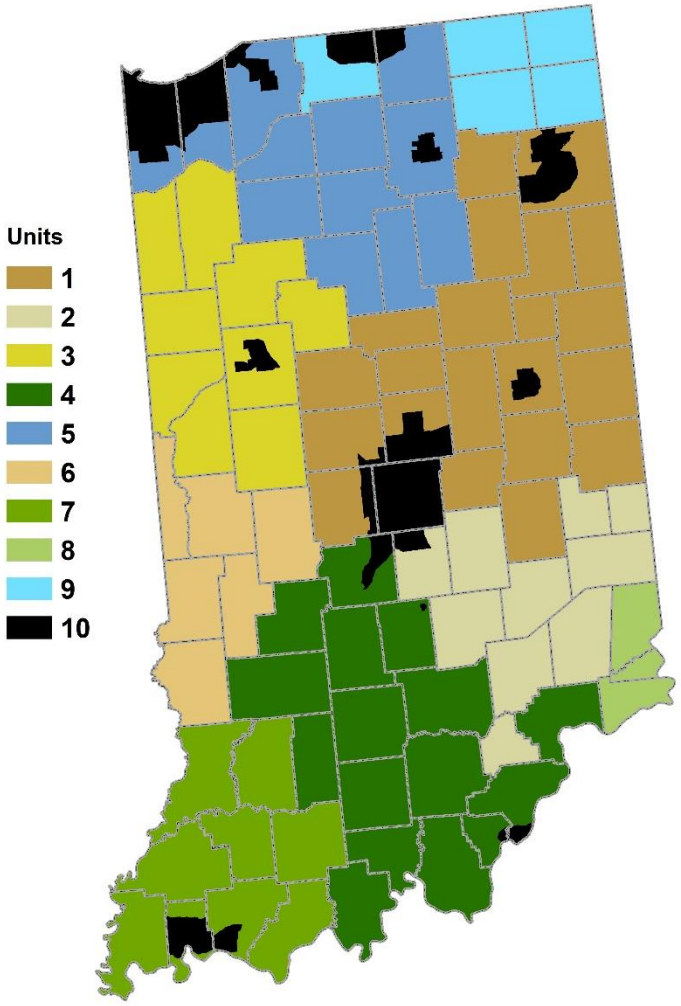


Figure 10-2. Final map of white-tailed deer research management units (RMUs) in Indiana, delineated using multivariate regression, mixture clustering, and expert opinion.

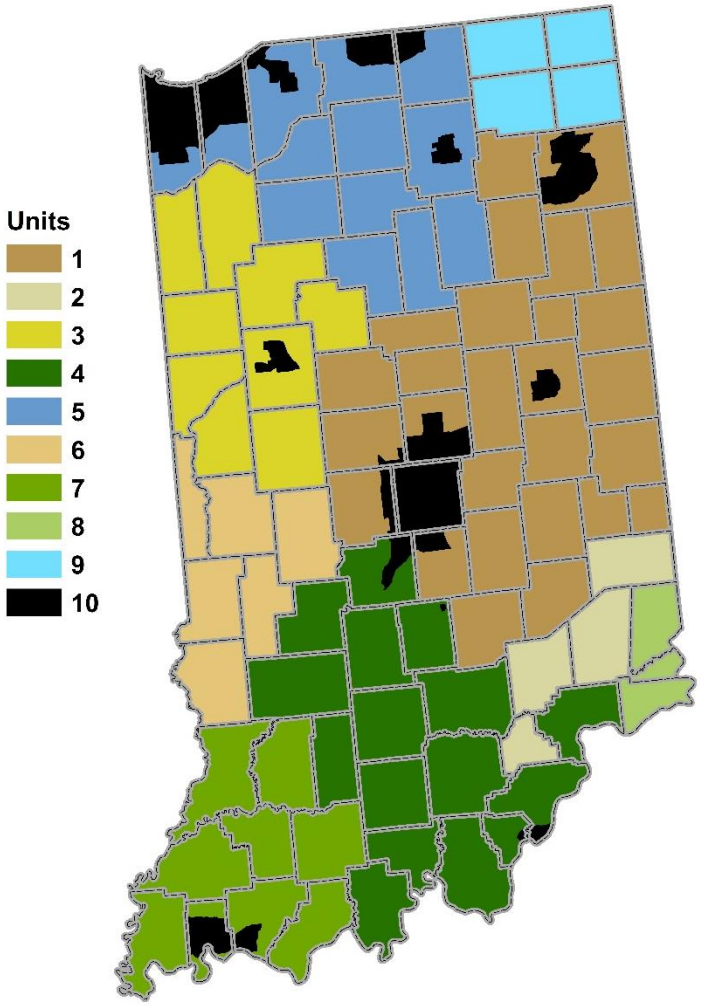


Figure 10-3. Map of white-tailed deer management units (DMUs) in Indiana, adapted for use by Indiana DNR.

ESTIMATING DEER DENSITY ACROSS INDIANA

Zackary J. Delisle and Robert K. Swihart, *Purdue University*

An accurate and precise estimate of the number of white-tailed deer in an area is critical for efforts by Indiana DNR to manage the state's deer herd. Several methods for estimating deer population density are effective (Mandujano and Gallina 1995). However, many of these methods are not suitable for estimating deer density over an area as large as the state of Indiana (Anderson et al. 2013, Collier et al. 2013). Indiana DNR is partnering with Purdue University to evaluate density estimation methods and increase reliability and cost-effectiveness in large-scale monitoring. To accomplish this, a Ph.D. student from the Department of Forestry and Natural Resources at Purdue University will be estimating deer density in Regional Management Units 1, 2, and 3 (Chapter 10), using three different methods: fecal-pellet transects, trail cameras, and aerial surveying from a small airplane. These density estimates will be conducted over the next three years, and will weigh the pros and cons of each method based upon their cost, accuracy, and precision.

For all three of these methodologies, a "distance sampling" approach will be used to estimate deer density (Buckland et al. 1991, Buckland et al. 2001, Buckland et al. 2004). The concept of distance sampling is simple and logical—as the distance from a surveyor increases, the surveyor is less likely to detect a deer (or pellet group). By collecting data on the detection distance for each sighting, researchers can use statistical software to estimate a "detection function," which is the probability of detecting an object based on its distance from the surveyor. The detection function combines counts with an estimate of the effective area sampled to yield density estimates for each of the three methods.

Fecal-pellet surveying is a common method used to estimate deer density (Marques et al. 2001, Urbanek et al. 2012, DeCalesta 2013, Burt et al. 2014). By estimating the density of fecal-pellet groups deposited by deer, density estimates of deer can be calculated if the following is known: the defecation rates of deer (how many times a deer defecates per day), how long fecal-pellet groups persist in nature before degrading beyond recognition, and the time period during which fecal pellets could have been deposited. Surveyors will walk and search randomly placed transects for fecal-pellet groups during March and April. The distance from the transect line to each detected pellet group will be measured in order to calculate the detection function for density estimation. Separate projects will also be conducted to determine how long fecal-pellet groups persist in nature before degrading beyond recognition and the time period over which fecal pellets have been deposited (i.e., the time since leaf-off the previous fall, because leaves will cover all fecal-pellet groups deposited earlier). The results of prior projects that have estimated the defecation rates of deer also will be used.

Motion-triggered trail cameras will be evaluated to determine their efficacy at estimating density in local landscapes and across multiple counties (Jacobson et al. 1997, Curtis et al. 2009, Weckel et al. 2011, Howe et al. 2017). Browning Strike Force HD Cameras (Browning, Morgan, UT) will be deployed in the same areas as the fecal-pellet surveys and mounted on trees in forests, grasslands, pastures, and wetlands. In certain areas of the state, additional cameras will be set on t-posts in row-crop fields, to access deer density in agricultural areas. The distance from trail cameras to photographed deer will be estimated in order to calculate the detection function for camera sampling, which will facilitate an estimation of deer density. Cameras will be deployed in January and retrieved in early spring. All cameras will be marked with a sticker that reads "Purdue University Integrated Deer Management Project." If you happen to come across one of these cameras, please do not touch or alter the camera in any way.

Purdue University also will estimate deer density by flying aerial transects with a small airplane (LeResche and Rausch 1974, White et al. 1989, Pojar et al. 1995, Whittaker et al. 2003, Beaver et al. 2014). The sampling protocol for flying aerial transects is fairly similar to walking transects and searching for fecal-pellet groups on foot. However, instead of walking randomly placed transects, transects will be systematically flown in an airplane; and instead of searching for fecal-pellet groups, infrared cameras will be used to search for deer from the airplane. A high-resolution digital camera also will be used to confirm that a heat signature detected by the infrared camera is actually a deer and not a goat, cow, sheep, coyote, or other mammal that can give off a similar heat signature (Franke et al. 2012). The distance from the centerline of the infrared video to each heat signature will be measured using computer software and will be used to calculate the detection function for estimating deer

density. Aerial transects will be conducted during March in the same areas that fecal-pellet and trail-camera surveying are conducted.

In a state where the vast majority of deer habitat is privately owned, the success of this project depends greatly upon the willingness of Indiana landowners to allow Purdue students and staff to walk transects and place cameras on their land. If a member of the research team asks for permission to sample on your property for the project, please grant them access. In doing so, you will be contributing to the greater understanding and improved management of white-tailed deer in Indiana.

Literature Cited

Anderson, C.W., C.K. Nielsen, C.M. Hester, R.D. Hubbard, J.K. Stroud, and E.M. Schauber. 2013. Comparison of indirect and direct methods of distance sampling for estimating density of white-tailed deer. Wildlife Society Bulletin 37:146–154.

Beaver, J.T., C.A. Harper, R.E. Kissell Jr, L.I. Muller, P.S. Basinger, M.J. Goode, F.T. Van Manen, W. Winton, and M.L. Kennedy. 2014. Aerial vertical-looking infrared imagery to evaluate bias of distance sampling techniques for white-tailed deer. Wildlife Society Bulletin 38:419–427.

Buckland, S.T., D.R. Anderson, K.P. Burnham, and J.L. Laake. 1991. Distance sampling: estimating abundance of biological populations. Chapman and Hall, London, United Kingdom.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, New York, New York, USA.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2004. Advanced distance sampling: estimating abundance of biological populations. Oxford University Press, New York, New York, USA.

Burt, M.L., D.L. Borchers, K.J. Jenkins, and T.A. Marques. 2014. Using mark–recapture distance sampling methods on line transect surveys. Methods in Ecology and Evolution 5:1180–1191.

Collier, B.A., S.S. Ditchkoff, C.R. Ruth, and J.B. Raglin. 2013. Spotlight surveys for white-tailed deer: Monitoring panacea or exercise in futility?. The Journal of Wildlife Management 77:165–171.

Curtis, P.D., B. Boldgiv, P.M. Mattison, and J.R. Boulanger. 2009. Estimating deer abundance in suburban areas with infrared-triggered cameras. Human-Wildlife Conflicts 3:116–128.

DeCalesta, D.S. 2013. Reliability and precision of pellet-group counts for estimating landscape-level deer density. Human–Wildlife Interactions 7:6.

Franke, U., B. Goll, U. Hohmann, and M. Heurich. 2012. Aerial ungulate surveys with a combination of infrared and high–resolution natural colour images. Animal Biodiversity and Conservation 35:285–293.

Howe, E.J., S.T. Buckland, M.L. Després-Einspenner, and H.S. Kühl. 2017. Distance sampling with camera traps. Methods in Ecology and Evolution 8:1558–1565.

Jacobson, H.A., J.C. Kroll, R.W. Browning, B.H. Koerth, and M.H. Conway. 1997. Infrared-triggered cameras for censusing white-tailed deer. Wildlife Society Bulletin 25:547–556.

LeResche, R.E., and R.A. Rausch. 1974. Accuracy and precision of aerial moose censusing. The Journal of Wildlife Management 38:175–182.

Mandujano, S. and S. Gallina. 1995. Comparison of deer censusing methods in tropical dry forest. Wildlife Society Bulletin 23:180–186.

Marques, F.F., S.T. Buckland, D. Goffin, C.E. Dixon, D.L. Borchers, B.A Mayle, and A.J. Peace. 2001. Estimating deer abundance from line transect surveys of dung: sika deer in southern Scotland. Journal of Applied Ecology 38:349–363.

Pojar, T.M., D.C. Bowden, and R.B. Gill. 1995. Aerial counting experiments to estimate pronghorn density and herd structure. The Journal of wildlife management 59:117–128.

Urbanek, R.E., C.K. Nielsen, T.S. Preuss, and G.A. Glowacki. 2012. Comparison of aerial surveys and pellet-based distance sampling methods for estimating deer density. Wildlife Society Bulletin 36:100–106.

Weckel, M., R.F. Rockwell, and F. Secret. 2011. A modification of Jacobson et al.'s (1997) individual branch-antlered male method for censusing white-tailed deer. Wildlife Society Bulletin 35:445–451.

White, G.C., R.M. Bartmann, L.H. Carpenter, and R.A. Garrott. 1989. Evaluation of aerial line transects for estimating mule deer densities. The Journal of Wildlife Management 53:625–635.

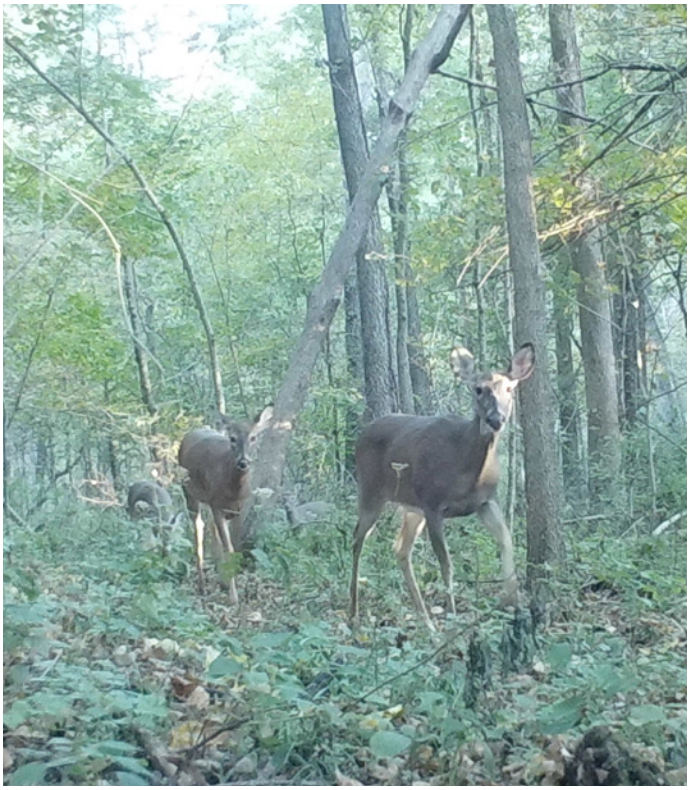
Whittaker, D.G., W.A. Van Dyke, and S.L. Love. 2003. Evaluation of aerial line transect for estimating pronghorn antelope abundance in low-density populations. Wildlife Society Bulletin 31:443–453.

RELATIONSHIP BETWEEN DEER AND HABITAT

Richard D. Sample, *Purdue University*

White-tailed deer selectively browse foliage and twigs of multiple plant species. As deer populations increase, browsing pressure increases. This increased browsing pressure affects the environment in multiple ways, making overabundant deer an important management issue (Waller and Alverson 1997). Deer browsing can reduce plant growth, survival, and reproduction by removing buds, leaves, and flowers. High levels of deer browsing also decreases forest tree recruitment. Preferred browse species like oak and hickory may be largely eliminated from the regeneration layer (Strole and Anderson 1992, Bradshaw and Waller 2016). Consequently, over-browsing leads to a loss of cover, which can increase predation on fawns (Ballard et al. 2001). Furthermore, the loss of important native species further reduces habitat quality because these species provide nutrients that are vital for reproduction, growth, and antler production in deer (Tajchman et al. 2018) Cervidae are characterised by specific requirements for nutrients due to the structure of their gastrointestinal tract. The period of development of male antlers and lactation in females is associated with increased demand for protein, energy, and minerals. The paper presents the importance of Ca and P in cervid nutrition and the effect of these minerals on the health and ontogenic quality of these animals The requirements for these macronutrients in relation to the age and sex of cervids as well as food availability are presented in the study. Periods in animals' life that require particular attention especially in farm breeding and methods for balancing dietary doses are indicated. Additionally, the relationships governing the availability of Ca and P in the environment and the effects of deficiency and excess of these minerals in the deer diet are discussed. Therefore, high browsing pressure not only decreases habitat quality but may also decrease the overall health of a herd.

Given that over-browsing can severely reduce habitat quality for deer, there is a need to accurately assess the impact deer have on vegetation communities. Deer densities and landscape context vary spatially across Indiana. Thus, techniques are needed to assess impacts of herbivory across a range of conditions. Vegetation communities in Indiana vary regionally, with differences



in geology, soils, and land type. Land use and forest management practices also vary regionally, creating mixes of intact native vegetation, highly disturbed and invaded forests, row crops, and developed urban-suburban areas across regions. These factors interact with and determine population sizes of deer, therefore affecting browsing intensities across the state. To determine the impact of deer browsing within Indiana, Indiana DNR has partnered with Purdue University. As part of this partnership, a Ph.D. student from Purdue University will spend three years collecting data to determine browsing intensities, species preferred for browse, and diet composition of deer across three characteristically different regions of Indiana.

This project will use four different techniques to measure browse intensity. The first technique is the twig aging method, which involves aging twigs of common tree species back to a browsed parent twig (Waller et al. 2017). Aging is done by counting the number of bud scale scars, which are areas on the twigs where the previous year's growth started. Therefore, one bud scale scar represents one year of twig age. This method allows for an estimate of the number of years since a twig was browsed and is therefore an indicator of the intensity of deer browse.

The second method for evaluating deer browsing intensity is known as stump sprout method (Royo et al. 2016) Forest managers are frequently confronted with sustaining vegetation diversity and structure in landscapes experiencing high ungulate browsing pressure. Often, managers monitor browse damage and risk to plant communities using vegetation as indicators (i.e., phytoindicators. Many hardwood tree species such as maple and ash produce multiple stump sprouts when they are cut. These sprouts grow quickly and may be rich in nutrients, as they are able to draw on the large energy reserves and uptake capacity of the tree's full root system. Because of this, they make an excellent browse resource for deer, and their vigorous growth allows them to persist when browsed heavily (Poorter et al. 2010)with potentially large consequences for vegetation dynamics, community composition, and species coexistence. Most of our knowledge of resprouting strategies comes from fire-prone systems, but this cannot be readily applied to other systems where disturbances are less intense. In this study we evaluated sapling responses to stem snapping for 49 moist-forest species and 36 dry-forest species from two Bolivian tropical forests. To this end we compared in a field experiment the survival and height growth of clipped and control saplings for a two-year period, and related this to the shade tolerance, carbohydrate reserves, and the morphological traits (wood density, leaf size. To measure browse intensity, this project will create hundreds of stump sprouts across Indiana and compare growth between sprouts that are protected from deer browse (with the use of small cages) and those that are not protected.

The third technique, the oak sentinel method (Blossey et al. 2017), is similar to the stump sprout method. Oak species are highly favored by deer, especially during the spring months, and deer browsing is known to reduce heights of oak (Wakeland and Swihart 2009, Blossey et al. 2017). However, naturally occurring oak seedlings are rare in the forests of Indiana and across most of the Central Hardwood Region. Planting oak seedlings provides a favored yet rare food source for deer and serves as a standardized food source to assess the rate of deer browsing. Therefore, planting oak seedlings and evaluating their growth and survival when protected or unprotected from deer browse (by use of fences) provides a rapid assessment of deer browse intensity.

The final technique to assess browsing intensity is the indicator species technique (Webster and Parker 2000). Three common Indiana plant species (sweet cicely, jack-in-the-pulpit, and white baneberry) have been shown to be useful indicators of deer browse. The heights of these plants can be used to determine the impacts of browsing, as taller average heights of these species have been shown to correlate with lower intensity of deer browsing.

The use of all four methods in this project will provide a more accurate estimation of the intensity of deer browsing across Indiana forests. In addition, a comparison of the four methods will identify which method most reliably and efficiently estimates browse intensity across different regions of Indiana.

Given that deer are selective browsers, understanding which species are preferred for browse under a given set of circumstances should be an integral aspect of a deer management plan. Different regions of Indiana will have varying deer densities, landscape configurations, and land uses. Thus, there is a need to determine how these factors interact to influence what plant species are available and used by deer. Each year, this project will seek to determine what species are available to deer and the rate of browse across species. To do this, the number of woody stems available to deer for browsing (which is defined by having twigs within 6 feet of the ground) and the number of stems that have been browsed will be counted. From this, species preference will be calculated by determining if a species is being consumed at a rate greater than its availability. For example, if oak species comprise 10% of all stems within a woodlot, but 95% of oak stems in the woodlot are browsed, then oak is a preferred species for browse because it is being browsed at a rate much greater than can be explained by its presence alone. However, if 40% of stems in a woodlot are elm, but only 10% of elms are browsed, then elm is not a preferred species.

To further examine which plant species deer are eating within Indiana, this project will use DNA barcoding to identify plant species in fecal pellets. By looking at the plant DNA found in pellets collected across three regions of Indiana, this project will determine what plant species deer are eating and what percentage of those species constitute an individual deer's diet. Together, these three goals will inform Indiana DNR of the impact deer are having on the environment and if the populations need to be adjusted to improve habitat quality.

Literature Cited

Ballard, W. B., D. Lutz, T. W. Keegan, L. H. Carpenter, and J. C. deVos. 2001. Deer-Predator Relationships: A Review of Recent North American Studies with Emphasis on Mule and Black-Tailed Deer. Wildlife Society Bulletin (1973-2006) 29:99–115.

Blossey, B., A. Dávalos, and V. Nuzzo. 2017. An indicator approach to capture impacts of white-tailed deer and other ungulates in the presence of multiple associated stressors. AoB PLANTS 9:plx034.

Bradshaw, L., and D. M. Waller. 2016. Impacts of white-tailed deer on regional patterns of forest tree recruitment. Forest Ecology and Management 375:1–11.

Poorter, L., K. Kitajima, P. Mercado, J. Chubiña, I. Melgar, and H. H. T. Prins. 2010. Resprouting as a persistence strategy of tropical forest trees: relations with carbohydrate storage and shade tolerance. Ecology 91:2613–2627.

Royo, A., D. W. Kramer, K. V. Miller, N. P. Nibbelink, and S. L. Stout. 2016. The canary in the coal mine: Sprouts as a rapid indicator of browse impact in managed forests. 69:269–275.

Strole, T. A., and R. C. Anderson. 1992. White-Tailed Deer Browsing: Species Preferences and Implications for Central Illinois Forests. Natural Areas Journal 12:139–144.

Tajchman, K., Z. Steiner-Bogdaszewska, and P. Zolkiewski. 2018. Requirements and Role of Selected Micro and Macro Elements in Nutrition. Applied Ecology and Environmental Research 16:7669–7686.

Wakeland, B., and R. K. Swihart. 2009. Ratings of White-Tailed Deer Preferences for Woody Browse in Indiana. Proceedings of the Indiana Academy of Science 118:96–101.

Waller, D. M., and W. S. Alverson. 1997. The White-Tailed Deer: A Keystone Herbivore. Wildlife Society Bulletin (1973-2006) 25:217–226.

Waller, D. M., S. E. Johnson, and J. C. Witt. 2017. A new rapid and efficient method to estimate browse impacts from twig age. Forest Ecology and Management 404:361–369.

Webster, C. R., and G. R. Parker. 2000. Evaluation of Osmorhiza claytonii (Michx.) C.B. Clarke, Arisaema triphyllum (L.) Schott, and Actaea pachypoda Ell. as Potential Indicators of White-tailed Deer Overabundance. Natural Areas Journal 20:176–188.

MEASURING HUMAN VALUES TOWARD DEER OF INDIANA RESIDENTS

Taylor Stinchcomb, *Purdue University*

As both white-tailed deer (henceforth deer) and human populations expand across rural to urban landscapes, deer-human interactions become a regular occurrence. Deer management typically emphasizes controlling deer populations and damage to property, but emerging positive values for wildlife may reflect desires to protect deer, even when wild populations threaten private property or livelihoods. Different values for deer among different social groups could lead to social conflicts that make management of deer difficult, especially when managers try to meet the needs of all residents in the state. More work is needed to understand how we can measure human values for and experiences with deer, and what role they play in social conflict over wildlife management.

Addressing social conflicts related to wildlife requires that we re-examine existing management frameworks. In the U.S., wildlife and other natural resources are ideally managed as public trusts, whereby appointed or elected government officials ("trustees") set broad, regional- or national-level goals for wildlife conservation and management. State resource agencies ("trust administrators") like Indiana DNR carry the primary responsibility for applying these goals to local contexts and managing wildlife populations for the equal benefit of their constituents (the residents of Indiana). The philosophy behind this framework suggests that natural resources should be managed following principles of common property, sustainability, widespread public participation, fair cost-benefit distributions, and unbiased consideration of the needs of all citizens.

Attaining the public trust ideal in deer management faces several challenges. First, effectively involving the public in management requires that managers and participants (or stakeholder groups) agree on deer population goals and understand who carries what responsibilities in the decision-making process. Coming to agreed-upon goals can be incredibly time consuming, and true consensus may never be reached due to conflicting values. Second, public interests in deer management to date have been limited to a select group of stakeholders, driven by mitigating deer-related impacts on property and livelihoods. This typically fails to account

for emotional, cultural, and situational factors that can lead to human-human conflicts over deer management. Third, the informational gap between managers and the public is bi-directional: managers remain unaware of the degree to which public perceptions of deer vary, and the public is often unaware of the possibility and/or feasibility of different management approaches. Finally, deer-human interactions tend to depend on local contexts, demanding that management approaches adapt to changes in both social and ecological variables within a single state.

Our study begins to integrate the social dimension into deer management in Indiana, aiming to address the above challenges using a combination of semi-structured interviews, surveys, and comparative analysis to understand the following questions:

1. How do Indiana residents and natural resource management professionals currently perceive, value, and experience deer populations across the state? What outcomes do residents and managers desire from deer management?
2. What is the existing relationship between Indiana residents and deer management professionals? How can this relationship be shifted to more equitably incorporate stakeholder interests?
3. How can the social and ecological data be integrated effectively to inform deer decision-making in Indiana?

We are currently conducting one-on-one interviews with Indiana residents and professionals from six broad categories: professional foresters, woodland owners, farmland owners, hunters, urban/suburban residents, and natural resource or wildlife professionals. These interviews aim to determine the range of values, experiences, and concerns related to deer that exist among Indiana residents and management professionals.

Results from these interviews will help us develop a survey that measures deer-related values, attitudes, and experiences among a much larger sample of Indiana residents. The survey will refine our understanding of how interactions with deer vary across Indiana.

We will also examine how the concerns and goals of deer management professionals relate to residents' reported concerns and desired outcomes. Examining this relationship will help us understand what trade-offs are being made in deer decision-making, and whether potentially diverse values for deer could be incorporated into Indiana DNR's revised deer management plan.

Residents interested in telling us about their experiences with white-tailed deer may contact Taylor Stinchcomb at tstinchc@purdue.edu to learn how to participate in an interview or survey.

APPENDIX A. UNDERSTANDING DMU AND COUNTY DEER DATA

The DMU and County Deer Data are tools used by Indiana DNR to monitor trends related to the deer population. Those trends are monitored over time to make decisions about harvest goals. This section discusses the data and how they are applied to make harvest decisions in each DMU and Indiana county.

Population Indices

A generally accepted fact in wildlife management is that, except for in very limited situations, it is effectively impossible to directly measure wildlife populations on a large scale. Wildlife managers can never know exactly how many individuals of a species are present on the landscape. On a small scale, such as on someone's property that is managed for deer, the deer can be counted, and an estimated population can be calculated. But on a broad scale, this can be nearly impossible. Thus, biologists use measurable factors that are related to the trends in the population. These factors create a population index.

With an ideal population index, the index number would go up or down in a synchronous fashion with the deer population. A common index employed by wildlife managers to assess deer populations on their property is the spotlight count. Individuals drive around in a predetermined route and count the deer they see. The amount of area they can see while driving is estimated, and the visibility of the deer is also taken into consideration. The wildlife manager then conducts multiple routes over time; for example, five more times over the next two weeks to account for differences in movement by the deer. At the end, the wildlife manager calculates how many deer were seen per square mile, then that number is applied to the entire property. An important aspect of the survey is that the area sampled is representative of the property as a whole. So, if a property is 70% upland and 30% wetland, then that same habitat in the same percentages should be covered in the spotlight count route. If not, other adjustments using math and statistics would need to be made to account for those differences. Once the manager has the count (for example, 30 deer per square mile), that does not mean there are exactly that many (30) deer per square mile on that property. That is just the index value.

The true usefulness of an index is only realized over time. Each year, the wildlife manager plans out his spotlight counts in the exact same fashion. Ideally, there are no differences from year to year. If there are, that has to be taken into account during the calculations. Over a six-year period, the manager may count 30 deer/sq. mi., 32 deer/sq. mi., 35 deer/sq. mi., 27 deer/sq. mi., 36 deer/sq. mi., and 34 deer/sq. mi. The trend in these estimates is what is important, not the individual numbers. Remember, this is just an indicator of what the deer population is doing. In this example, there is a general increase in the deer population. If the manager is happy with this, he would maintain his management strategies until another indicator, such as the amount of fawning habitat or forage quality, reaches a point at which the manager would need to increase the harvest to decrease the deer population. Because the spotlight counts may be expensive compared to doing a habitat survey, once the manager knows how the habitat survey is affected by a changing deer population, the manager may decide to only use the habitat survey as an indicator of the direction of the deer population.

Notice in the example spotlight survey counts above, there was a sharp drop in the measured deer population during the fourth spotlight survey. This could be caused by a variety of reasons such as unseasonably hot or cold weather that significantly altered deer movements; there could have been a significant modification in the habitat, such as a 5-year burn; neighboring properties could have changed their management practices; or there could have been a significant mortality event caused by EHD or another disease. In this case, it would have been a mistake for the manager to try to immediately make a change to offset that decrease, especially if the manager did not know exactly why the change occurred. Similarly, this is why the Indiana DNR does not immediately respond to sharp changes in population indices; rather, we wait and observe the trends over time. A sharp change in the deer harvest regulations based on any given year's data could result in wild changes in the deer population, whereas the general goal of managing a hunted species is to minimize these changes.

Indices Used by Indiana DNR to Monitor Deer Population Trends

The primary indices Indiana DNR uses to monitor deer population trends include: 1) various harvest metrics such as number of deer harvested per county and the ratio of males to females harvested, 2) trends in deer damage complaints, 3) trends in deer-vehicle collisions, and 4) trends in hunter and landowner attitudes. The data are examined for significant trends as the results change over time. One way that biologists do this is by looking at the Effect Size of the change from a five-year average.

Effect size is a statistic that compares one statistic to another statistic measured in the same fashion. In this case, the current year's deer harvest and DVCs are compared with a five-year average of the same value to determine how much the current year's data differ from the average. If the raw data are examined on their own, it can be difficult to determine if a change is significant. For example, in Boone County from 2017 to 2018, there was an increase in DVC by 25 collisions. Now the question is, "Is this a big or important increase in DVCs"? When the 2018 value is compared with the five-year average (131 DVC) instead of just the previous year's, the increase in DVCs is only 3. But is 3 DVCs a big increase? To determine that, the effect size statistics are calculated for each index. When 2018's data point is compared to the five-year average (2013-2017), it is only an increase of 0.24 standard deviation (SD). A standard deviation is a statistic that looks at a number of different magnitudes on the same scale. In Boone County, there was an increase of 0.24 SD. In Bartholomew County, the increase in DVCs was -0.01 SD (really no increase from the previous five years). In Clark County, there was a decrease in DVCs of -3.45 SD, which is huge, especially when compared to other counties. So, the effect size allows for comparison between counties without having to look at the raw data and then making a separate judgment each time. Right now, an increase or decrease of less than two SD is considered non-significant. Part of the research Indiana DNR is conducting aims to determine the level of change that should be considered significant.

The effect size also allows for the comparison of different data types from different indices. For example, in the total harvest trend in Clark County, there was a decrease in the harvest by -5.58 SD. This would be considered a significant decrease in the harvest over time. Looking at the trend in SDs, the harvest has been declining in Clark County for several years. A decline in harvest only means that fewer deer were harvested—it does not explain why. However, the decline in harvest compared with the trend in DVCs shows a general decline in DVCs as well. This might indicate an actual decline in the deer population in that county.

Requests for deer damage permits have been included in the past as a metric for assessing damage caused by deer. However, because the individual number of permits requested by landowners is so low, typically fewer than five to 10 per county, this metric is only useful in general terms. Indiana DNR is currently working to convert this number into cost of damage and/or acres damaged.

Another trend that is monitored that is linked to population size is satisfaction of hunters and landowners with the perceived size of the deer population. Historically on a three-year cycle and now annually, Indiana DNR conducts surveys to assess hunters and farming landowners for a variety of factors, including satisfaction. Declining hunter satisfaction and increasing desires by landowners for more deer may be an indicator of a declining deer herd. Increasing satisfaction by hunters with deer management in the state and decreasing desires of landowners for more deer may be an indicator of an increasing herd. It is unclear how this index tracks with deer populations other than in a much more generalized fashion because many factors influence hunter and landowner satisfaction. In both cases, an attitude score is calculated each time a survey is conducted, and the percentage of change is used to gauge the change over time.

When each of these four indices are considered together, a general trend can form for what is occurring with the deer population. Again, these data are just used to monitor the generalized trend in the deer data. It is unclear what the actual population is, but the trends provide relative insight. Currently, there is a research project underway with wildlife researchers at Purdue University to re-verify the relationship of the indices currently used with the deer population size and to identify new cost-effective indices that could be used in addition to those currently employed.

Indices Used by Indiana DNR to Determine Desired Trends in Deer Populations

The various indices discussed that are used to monitor population trends are just the first step in setting harvest limits. The next step is to look at factors that affect what the desired direction of the deer population should be. In general, various human dimension surveys provide this input. In the DMU and County Deer Data sections, most of these data are included on the third and fourth pages of each region and county's report. Indiana DNR looks at a combination of factors to assess what trends in the deer population Indiana's hunters and landowners want, including the desired management priorities, hunter satisfaction with deer management, landowner desire for the direction of the deer population, and satisfaction with various management practices. Other factors such as the presence of disease or deer reduction zones are also considered.

This year, the DMU and County Deer Data Sheets include a more detailed analysis of hunter and non-hunter opinions. The response to the individual deer management survey questions are presented graphically and were also summarized using factor analysis. The Deer Management Survey provides a large number of questions that offer a wealth of information, but can be overwhelming to analyze individually, particularly when the data are further broken down into counties or management units. Although we ask many questions, we are more interested in the underlying thoughts and feelings that drive the responses than in individual answers. In this scenario, factor analysis is a useful tool for aggregating, visualizing, and understanding patterns in survey responses. Factor analysis is a statistical method used to cluster shared variability in survey responses into a smaller number of unobserved latent variables or factors. This analysis assumes that the questions we ask have a similar pattern of responses because they are all associated with an underlying factor that we can extract and measure. The relationship between each question and the underlying factor is expressed as a factor loading, with larger absolute values indicating a stronger correlation with the factor.

We performed two factor analyses on questions from the deer management survey. The first factor analysis was performed on questions asked of all individuals that participated in the survey (Figure A-1). If hunters harvested deer in a county other than one in which they lived, they were given the option of answering these questions about both counties. The second factor analysis was performed on questions asked only of individuals that hunted about the county in which they hunt (Figure A-2). In the first factor analysis, two important factors were extracted (Figure A-1). The first factor was related to questions about the deer population size, and the second was related to questions about deer management (Figure A-1). In the second factor analysis, a single factor was extracted and was most strongly associated with questions related to changes in deer harvest over the past five years (Figure A-2). The first factor analysis accounted for approximately 62% of the variation in the responses, and the second factor analysis accounted for approximately 46% of the variation in the responses.

We can see clear differences in the participant groups during both years of the deer management survey for the population size factor (Figure A-3). Non-hunters were fairly neutral about the deer population size, whereas hunters believed it was too low, particularly where they hunt (Figure A-3). For the deer management factor, we see changes between groups and between the two years (Figure A-4). Non-hunters were more satisfied with deer management than hunters, and hunters were more satisfied with deer management where they live than where they hunt (Figure A-4). All groups of participants were more satisfied with management in 2019 than in 2018 (Figure A-4). The hunter opinion factor also increased slightly between 2018 and 2019 (Figure A-5). Overall, these factors help provide a clearer picture of deer management in Indiana, and we will continue to track how they change over time.

Putting it All Together to Form Management Recommendations for Each County

Once the data are collected and analyzed by the Deer Research Program, it is shared with various biologists, administrators, and the public. Indiana DNR private lands biologists examine the data provided, in addition to data they may have collected throughout the year, such as additional damage reports or comments from individuals living within those counties. They then make recommendations for the upcoming year's bonus antlerless quotas for the counties they oversee. Indiana DNR

accepts comments and recommendations from Indiana DNR Law Enforcement conservation officers who are assigned to each county, as well as accepting comments directly from the general public. Indiana DNR administrators collect those comments and recommendations and make their own recommendations. The Deer Research Program also makes recommendations exclusively on the data collected throughout the year.

Once all of the information and recommendations are gathered, a group of Indiana DNR administrators, representatives from Indiana DNR Law Enforcement and biologists from the Deer Research Program meet to discuss the data and recommendations provided by their respective sections. Once a recommendation for the upcoming year's bonus antlerless quotas is agreed upon by the group, those recommendation are recorded and presented to the Indiana DNR director for approval.

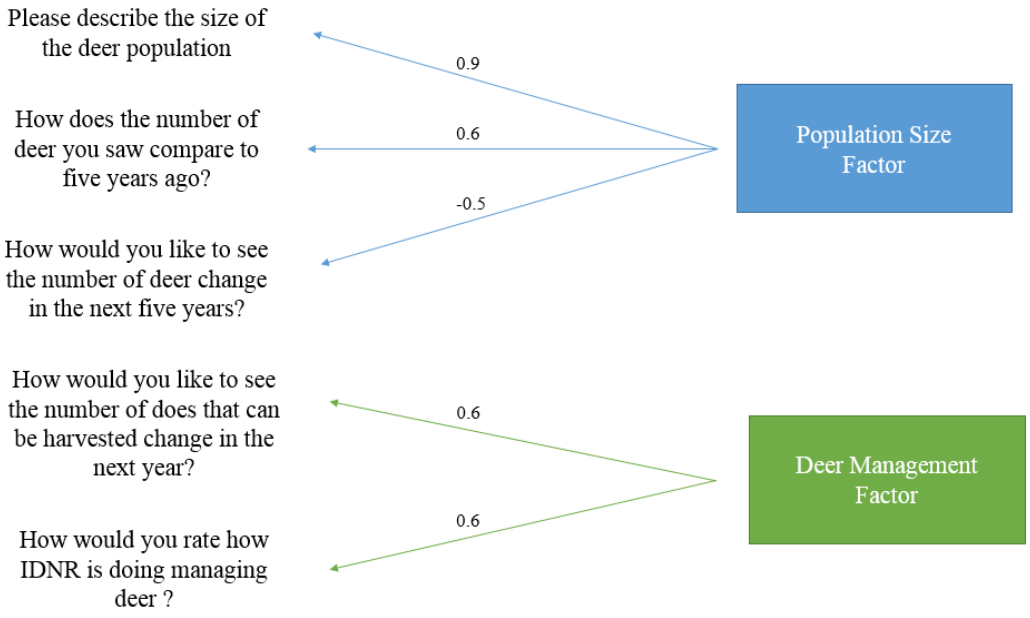


Figure A-1. Questions asked to all participants in the deer management survey and how they relate to factors extracted via factor analysis. The numbers represent factor loadings with larger absolute values indicating a stronger association.

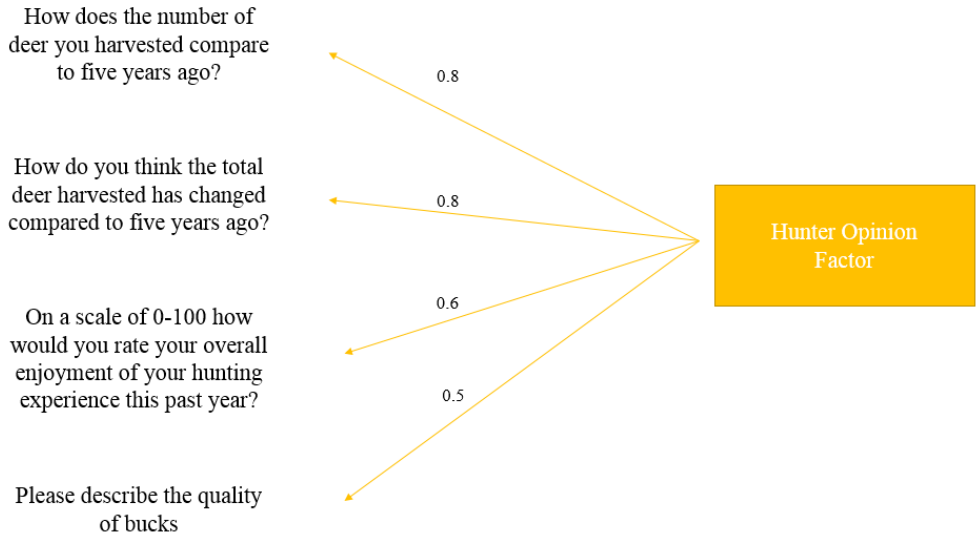


Figure A-2. Questions asked only of hunters in the deer management survey and how they relate to the factor extracted via factor analysis. The numbers represent factor loadings with larger absolute values indicating a stronger association.

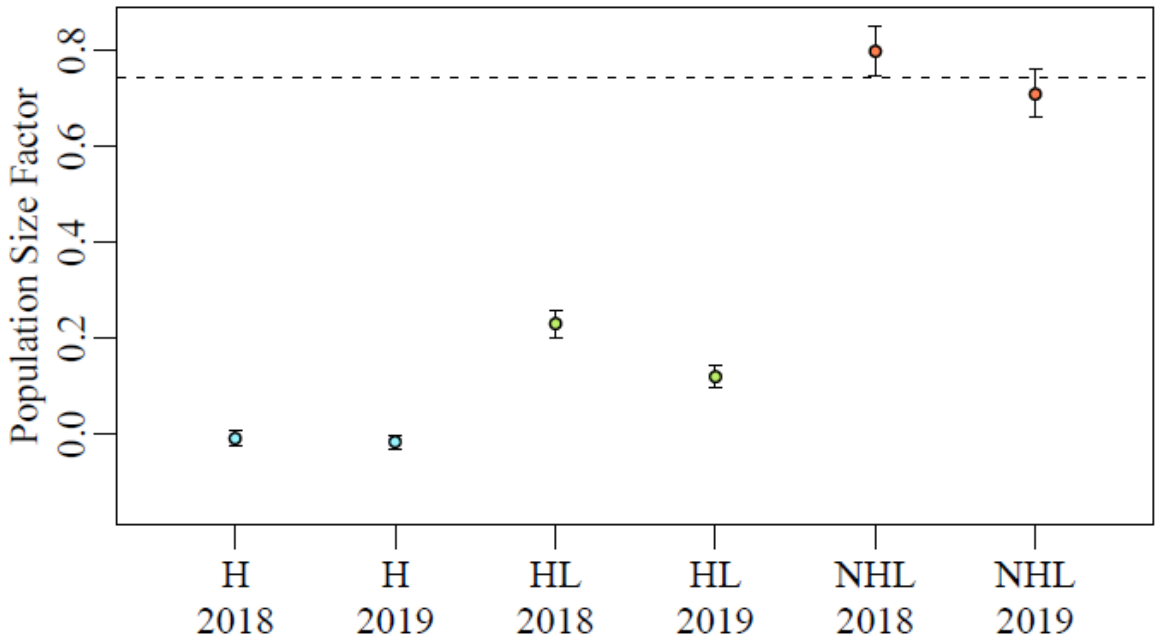


Figure A-3. Mean population size factor scores (with 95% confidence intervals) for hunters in the county where they hunt (H), hunters in the county where they live (HL), and non-hunters in the county where they live (NHL). The dashed line represents the score if all questions were answered neutrally.

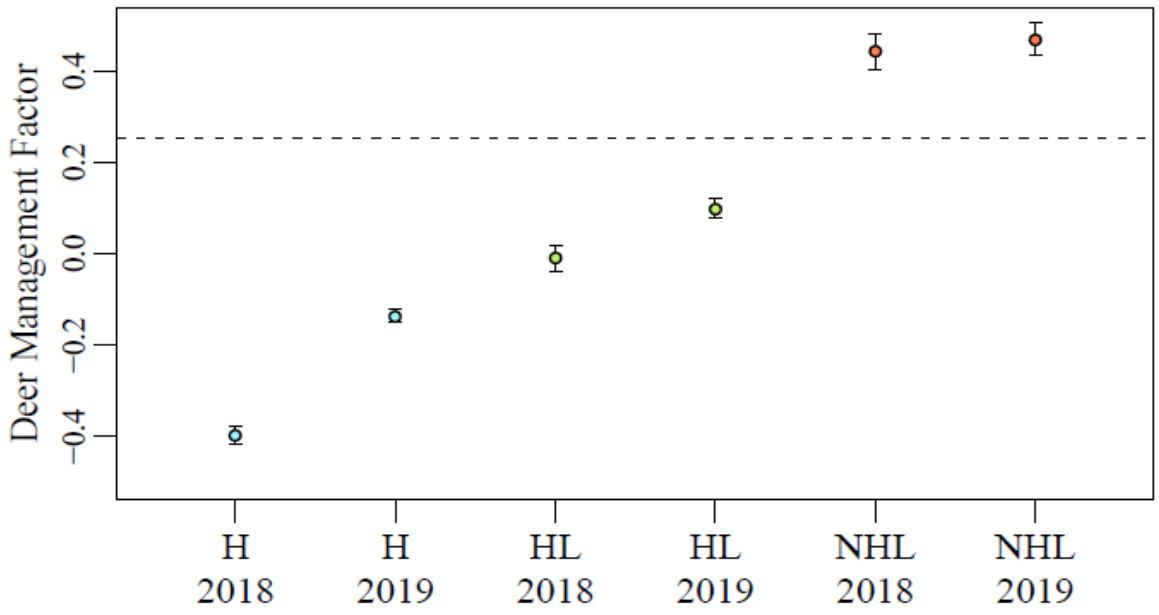


Figure A-4. Mean deer management factor scores (with 95% confidence intervals) for hunters in the county where they hunt (H), hunters in the county where they live (HL), and non-hunters in the county where they live (NHL). The dashed line represents the score if all questions were answered neutrally.

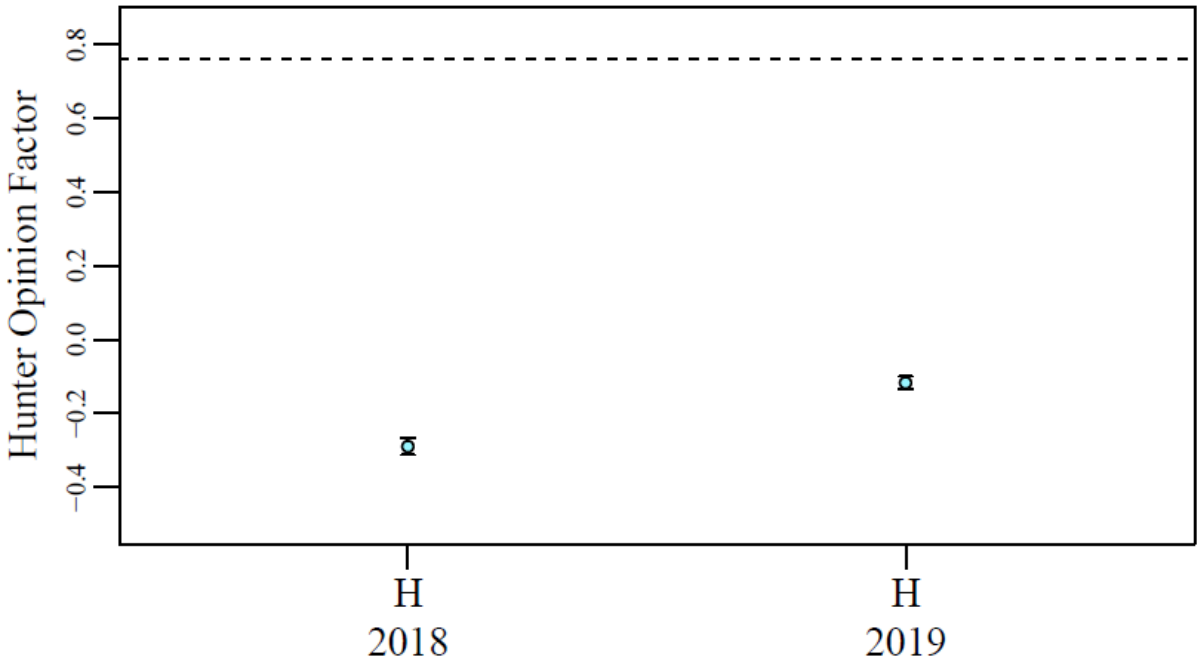


Figure A-5. Mean hunter opinion factor scores (with 95% confidence intervals) for hunters in the county where they hunt (H) in 2018 and 2019. The dashed line represents the score if all questions were answered neutrally.

APPENDIX B_DMU DEER DATA SHEET 2018

DMU 1: Northwest

6/26/2019

Total Square Miles: 6,019
Square Miles of Deer Habitat: 1,253
Percent Deer Habitat: 21

Table 1. Total harvest, buck harvest, and doe harvest (error approximately 1 percent). Damage permits are issued by DNR to landowners to control deer damage. Deer vehicle collisions (DVC) are reported by the Indiana Department of Transporation. Mean CBAQ is the average county bonus antlerless quota of all counties in the DMU. The trend in total harvest, buck harvest, doe harvest, and DVCs are in standard deviations (SD) and are equivalent to effect size. A change greater than 2 SD is considered both a large and statistically significant effect size.

Year	Total	Total Trend in SD	Buck Harvest	Buck Trend in SD	Buck Harvest per SQ MI Habitat	Doe Harvest	Doe Trend in SD	Doe Harvest per SQ MI Habitat	% Doe in Harvest	Damage Permit Deer Taken	Total DVC	DVC Trend in SD	Mean CBAQ
2009	24,688		11,806		9.42	12,882		10.28	52.18		4,082		6.31
2010	25,088	1.28	12,043	1.21	9.61	13,045	1.28	10.41	52.00		3,895	-0.52	6.38
2011	22,870	-0.42	11,139	-0.82	8.89	11,731	-0.21	9.36	51.29		3,727	-3.31	7.08
2012	23,755	-0.16	10,527	-3.27	8.40	13,228	1.36	10.56	55.69		3,340	-3.73	6.77
2013	20,195	-4.53	9,402	-3.27	7.50	10,793	-2.84	8.61	53.44		3,441	-1.24	5.77
2014	19,810	-1.80	9,456	-1.43	7.55	10,354	-1.90	8.26	52.27		3,304	-1.27	4.38
2015	19,854	-1.09	9,968	-0.48	7.96	9,886	-1.50	7.89	49.79		3,494	-0.18	4.31
2016	19,150	-1.15	9,867	-0.31	7.87	9,283	-1.45	7.41	48.48	165	3,190	-1.62	4.62
2017	17,360	-1.75	8,451	-3.06	6.74	8,909	-1.19	7.11	51.32	295	3,471	0.30	3.31
2018	18,245	-0.91	9,463	0.06	7.55	8,782	-1.39	7.01	48.13	188	3,412	-0.07	2.62

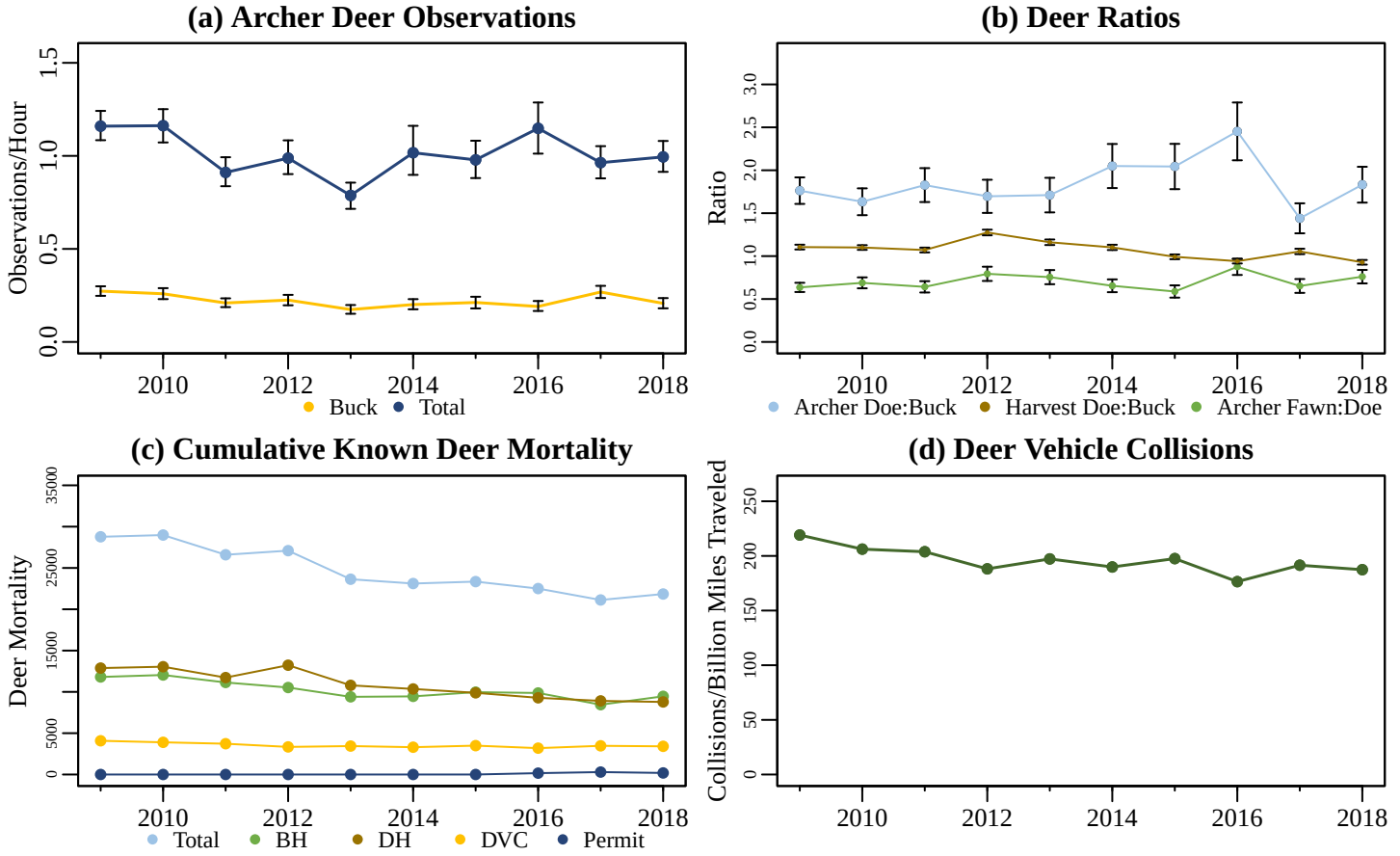


Figure 1. (a) Total deer and buck observations based on the Archer Index. (b) Annual doe:buck ratios and fawn:doe ratios based on the Archer Index and harvest records. (c) The total known annual deer mortality based on buck harvests (BH), doe harvests (DH), deer vehicle collisions (DVC), and deer permit takes. (d) Deer vehicle collisions per billion miles traveled.

DMU 1: Northwest

6/26/2019

Total Square Miles: 6,019
Square Miles of Deer Habitat: 1,253
Percent Deer Habitat: 21

Table 2. Estimated number of antlered (A) and antlerless (AL) deer harvested per hunter. Estimated totals may not match exactly with total number of deer harvested. Reporting errors are examined and investigated as they are located; therefore, subsequent reports may contain corrected totals.

Year	Total Hunters	0 A	1 A	2 A	3 A	0 AL	1 AL	2 AL	3 AL	4 AL	5 AL	6 AL	7 AL	8 AL	9 AL	10 AL
2015	14,201	6,287	7,808	105	1	5,513	6,442	1,661	397	112	48	16	7	4	0	0
2016	13,673	5,901	7,676	95	1	5,448	6,060	1,577	404	113	40	21	4	5	1	0
2017	12,272	5,752	6,401	117	1	4,396	5,822	1,549	325	122	35	11	7	4	0	0
2018	12,983	5,517	7,331	133	2	5,092	5,818	1,600	351	82	22	10	1	2	3	1

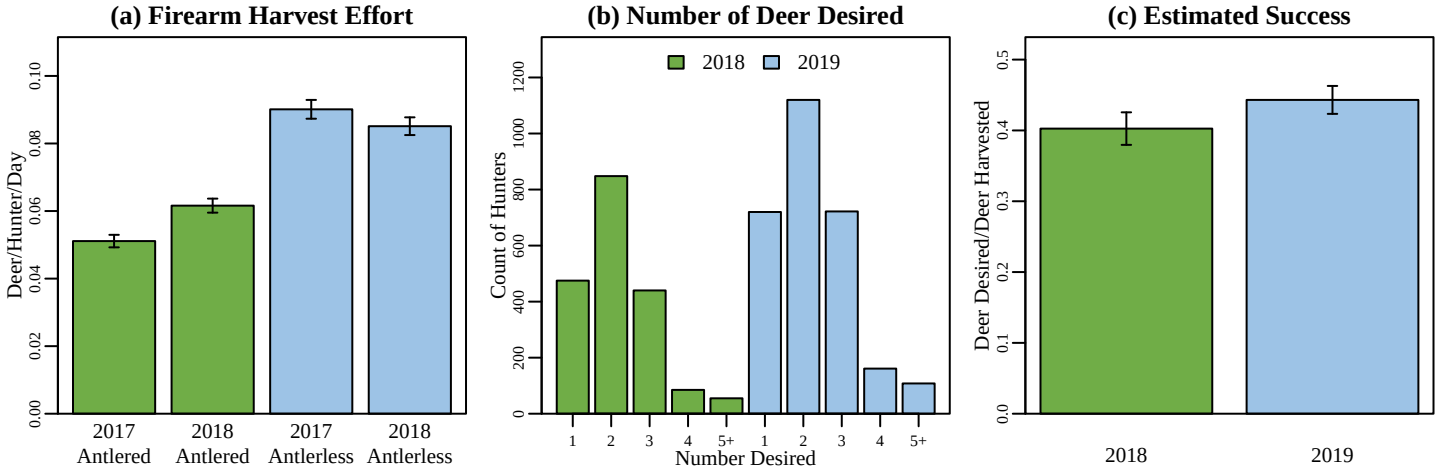


Figure 2. (a) Firearm harvest/effort is the number of deer killed by firearms per hunter divided by the mean number of days hunted per hunter during the firearm season based on data reported in the deer management survey. (b) The annual count of hunters wishing to harvest each number of deer reported in the deer management survey. (c) Success rate is estimated from the deer management survey as the Number of Harvested Deer/Number of Deer Desired (reported only; does not account for attempts that were not made).

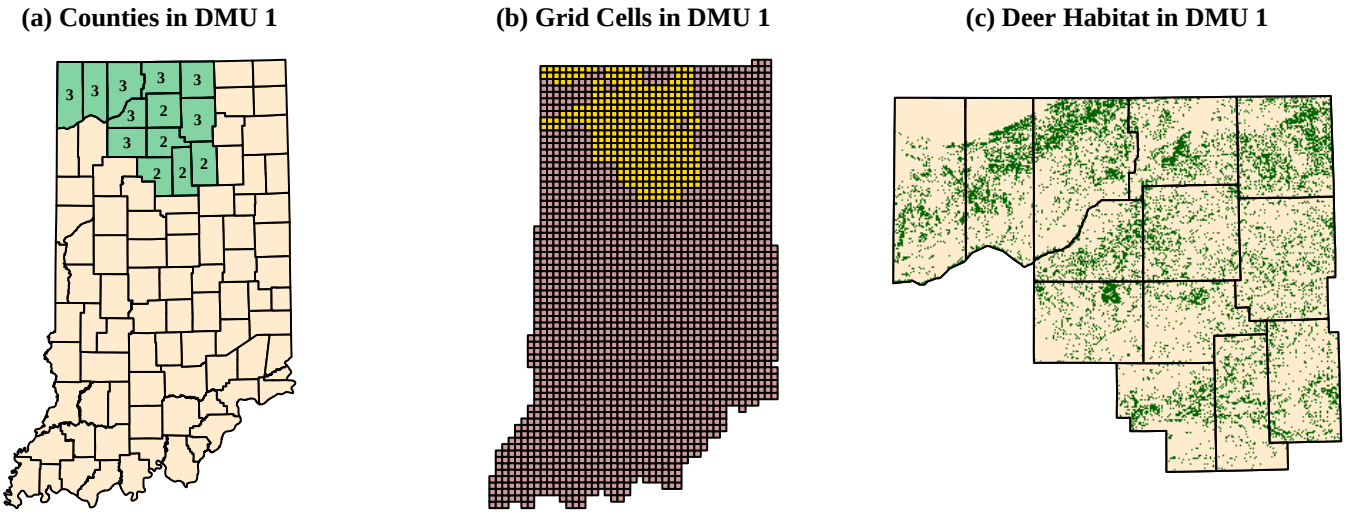


Figure 3. (a) Counties included in DMU 1 for summarizing harvest statistics. Labels are the 2018 county bonus anterless quotas. (b) 4 x 4 mile grid cells included in DMU 1 for summarizing annual deer management survey statistics. (c) Green represents the land use types classified as deer habitat in DMU 1.

DMU 1: Northwest

6/26/2019

Deer Management Survey Results

DNR Management Satisfaction: State

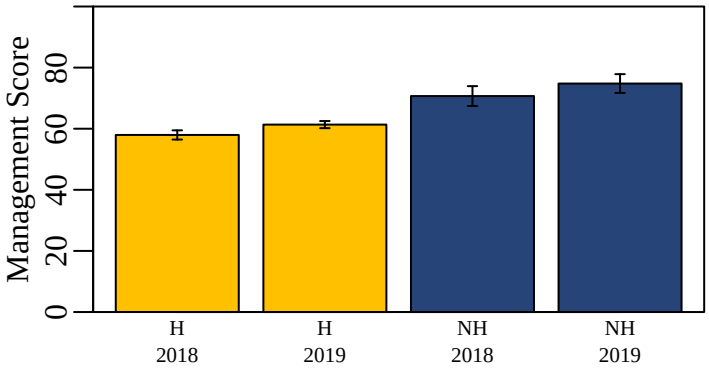


Figure 4. Hunters (H) and nonhunters (NH) were asked to score the DNR's statewide deer management on a scale of 0 (poor) to 100 (excellent).

DNR Management Satisfaction: County

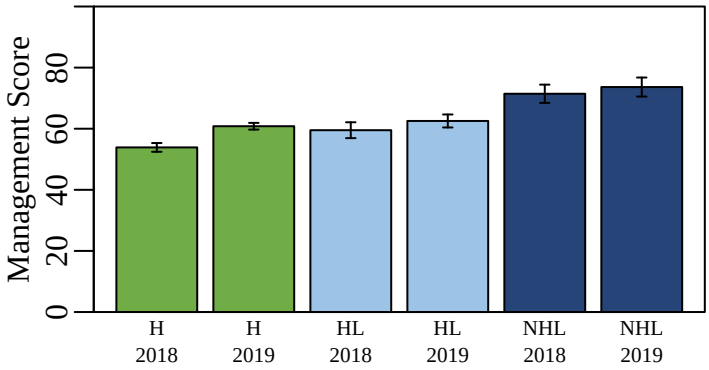


Figure 5. Opionion of county deer management on a scale of 0 (poor) to 100 (excellent) from individuals who hunt in a county (H), individuals that live in a county but hunt elsewhere (HL), and nonhunters that live in a county (NHL).

County Bonus Antlerless Quota

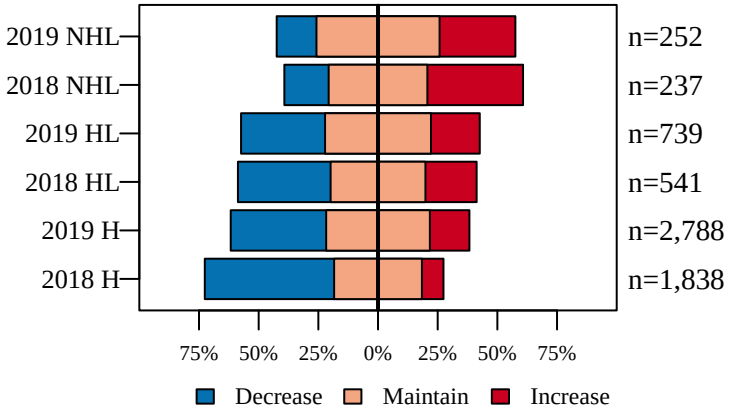


Figure 6. Opinion on how the County Bonus Antlerless Quota should change from nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Deer Population Size

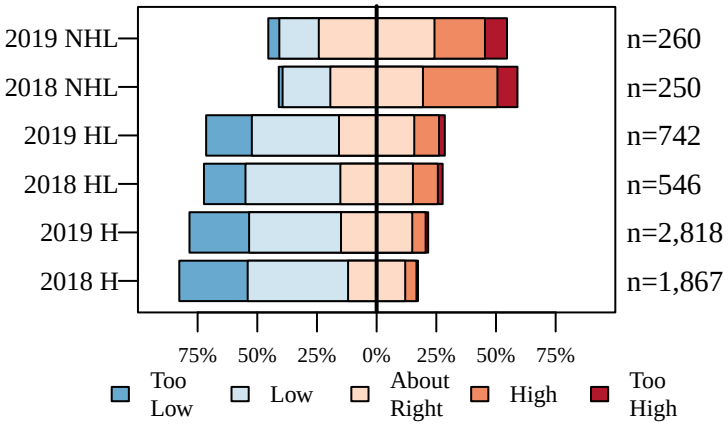


Figure 7. The current size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Perceived Population Change

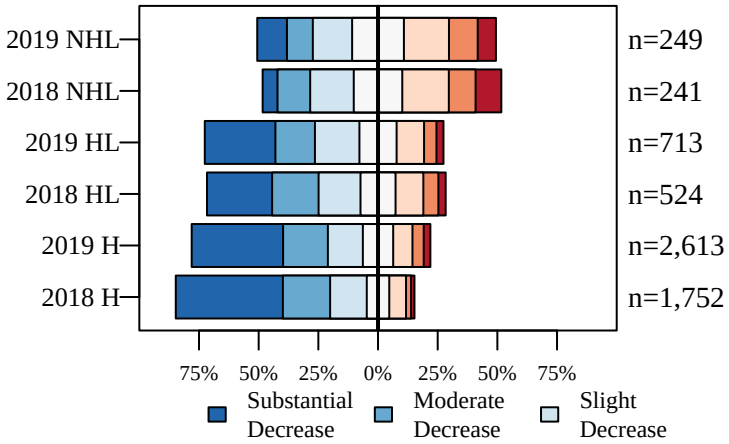


Figure 8. The number of deer seen compared to five years ago described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Desired Population Change

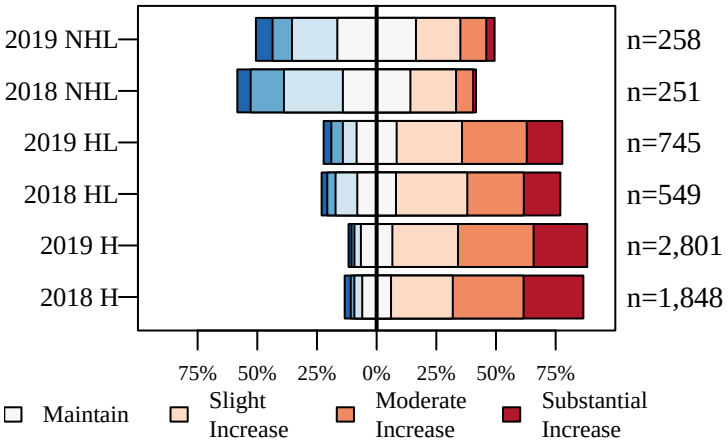


Figure 9. The desired change in the size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

DMU 1: Northwest

6/26/2019

Deer Management Survey Results

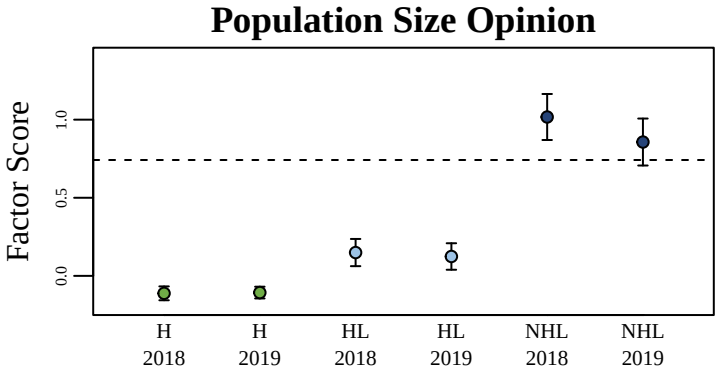


Figure 10. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on the deer population size. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

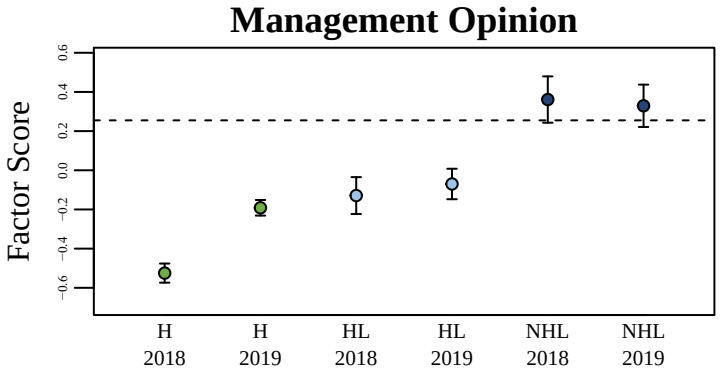


Figure 11. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on deer management. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

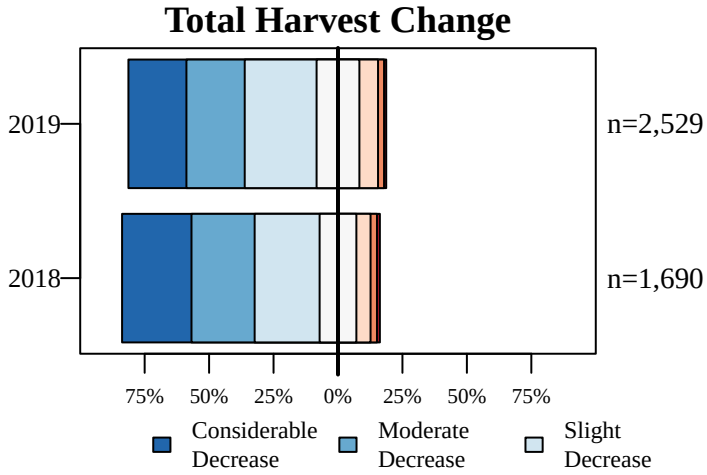


Figure 12. Opinion of hunters on how the total number of harvested deer has changed over the last five years.

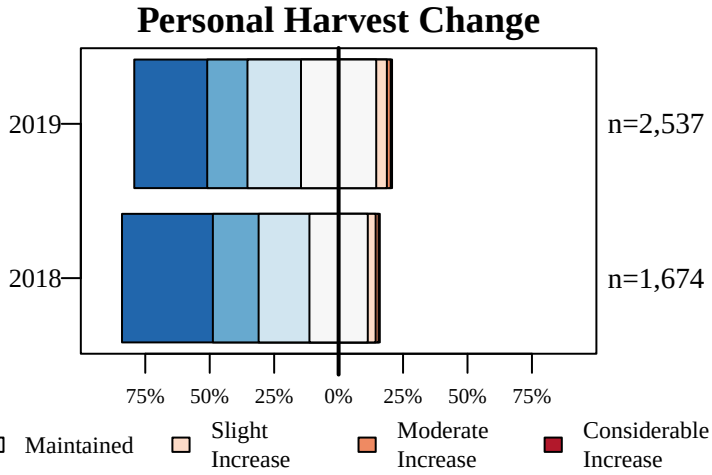


Figure 13. Opinion of hunters on how their personal number of harvested deer has changed over the last five years.

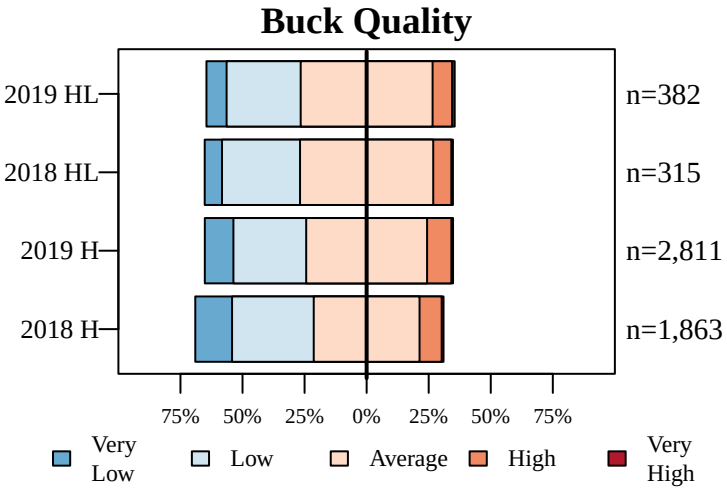


Figure 14. Hunters describe the quality of bucks where they live (HL) and where they hunt (H).

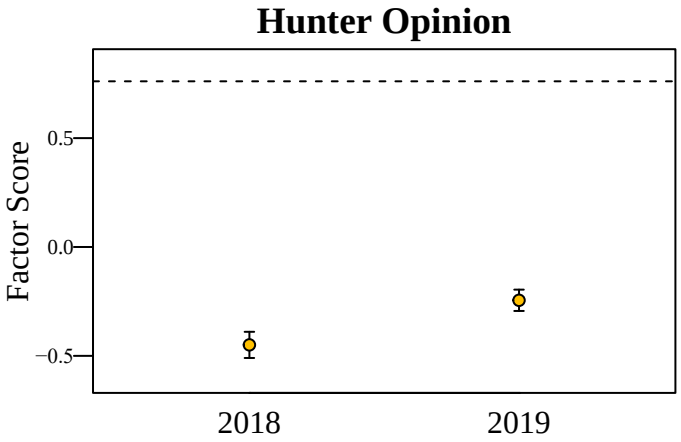


Figure 15. Hunter opinon score over two years of the deer management survey. The score was aggregated using factor analysis of questions asked only to hunters. The dashed line represents the score if all questions were answered neutrally.

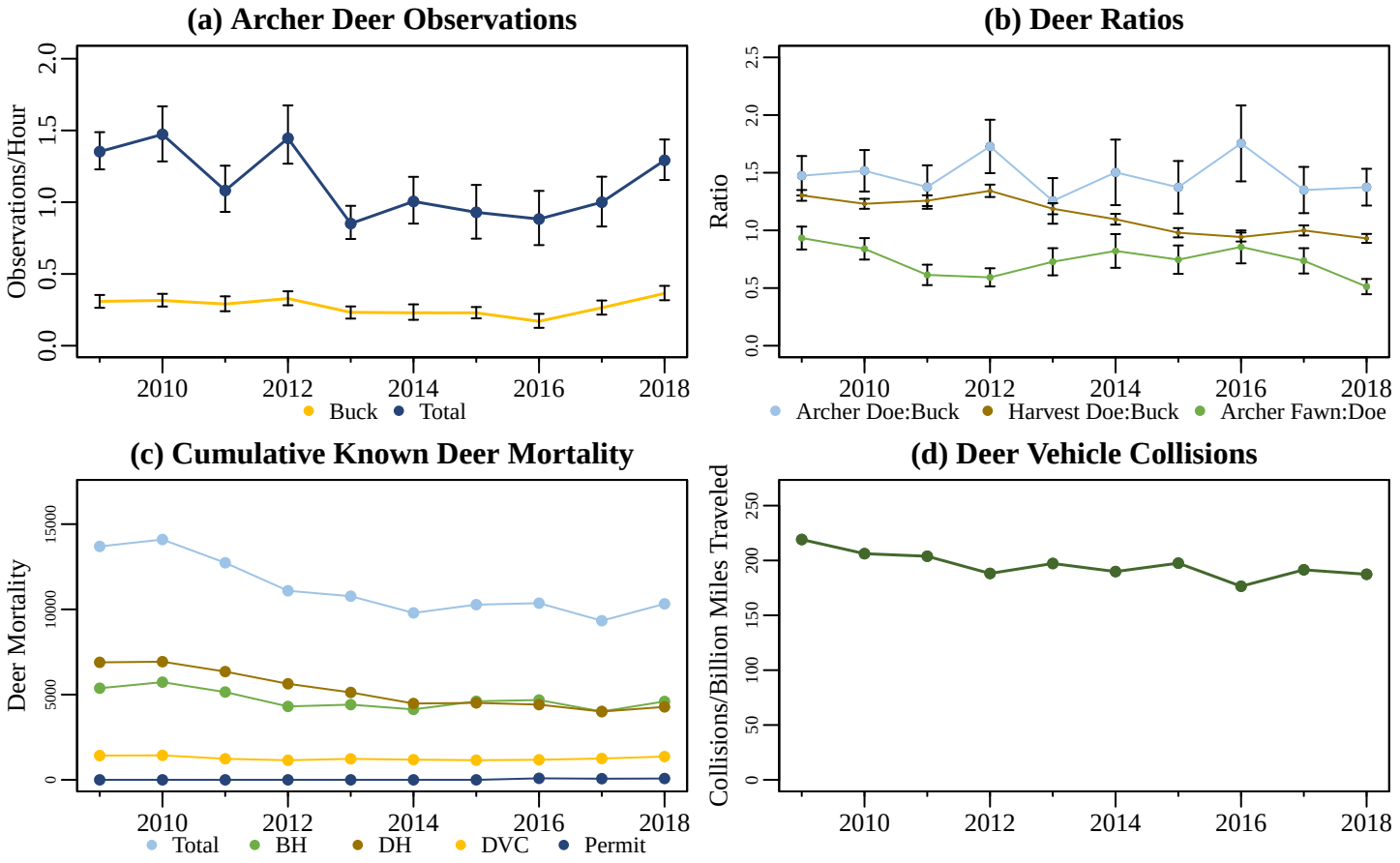
DMU 2: Northeast

6/26/2019

Total Square Miles: 1,490
Square Miles of Deer Habitat: 530
Percent Deer Habitat: 35

Table 1. Total harvest, buck harvest, and doe harvest (error approximately 1 percent). Damage permits are issued by DNR to landowners to control deer damage. Deer vehicle collisions (DVC) are reported by the Indiana Department of Transporation. Mean CBAQ is the average county bonus antlerless quota of all counties in the DMU. The trend in total harvest, buck harvest, doe harvest, and DVCs are in standard deviations (SD) and are equivalent to effect size. A change greater than 2 SD is considered both a large and statistically significant effect size.

Year	Total	Total Trend in SD	Buck Harvest	Buck Trend in SD	Buck Harvest per SQ MI Habitat	Doe Harvest	Doe Trend in SD	Doe Harvest per SQ MI Habitat	% Doe in Harvest	Damage Permit Deer Taken	Total DVC	DVC Trend in SD	Mean CBAQ
2009	12,268		5,375		10.14	6,893		13.01	56.19		1,425		6.00
2010	12,661	1.59	5,730	2.20	10.81	6,931	1.14	13.08	54.74		1,437	1.24	6.00
2011	11,499	-0.26	5,150	-0.25	9.72	6,349	-0.26	11.98	55.21		1,234	-8.44	8.00
2012	9,941	-3.67	4,306	-4.29	8.12	5,635	-2.85	10.63	56.68		1,150	-2.76	8.00
2013	9,540	-2.02	4,412	-1.43	8.32	5,128	-2.54	9.68	53.75		1,232	-0.75	5.00
2014	8,610	-1.85	4,132	-1.40	7.80	4,478	-2.16	8.45	52.01		1,183	-0.88	4.00
2015	9,123	-0.82	4,609	-0.20	8.70	4,514	-1.23	8.52	49.48		1,154	-0.83	3.50
2016	9,098	-0.59	4,684	0.41	8.84	4,414	-1.02	8.33	48.52	90	1,177	-0.33	3.50
2017	8,012	-2.49	4,007	-1.88	7.56	4,005	-1.56	7.56	49.99	68	1,253	1.75	2.50
2018	8,880	0.01	4,600	0.79	8.68	4,280	-0.57	8.08	48.20	79	1,365	4.03	1.75



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6/26/2019

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Year	Total Hunters	0 A	1 A	2 A	3 A	0 AL	1 AL	2 AL	3 AL	4 AL	5 AL	6 AL	7 AL	8 AL	9 AL	10 AL
2015	6,792	3,125	3,649	18	0	2,648	3,144	790	151	42	12	3	1	1	0	0
2016	6,658	2,921	3,716	20	1	2,653	2,985	788	171	47	10	3	0	0	1	0
2017	5,979	2,817	3,139	22	0	2,239	2,858	726	122	24	7	3	0	0	0	0
2018	6,611	2,870	3,704	37	0	2,590	3,143	725	124	17	7	2	2	1	0	0

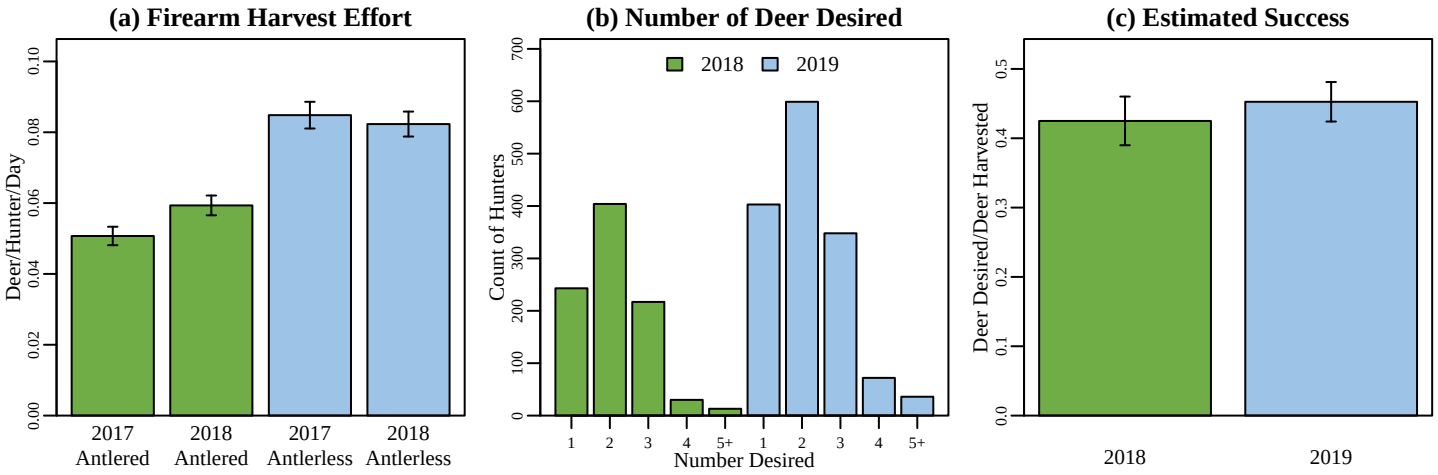


Figure 2. (a) Firearm harvest/effort is the number of deer killed by firearms per hunter divided by the mean number of days hunted per hunter during the firearm season based on data reported in the deer management survey. (b) The annual count of hunters wishing to harvest each number of deer reported in the deer management survey. (c) Success rate is estimated from the deer management survey as the Number of Harvested Deer/Number of Deer Desired (reported only; does not account for attempts that were not made).

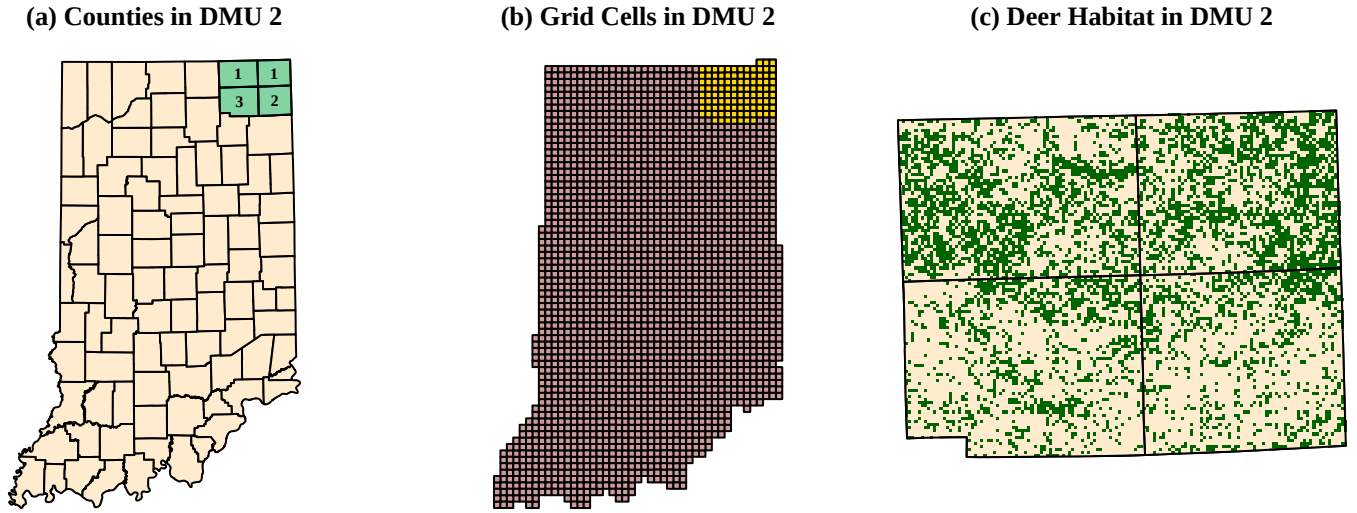


Figure 3. (a) Counties included in DMU 2 for summarizing harvest statistics. Labels are the 2018 county bonus anterless quotas. (b) 4 x 4 mile grid cells included in DMU 2 for summarizing annual deer management survey statistics. (c) Green represents the land use types classified as deer habitat in DMU 2.

DMU 2: Northeast

6/26/2019

Deer Management Survey Results

DNR Management Satisfaction: State

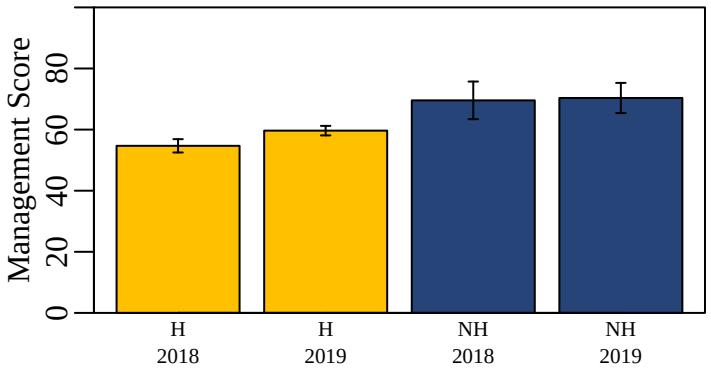


Figure 4. Hunters (H) and nonhunters (NH) were asked to score the DNR's statewide deer management on a scale of 0 (poor) to 100 (excellent).

DNR Management Satisfaction: County

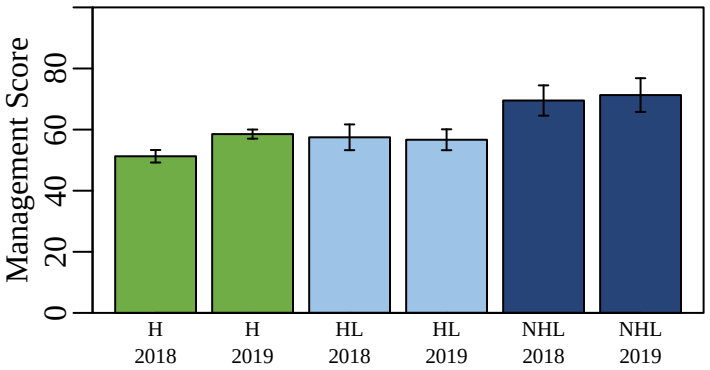


Figure 5. Opionion of county deer management on a scale of 0 (poor) to 100 (excellent) from individuals who hunt in a county (H), individuals that live in a county but hunt elsewhere (HL), and nonhunters that live in a county (NHL).

County Bonus Antlerless Quota

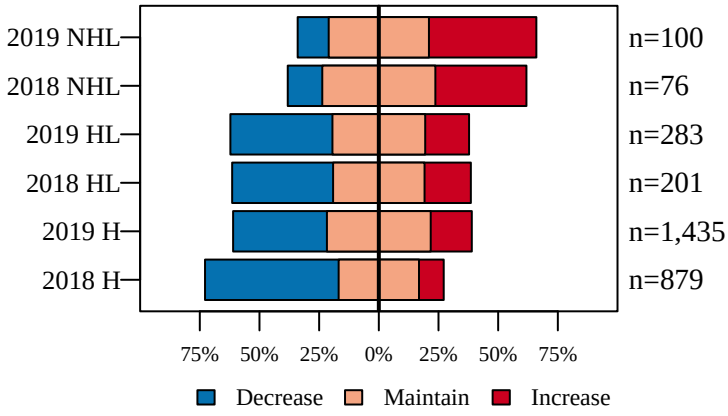


Figure 6. Opinion on how the County Bonus Antlerless Quota should change from nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Deer Population Size

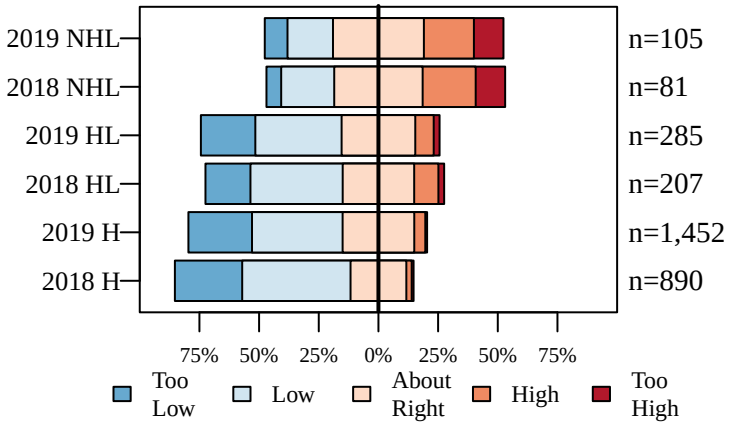


Figure 7. The current size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Perceived Population Change

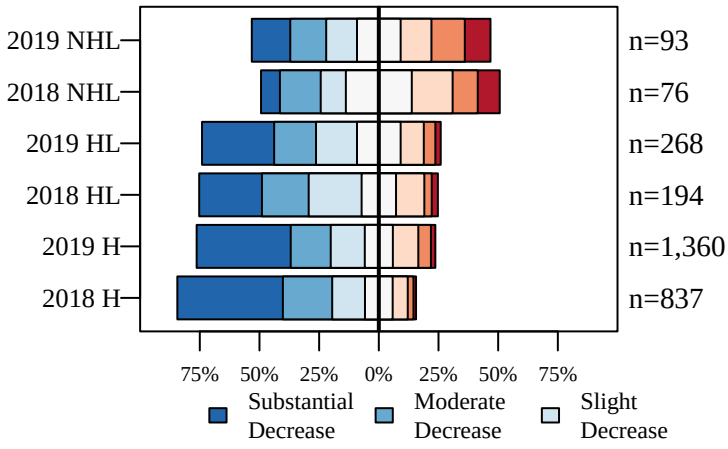


Figure 8. The number of deer seen compared to five years ago described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Desired Population Change

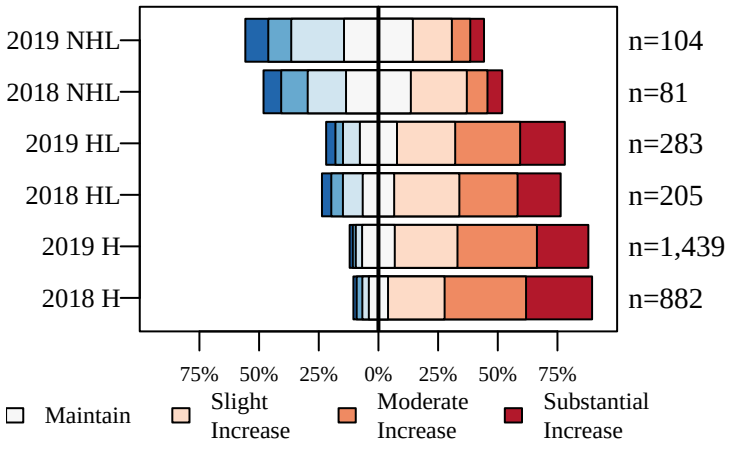


Figure 9. The desired change in the size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

DMU 2: Northeast

6/26/2019

Deer Management Survey Results

Population Size Opinion

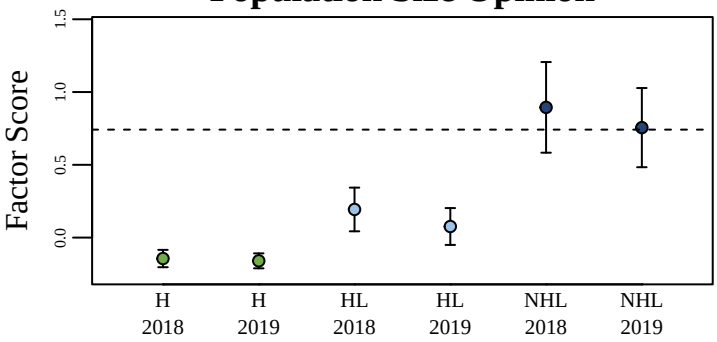


Figure 10. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on the deer population size. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

Management Opinion

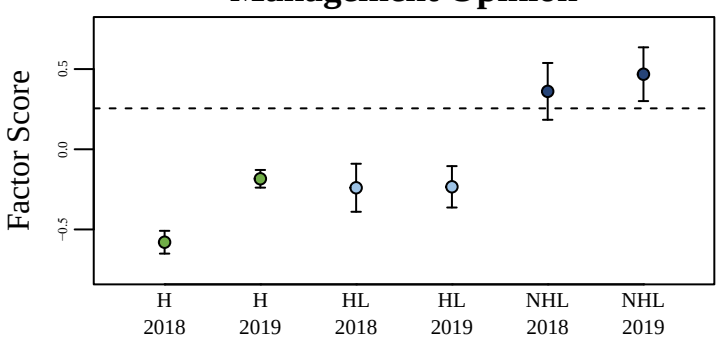


Figure 11. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on deer management. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

Total Harvest Change

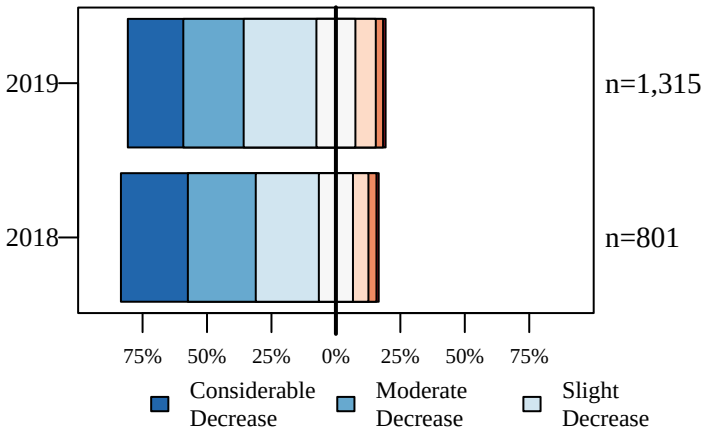


Figure 12. Opinion of hunters on how the total number of harvested deer has changed over the last five years.

Personal Harvest Change

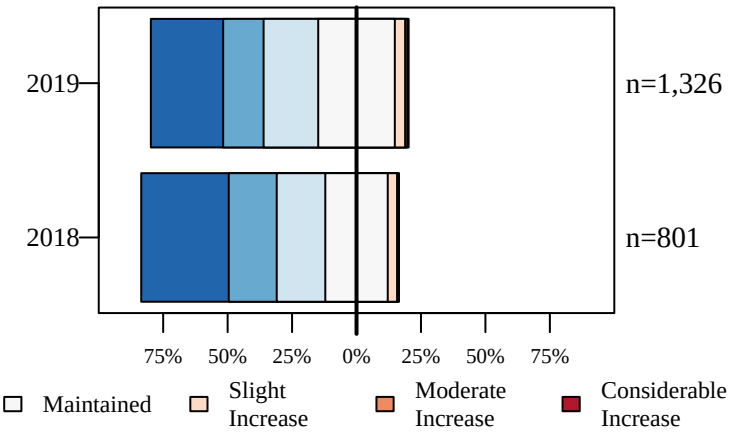


Figure 13. Opinion of hunters on how their personal number of harvested deer has changed over the last five years.

Buck Quality

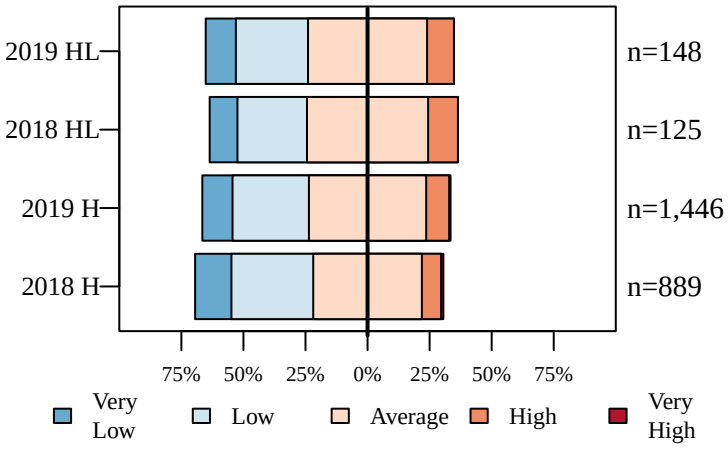


Figure 14. Hunters describe the quality of bucks where they live (HL) and where they hunt (H).

Hunter Opinion

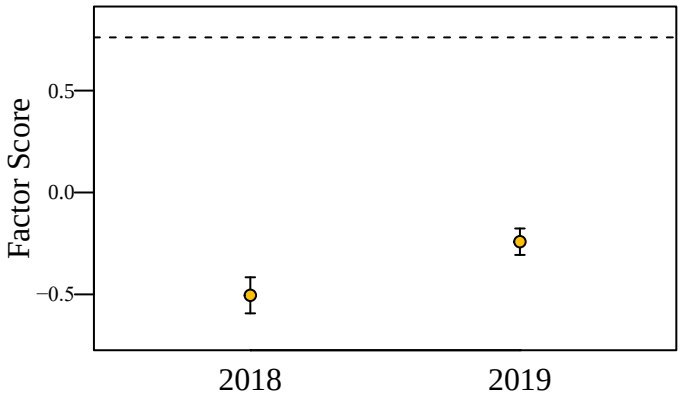


Figure 15. Hunter opinon score over two years of the deer management survey. The score was aggregated using factor analysis of questions asked only to hunters. The dashed line represents the score if all questions were answered neutrally.

DMU 3: West Central

6/26/2019

Total Square Miles: 4,025
Square Miles of Deer Habitat: 610
Percent Deer Habitat: 15

Table 1. Total harvest, buck harvest, and doe harvest (error approximately 1 percent). Damage permits are issued by DNR to landowners to control deer damage. Deer vehicle collisions (DVC) are reported by the Indiana Department of Transporation. Mean CBAQ is the average county bonus antlerless quota of all counties in the DMU. The trend in total harvest, buck harvest, doe harvest, and DVCs are in standard deviations (SD) and are equivalent to effect size. A change greater than 2 SD is considered both a large and statistically significant effect size.

Year	Total	Total Trend in SD	Buck Harvest	Buck Trend in SD	Buck Harvest per SQ MI Habitat	Doe Harvest	Doe Trend in SD	Doe Harvest per SQ MI Habitat	% Doe in Harvest	Damage Permit Deer Taken	Total DVC	DVC Trend in SD	Mean CBAQ
2009	9,446		4,831		7.92	4,615		7.57	48.86		1,574		5.33
2010	10,294	2.98	5,379	3.27	8.82	4,915	2.00	8.06	47.75		1,416	-1.15	5.33
2011	10,218	1.36	5,338	1.30	8.75	4,880	1.26	8.00	47.76		1,380	-2.03	5.89
2012	10,781	2.39	5,001	-0.59	8.20	5,780	5.54	9.48	53.61		1,230	-2.73	5.89
2013	9,176	-1.58	4,456	-2.75	7.30	4,720	-0.46	7.74	51.44		1,398	-0.28	5.44
2014	8,698	-1.95	4,424	-1.51	7.25	4,274	-1.53	7.01	49.14		1,332	-0.55	4.33
2015	8,344	-1.73	4,380	-1.17	7.18	3,964	-1.74	6.50	47.51		1,243	-1.45	4.28
2016	8,072	-1.33	4,486	-0.55	7.35	3,586	-1.64	5.88	44.43	102	1,162	-2.00	4.17
2017	7,032	-1.85	3,720	-3.25	6.10	3,312	-1.36	5.43	47.10	61	1,269	-0.23	2.94
2018	7,191	-1.34	4,023	-0.84	6.60	3,168	-1.45	5.19	44.06	42	1,314	0.31	2.06

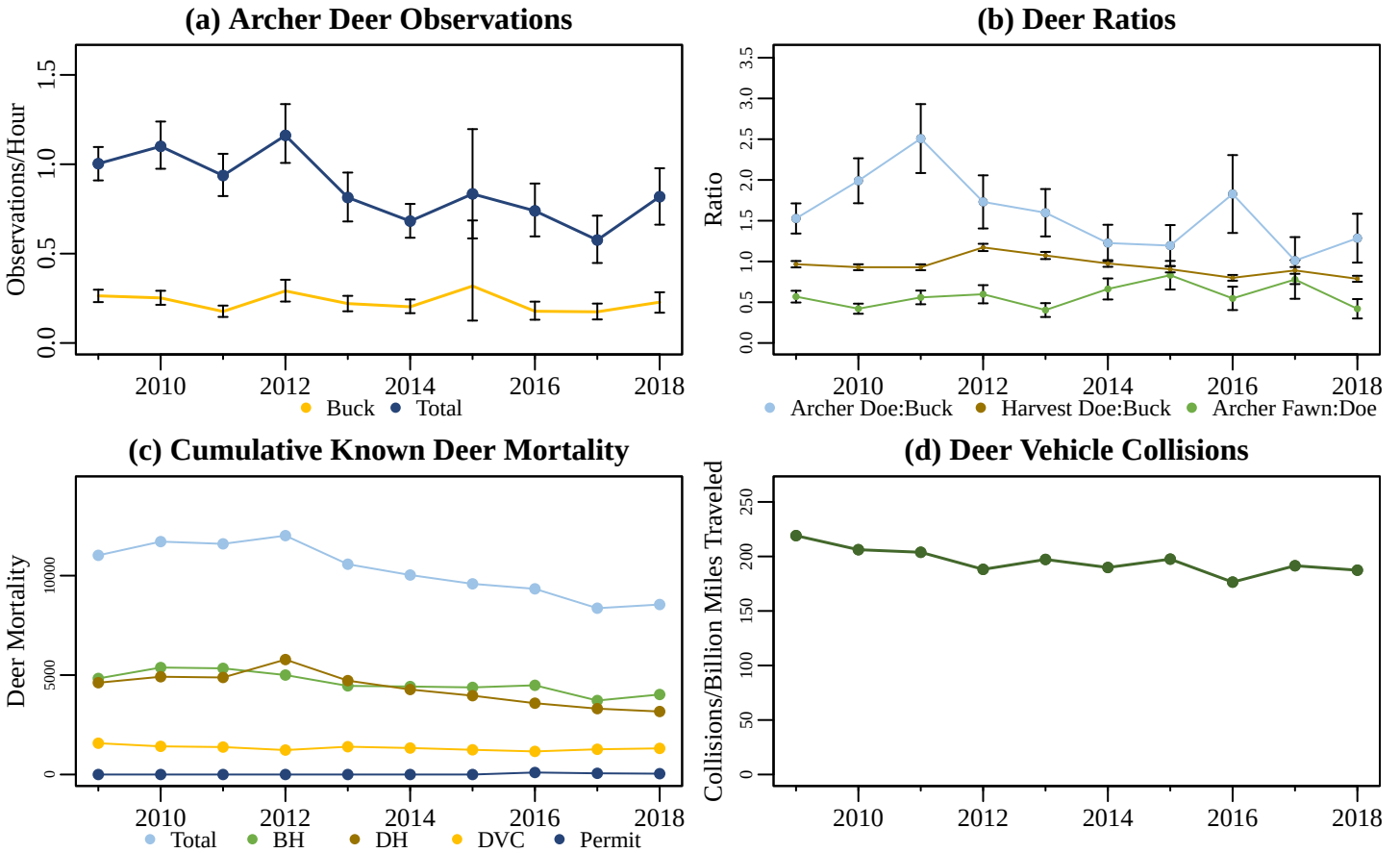


Figure 1. (a) Total deer and buck observations based on the Archer Index. (b) Annual doe:buck ratios and fawn:doe ratios based on the Archer Index and harvest records. (c) The total known annual deer mortality based on buck harvests (BH), doe harvests (DH), deer vehicle collisions (DVC), and deer permit takes. (d) Deer vehicle collisions per billion miles traveled.

DMU 3: West Central

6/26/2019

Total Square Miles: 4,025
Square Miles of Deer Habitat: 610
Percent Deer Habitat: 15

Table 2. Estimated number of antlered (A) and antlerless (AL) deer harvested per hunter. Estimated totals may not match exactly with total number of deer harvested. Reporting errors are examined and investigated as they are located; therefore, subsequent reports may contain corrected totals.

Year	Total Hunters	0 A	1 A	2 A	3 A	0 AL	1 AL	2 AL	3 AL	4 AL	5 AL	6 AL	7 AL	8 AL	9 AL	10 AL
2015	6,149	2,657	3,479	13	0	2,502	2,732	721	138	37	12	6	1	0	0	0
2016	6,055	2,397	3,634	22	2	2,722	2,515	652	115	34	15	1	1	0	0	0
2017	5,227	2,306	2,893	27	0	2,155	2,276	635	116	39	5	1	0	0	0	0
2018	5,509	2,172	3,315	22	0	2,456	2,377	593	71	7	4	0	0	1	0	0

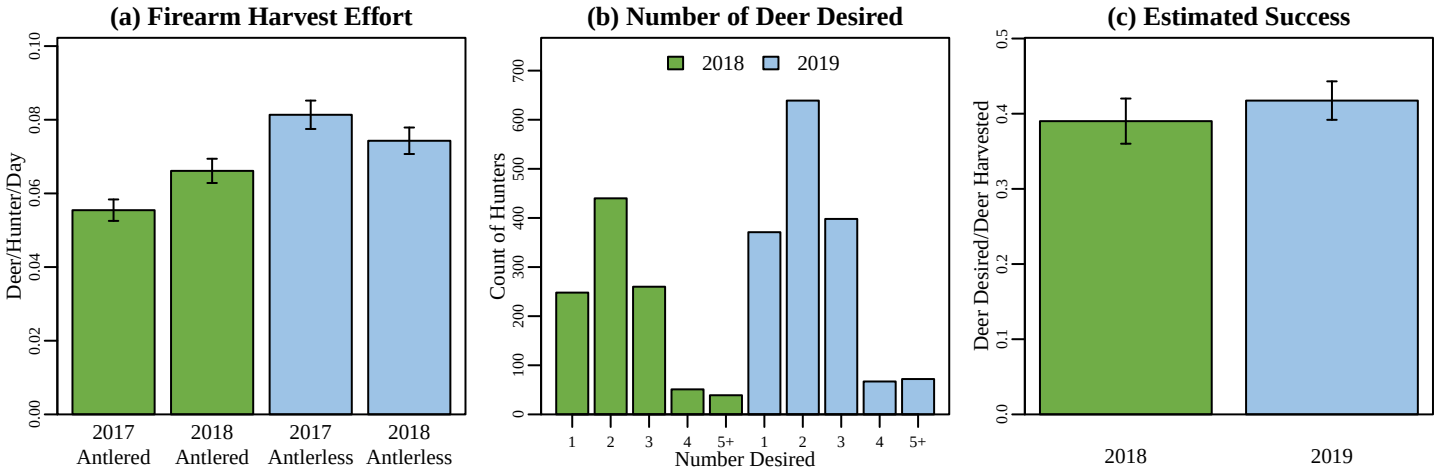


Figure 2. (a) Firearm harvest/effort is the number of deer killed by firearms per hunter divided by the mean number of days hunted per hunter during the firearm season based on data reported in the deer management survey. (b) The annual count of hunters wishing to harvest each number of deer reported in the deer management survey. (c) Success rate is estimated from the deer management survey as the Number of Harvested Deer/Number of Deer Desired (reported only; does not account for attempts that were not made).

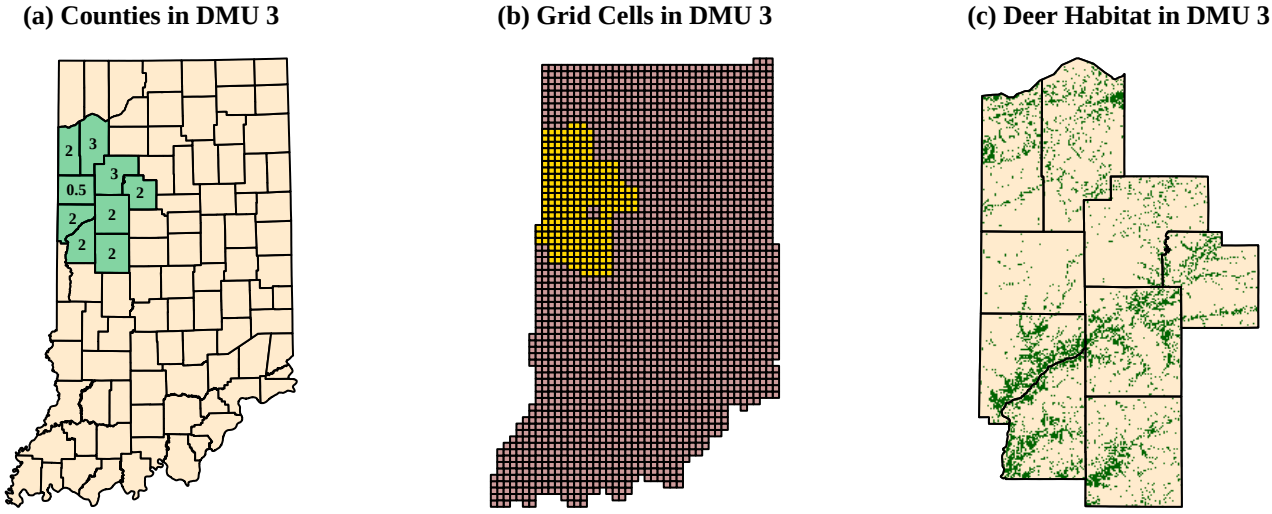


Figure 3. (a) Counties included in DMU 3 for summarizing harvest statistics. Labels are the 2018 county bonus anterless quotas. (b) 4 x 4 mile grid cells included in DMU 3 for summarizing annual deer management survey statistics. (c) Green represents the land use types classified as deer habitat in DMU 3.

DMU 3: West Central

6/26/2019

Deer Management Survey Results

DNR Management Satisfaction: State

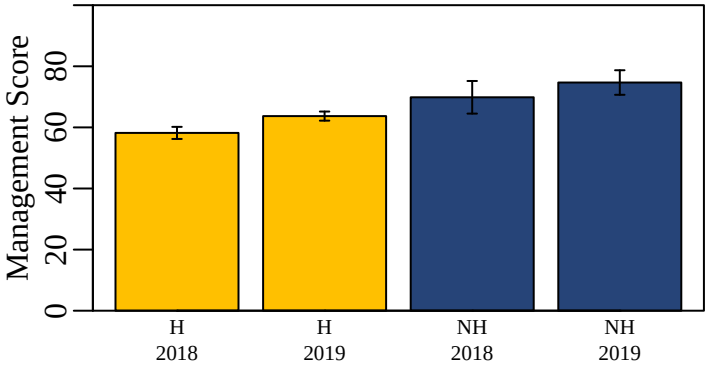


Figure 4. Hunters (H) and nonhunters (NH) were asked to score the DNR's statewide deer management on a scale of 0 (poor) to 100 (excellent).

DNR Management Satisfaction: County

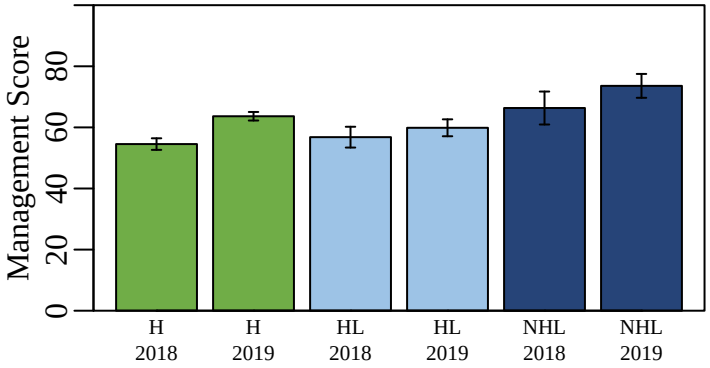


Figure 5. Opionion of county deer management on a scale of 0 (poor) to 100 (excellent) from individuals who hunt in a county (H), individuals that live in a county but hunt elsewhere (HL), and nonhunters that live in a county (NHL).

County Bonus Antlerless Quota

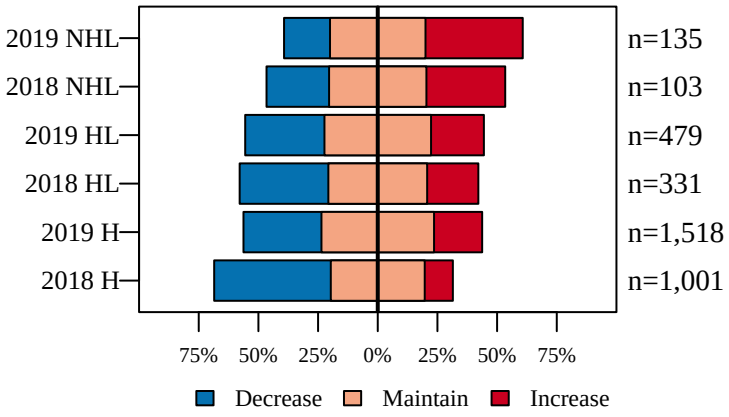


Figure 6. Opinion on how the County Bonus Antlerless Quota should change from nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Deer Population Size

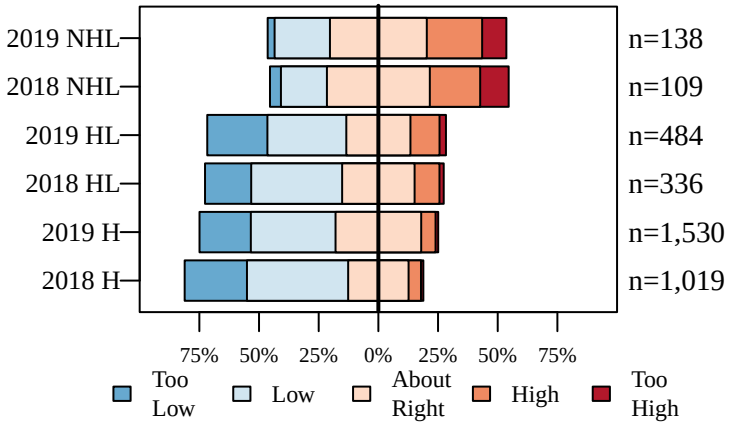


Figure 7. The current size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Perceived Population Change

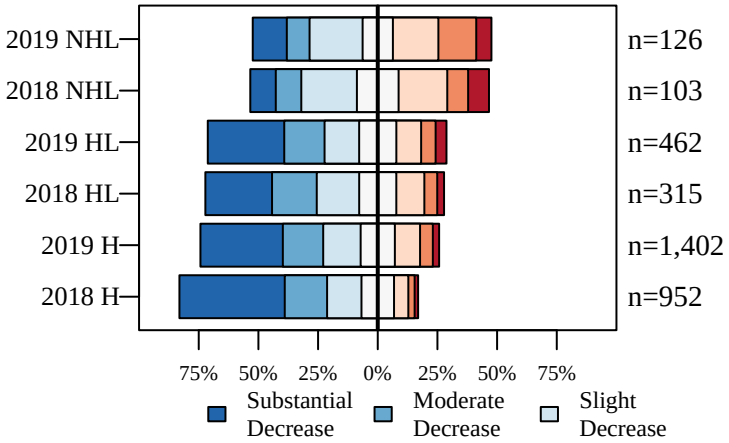


Figure 8. The number of deer seen compared to five years ago described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Desired Population Change

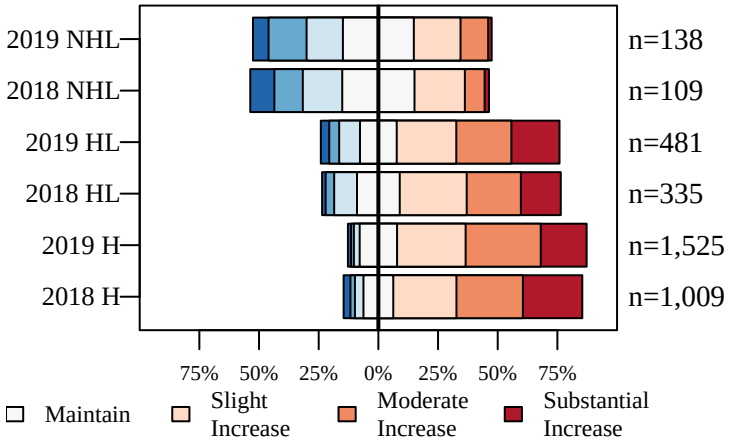


Figure 9. The desired change in the size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

DMU 3: West Central

6/26/2019

Deer Management Survey Results

Population Size Opinion

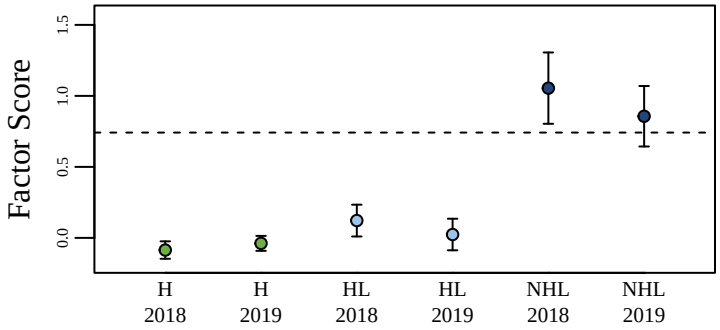
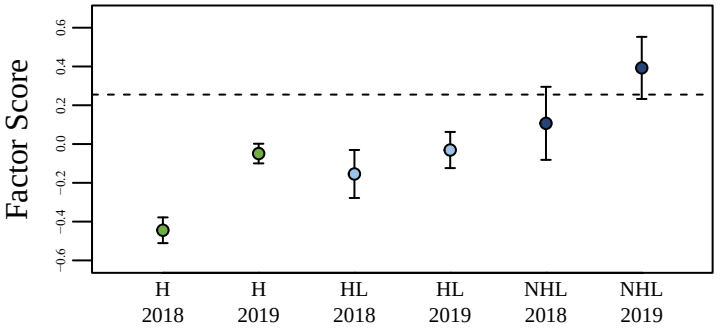


Figure 10. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on the deer population size. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

Management Opinion



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Total Harvest Change

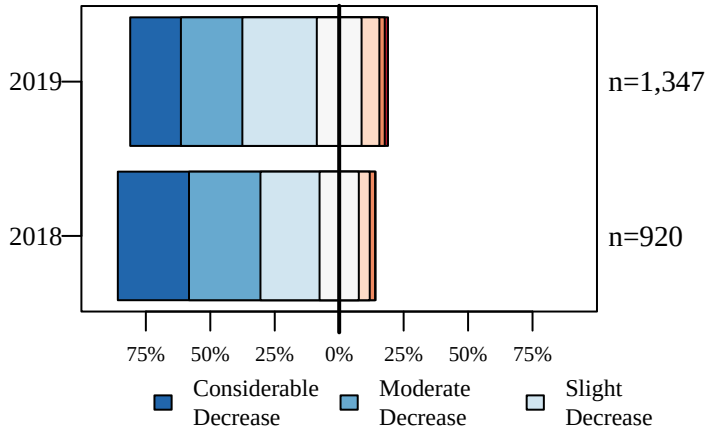
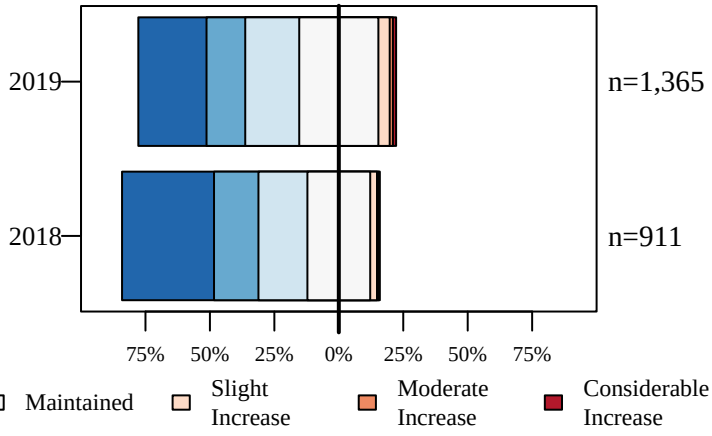


Figure 12. Opinion of hunters on how the total number of harvested deer has changed over the last five years.

Personal Harvest Change



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Buck Quality

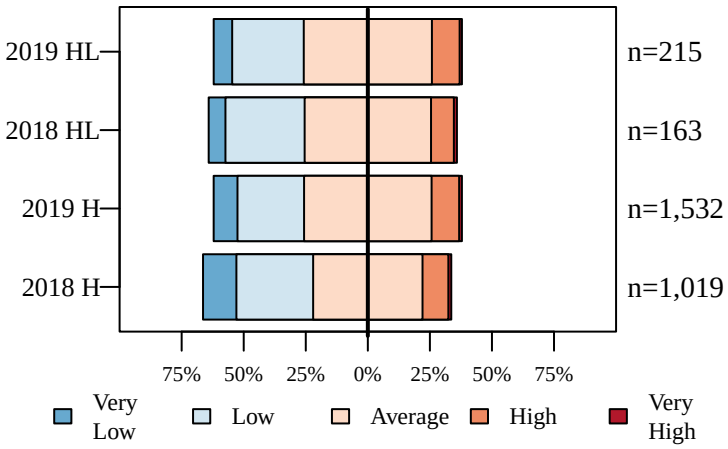


Figure 14. Hunters describe the quality of bucks where they live (HL) and where they hunt (H).

Hunter Opinion

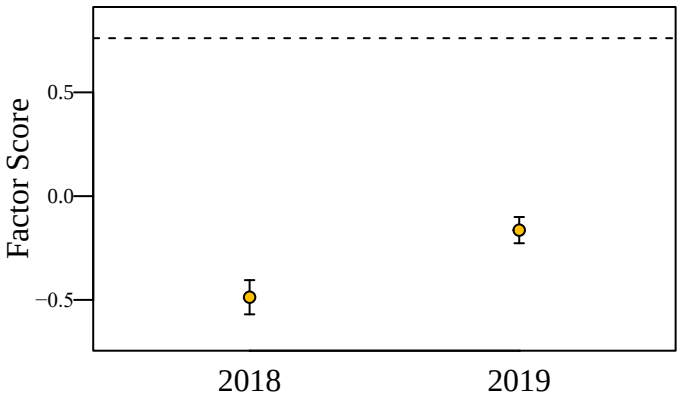


Figure 15. Hunter opinon score over two years of the deer management survey. The score was aggregated using factor analysis of questions asked only to hunters. The dashed line represents the score if all questions were answered neutrally.

DMU 4: East Central

6/26/2019

Total Square Miles: 9,955
Square Miles of Deer Habitat: 1,468
Percent Deer Habitat: 15

Table 1. Total harvest, buck harvest, and doe harvest (error approximately 1 percent). Damage permits are issued by DNR to landowners to control deer damage. Deer vehicle collisions (DVC) are reported by the Indiana Department of Transporation. Mean CBAQ is the average county bonus antlerless quota of all counties in the DMU. The trend in total harvest, buck harvest, doe harvest, and DVCs are in standard deviations (SD) and are equivalent to effect size. A change greater than 2 SD is considered both a large and statistically significant effect size.

Year	Total	Total Trend in SD	Buck Harvest	Buck Trend in SD	Buck Harvest per SQ MI Habitat	Doe Harvest	Doe Trend in SD	Doe Harvest per SQ MI Habitat	% Doe in Harvest	Damage Permit Deer Taken	Total DVC	DVC Trend in SD	Mean CBAQ
2009	18,223		9,567		6.52	8,656		5.90	47.50		3,945		3.17
2010	17,914	0.67	9,538	0.58	6.50	8,376	0.58	5.71	46.76		3,751	-0.64	3.50
2011	18,487	1.20	9,673	0.79	6.59	8,814	1.68	6.00	47.68		3,699	-2.02	3.94
2012	18,258	0.51	8,873	-2.02	6.04	9,385	3.59	6.39	51.40		3,458	-2.74	3.83
2013	17,243	-1.47	8,733	-1.59	5.95	8,510	-0.37	5.80	49.35		3,385	-1.86	3.50
2014	18,029	0.01	9,321	0.10	6.35	8,708	-0.10	5.93	48.30		3,596	-0.23	3.37
2015	18,299	0.67	9,755	1.28	6.65	8,544	-0.55	5.82	46.69		3,665	0.56	3.33
2016	17,892	-0.35	9,855	1.27	6.71	8,037	-2.14	5.47	44.92	44	3,242	-2.36	3.33
2017	16,506	-3.38	8,676	-1.25	5.91	7,830	-1.66	5.33	47.44	43	3,648	0.79	3.00
2018	16,985	-0.84	9,476	0.38	6.46	7,509	-2.19	5.12	44.21	43	3,704	1.04	1.89

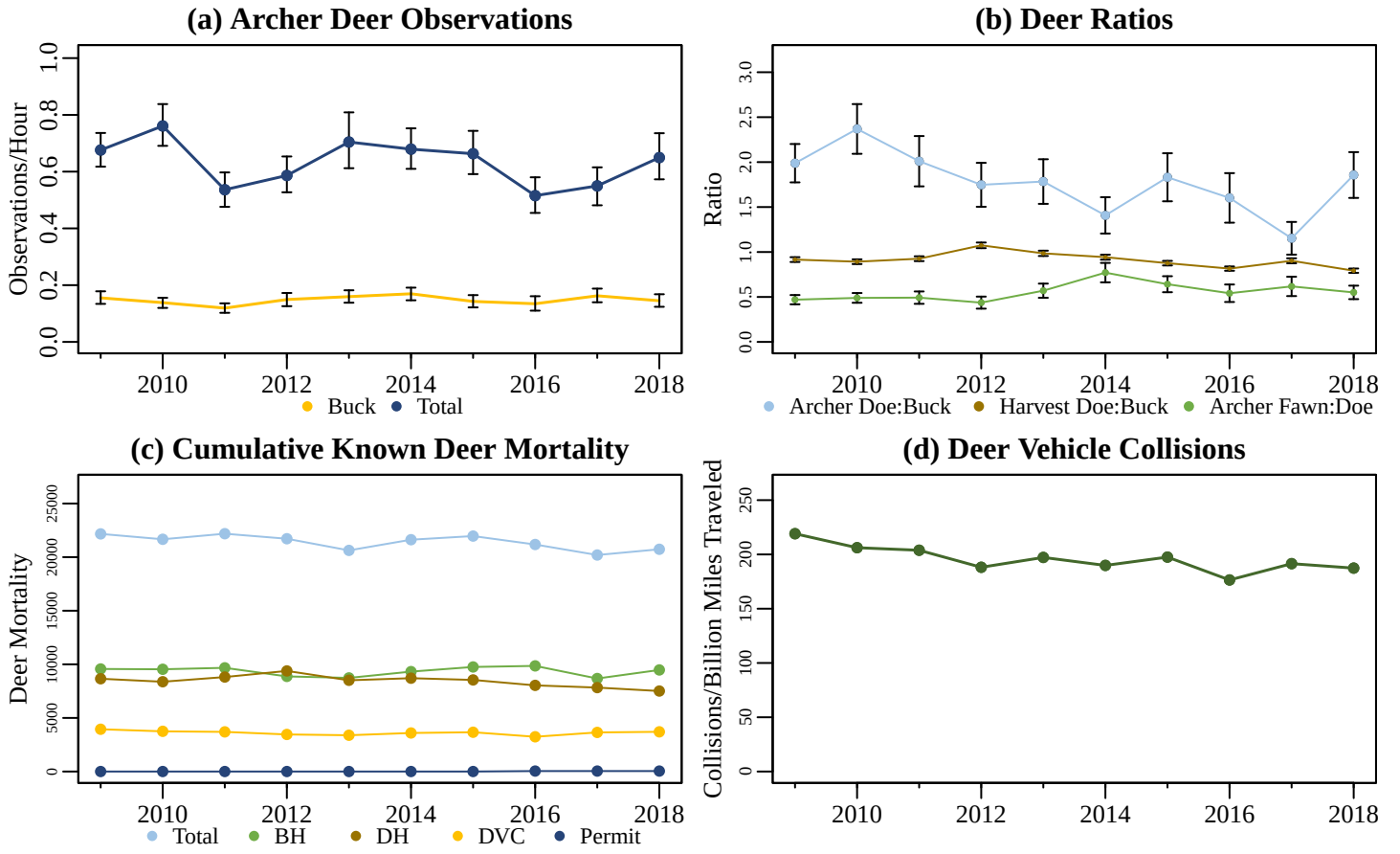


Figure 1. (a) Total deer and buck observations based on the Archer Index. (b) Annual doe:buck ratios and fawn:doe ratios based on the Archer Index and harvest records. (c) The total known annual deer mortality based on buck harvests (BH), doe harvests (DH), deer vehicle collisions (DVC), and deer permit takes. (d) Deer vehicle collisions per billion miles traveled.

DMU 4: East Central

6/26/2019

Total Square Miles: 9,955
Square Miles of Deer Habitat: 1,468
Percent Deer Habitat: 15

Table 2. Estimated number of antlered (A) and antlerless (AL) deer harvested per hunter. Estimated totals may not match exactly with total number of deer harvested. Reporting errors are examined and investigated as they are located; therefore, subsequent reports may contain corrected totals.

Year	Total Hunters	0 A	1 A	2 A	3 A	0 AL	1 AL	2 AL	3 AL	4 AL	5 AL	6 AL	7 AL	8 AL	9 AL	10 AL
2015	14,083	6,608	7,411	61	3	5,557	6,783	1,404	251	56	13	11	7	0	1	0
2016	13,760	6,097	7,568	92	3	5,769	6,328	1,332	239	65	12	6	6	3	0	0
2017	12,554	5,950	6,520	82	1	4,794	6,112	1,350	224	48	19	5	2	0	0	0
2018	13,155	5,721	7,368	66	0	5,529	6,091	1,296	176	46	13	3	1	0	0	0

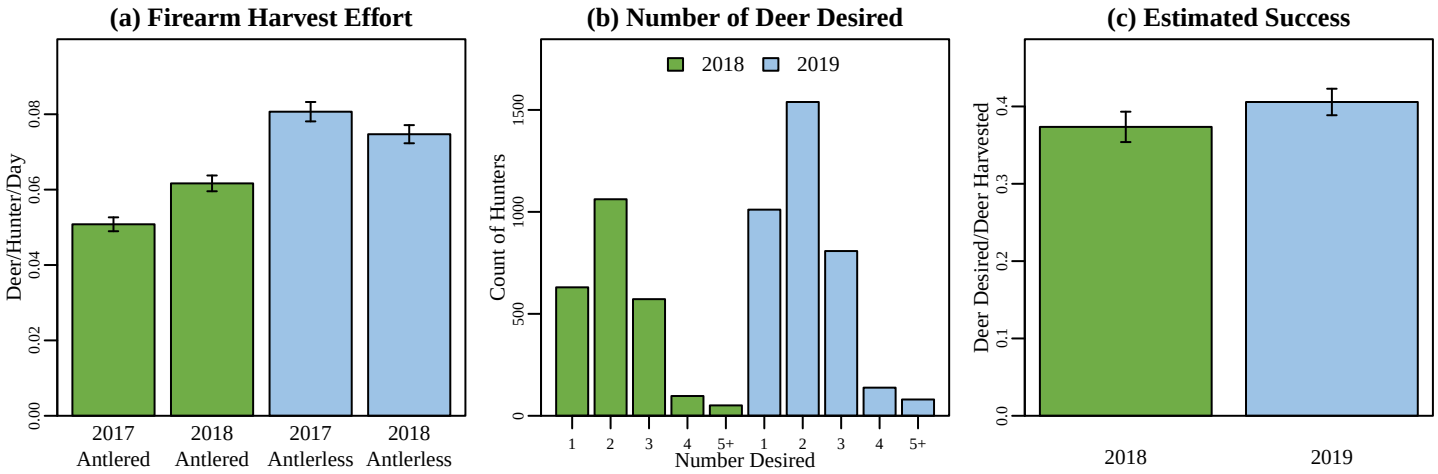


Figure 2. (a) Firearm harvest/effort is the number of deer killed by firearms per hunter divided by the mean number of days hunted per hunter during the firearm season based on data reported in the deer management survey. (b) The annual count of hunters wishing to harvest each number of deer reported in the deer management survey. (c) Success rate is estimated from the deer management survey as the Number of Harvested Deer/Number of Deer Desired (reported only; does not account for attempts that were not made).

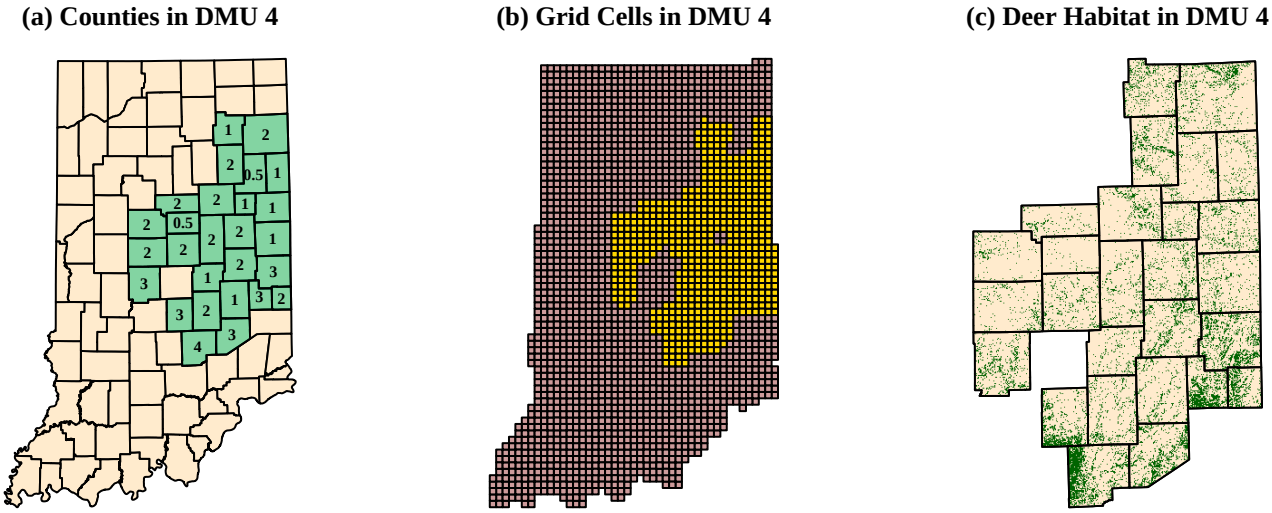


Figure 3. (a) Counties included in DMU 4 for summarizing harvest statistics. Labels are the 2018 county bonus anterless quotas. (b) 4 x 4 mile grid cells included in DMU 4 for summarizing annual deer management survey statistics. (c) Green represents the land use types classified as deer habitat in DMU 4.

DMU 4: East Central

6/26/2019

Deer Management Survey Results

DNR Management Satisfaction: State

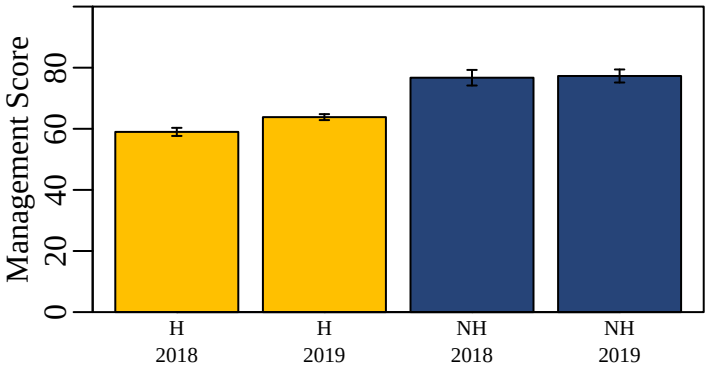


Figure 4. Hunters (H) and nonhunters (NH) were asked to score the DNR's statewide deer management on a scale of 0 (poor) to 100 (excellent).

DNR Management Satisfaction: County

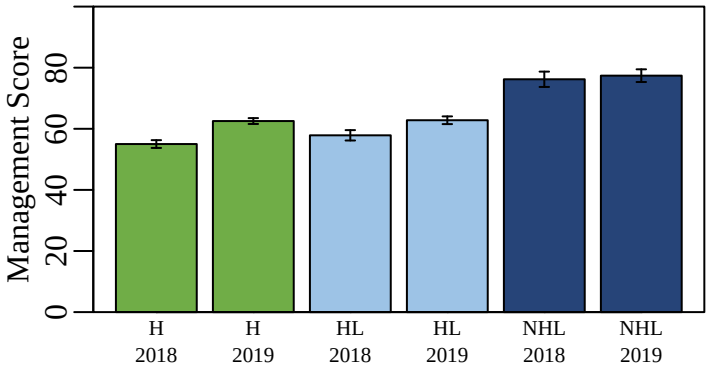


Figure 5. Opionion of county deer management on a scale of 0 (poor) to 100 (excellent) from individuals who hunt in a county (H), individuals that live in a county but hunt elsewhere (HL), and nonhunters that live in a county (NHL).

County Bonus Antlerless Quota

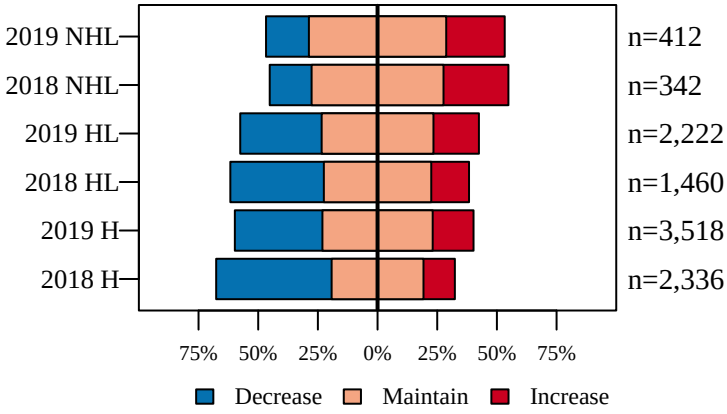


Figure 6. Opinion on how the County Bonus Antlerless Quota should change from nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Deer Population Size

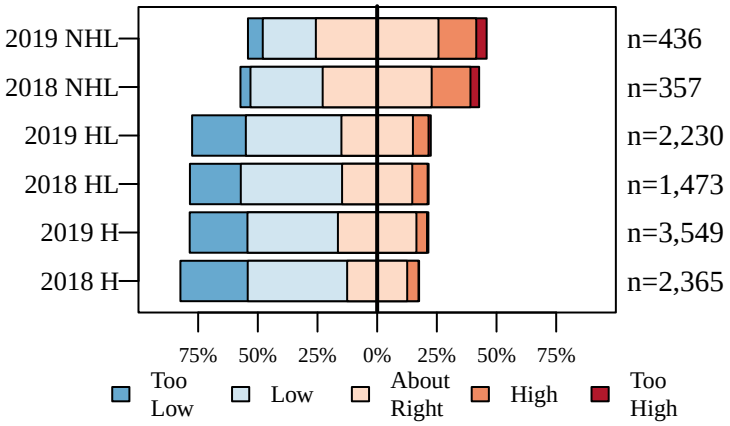


Figure 7. The current size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Perceived Population Change

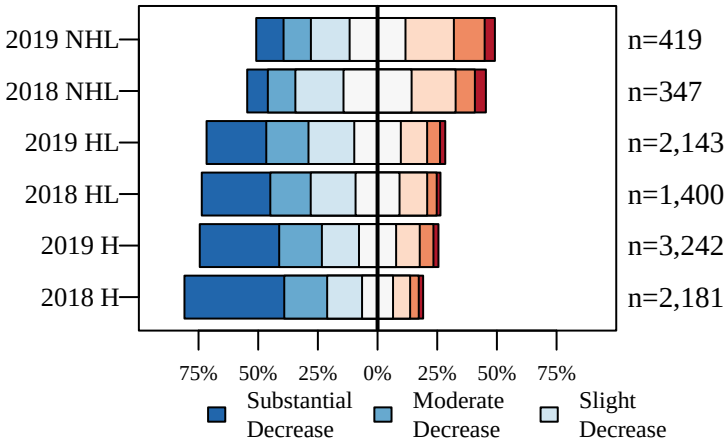


Figure 8. The number of deer seen compared to five years ago described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Desired Population Change

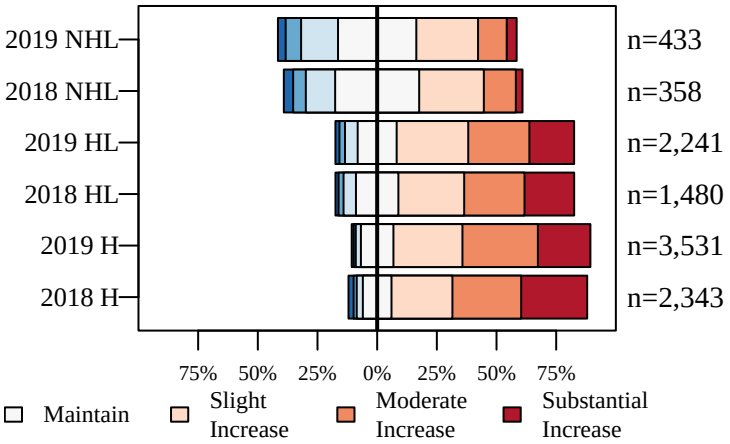


Figure 9. The desired change in the size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

DMU 5: Wabash

6/26/2019

Total Square Miles: 2,417
Square Miles of Deer Habitat: 944
Percent Deer Habitat: 39

Table 1. Total harvest, buck harvest, and doe harvest (error approximately 1 percent). Damage permits are issued by DNR to landowners to control deer damage. Deer vehicle collisions (DVC) are reported by the Indiana Department of Transporation. Mean CBAQ is the average county bonus antlerless quota of all counties in the DMU. The trend in total harvest, buck harvest, doe harvest, and DVCs are in standard deviations (SD) and are equivalent to effect size. A change greater than 2 SD is considered both a large and statistically significant effect size.

Year	Total	Total Trend in SD	Buck Harvest	Buck Trend in SD	Buck Harvest per SQ MI Habitat	Doe Harvest	Doe Trend in SD	Doe Harvest per SQ MI Habitat	% Doe in Harvest	Damage Permit Deer Taken	Total DVC	DVC Trend in SD	Mean CBAQ
2009	10,377		5,429		5.75	4,948		5.24	47.68		911		5.83
2010	10,633	1.64	5,599	1.33	5.93	5,034	1.34	5.33	47.34		809	-0.52	6.67
2011	10,827	1.71	5,657	1.49	5.99	5,170	1.49	5.48	47.75		820	-0.84	6.67
2012	11,128	1.62	5,243	-0.77	5.55	5,885	3.11	6.23	52.88		729	-2.17	7.33
2013	9,510	-2.21	4,840	-2.76	5.13	4,670	-1.06	4.95	49.11		769	-0.86	6.00
2014	9,116	-2.24	4,727	-1.90	5.01	4,389	-1.66	4.65	48.15		712	-1.41	5.33
2015	9,785	-0.52	5,115	-0.23	5.42	4,670	-0.63	4.95	47.73		797	0.61	5.17
2016	9,943	-0.15	5,487	1.01	5.81	4,456	-0.85	4.72	44.82	78	844	1.74	5.17
2017	9,643	-0.33	5,037	-0.15	5.34	4,606	-0.34	4.88	47.77	76	806	0.53	4.50
2018	9,831	0.74	5,387	1.18	5.71	4,444	-0.89	4.71	45.20	72	853	1.46	3.50

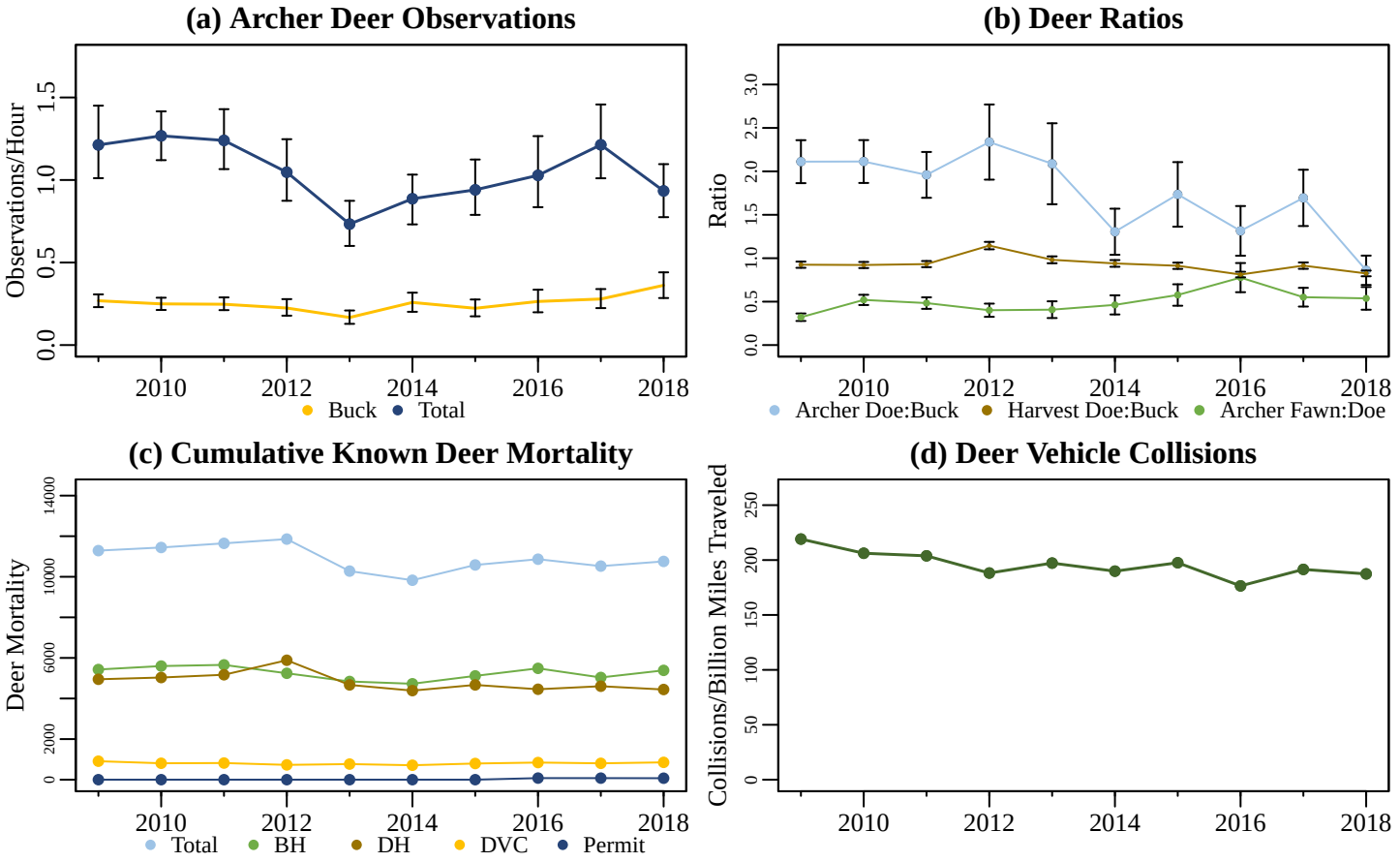


Figure 1. (a) Total deer and buck observations based on the Archer Index. (b) Annual doe:buck ratios and fawn:doe ratios based on the Archer Index and harvest records. (c) The total known annual deer mortality based on buck harvests (BH), doe harvests (DH), deer vehicle collisions (DVC), and deer permit takes. (d) Deer vehicle collisions per billion miles traveled.

DMU 5: Wabash

6/26/2019

Total Square Miles: 2,417
Square Miles of Deer Habitat: 944
Percent Deer Habitat: 39

Table 2. Estimated number of antlered (A) and antlerless (AL) deer harvested per hunter. Estimated totals may not match exactly with total number of deer harvested. Reporting errors are examined and investigated as they are located; therefore, subsequent reports may contain corrected totals.

Year	Total Hunters	0 A	1 A	2 A	3 A	0 AL	1 AL	2 AL	3 AL	4 AL	5 AL	6 AL	7 AL	8 AL	9 AL	10 AL
2015	7,147	3,103	4,028	16	0	2,929	3,140	797	196	53	14	9	7	1	0	1
2016	7,382	2,817	4,541	23	1	3,376	3,011	761	159	52	11	6	4	2	0	0
2017	6,929	2,912	3,983	31	3	2,912	2,875	865	178	68	16	9	4	2	0	0
2018	7,171	2,731	4,420	19	0	3,176	2,932	831	176	40	13	2	0	0	1	0

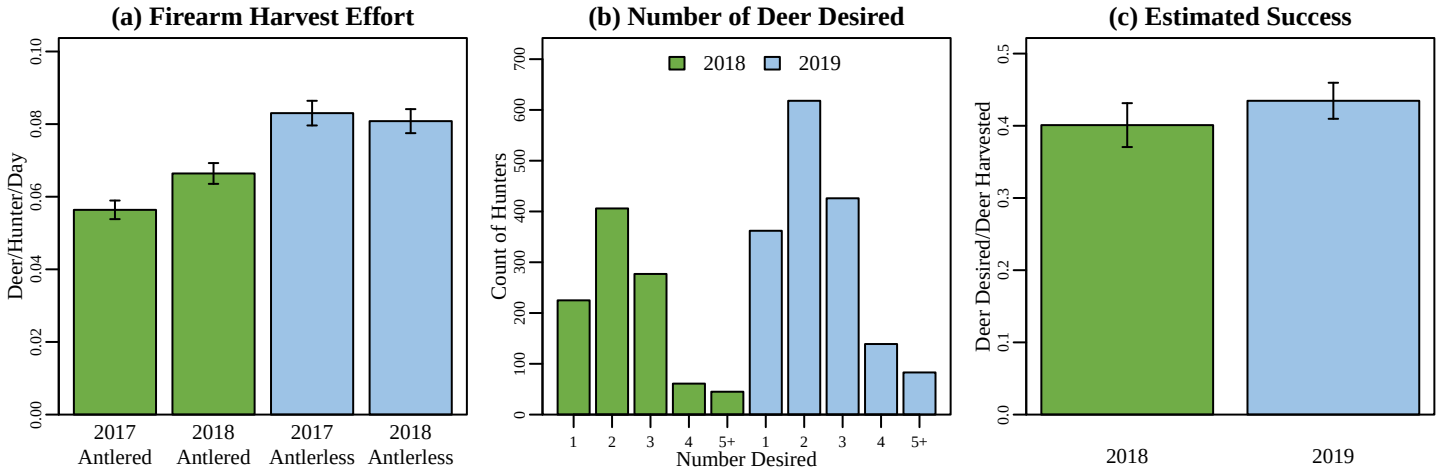


Figure 2. (a) Firearm harvest/effort is the number of deer killed by firearms per hunter divided by the mean number of days hunted per hunter during the firearm season based on data reported in the deer management survey. (b) The annual count of hunters wishing to harvest each number of deer reported in the deer management survey. (c) Success rate is estimated from the deer management survey as the Number of Harvested Deer/Number of Deer Desired (reported only; does not account for attempts that were not made).

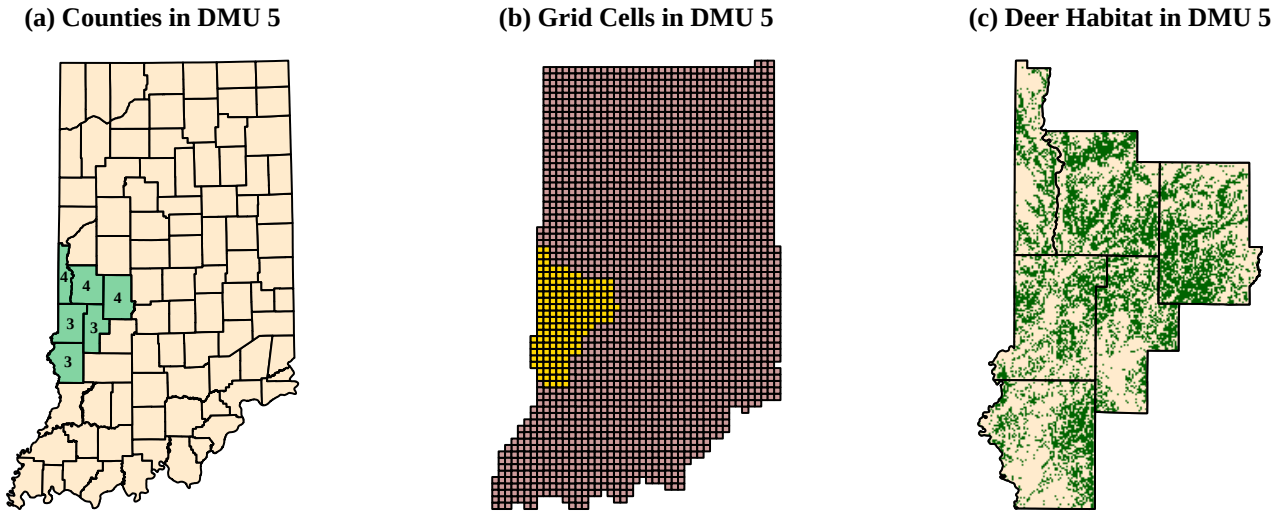


Figure 3. (a) Counties included in DMU 5 for summarizing harvest statistics. Labels are the 2018 county bonus anterless quotas. (b) 4 x 4 mile grid cells included in DMU 5 for summarizing annual deer management survey statistics. (c) Green represents the land use types classified as deer habitat in DMU 5.

DMU 5: Wabash

6/26/2019

Deer Management Survey Results

DNR Management Satisfaction: State

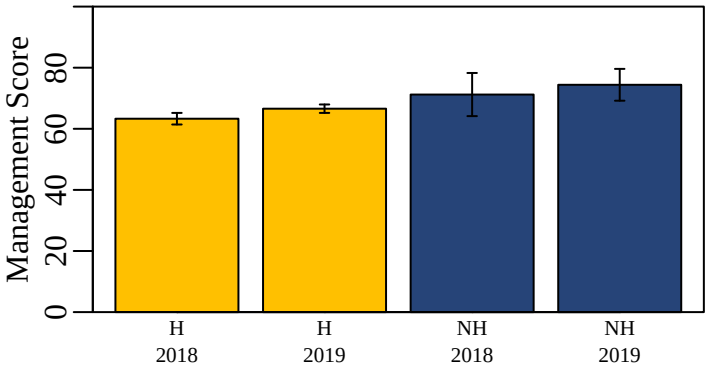


Figure 4. Hunters (H) and nonhunters (NH) were asked to score the DNR's statewide deer management on a scale of 0 (poor) to 100 (excellent).

DNR Management Satisfaction: County

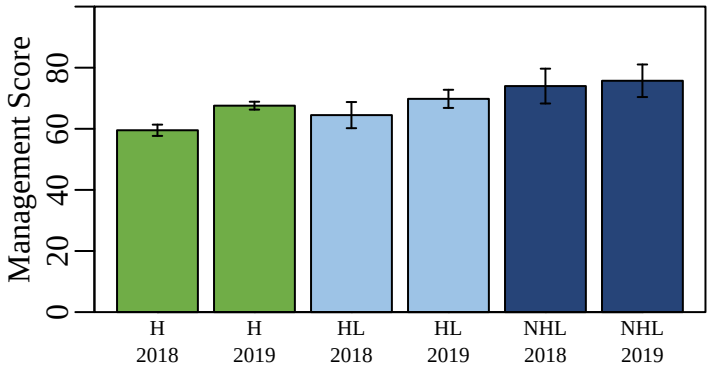


Figure 5. Opionion of county deer management on a scale of 0 (poor) to 100 (excellent) from individuals who hunt in a county (H), individuals that live in a county but hunt elsewhere (HL), and nonhunters that live in a county (NHL).

County Bonus Antlerless Quota

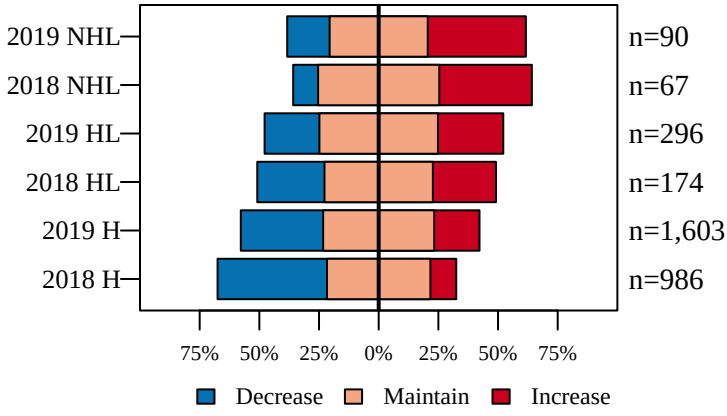


Figure 6. Opinion on how the County Bonus Antlerless Quota should change from nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Deer Population Size

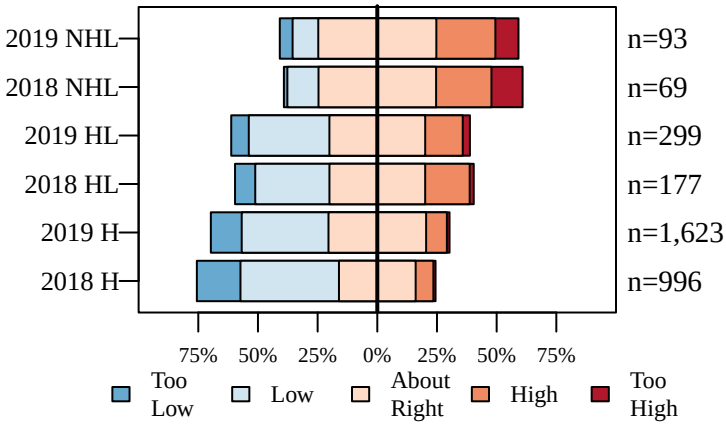


Figure 7. The current size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Perceived Population Change

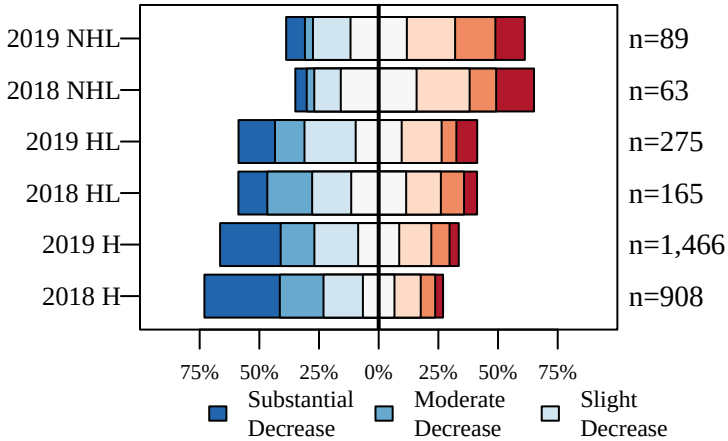


Figure 8. The number of deer seen compared to five years ago described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Desired Population Change

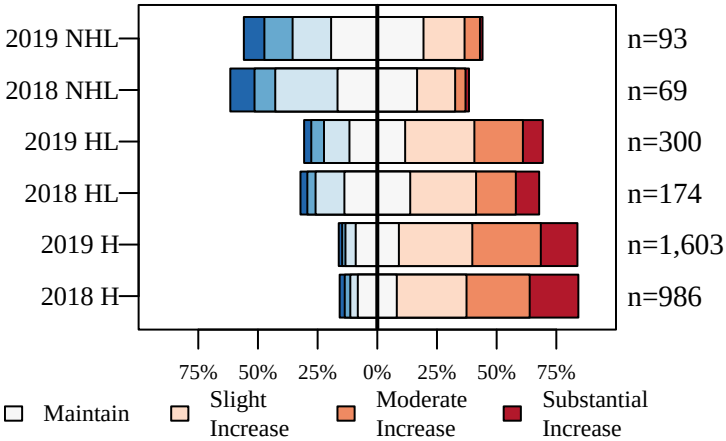


Figure 9. The desired change in the size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

DMU 5: Wabash

6/26/2019

Deer Management Survey Results

Population Size Opinion

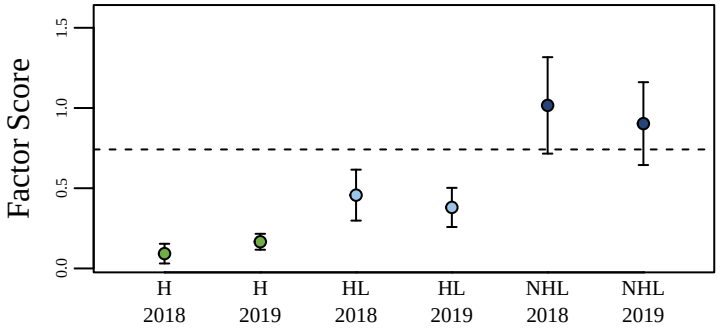


Figure 10. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on the deer population size. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

Management Opinion

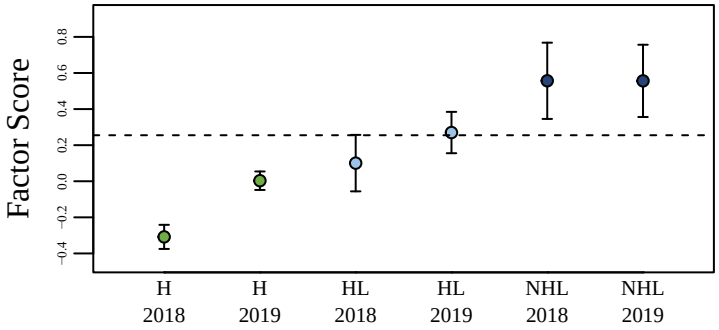


Figure 11. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on deer management. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

Total Harvest Change

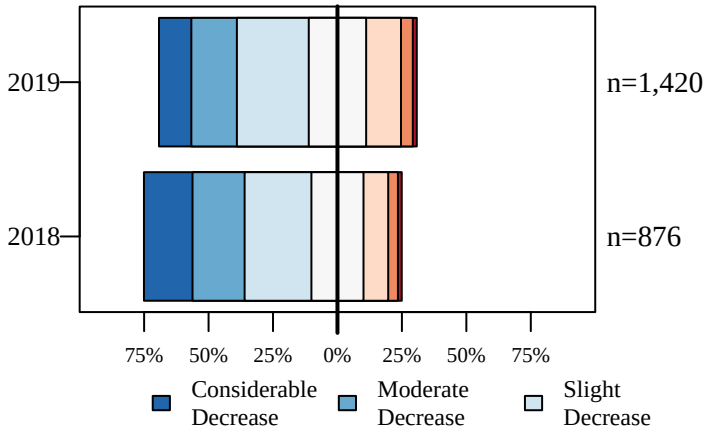


Figure 12. Opinion of hunters on how the total number of harvested deer has changed over the last five years.

Personal Harvest Change

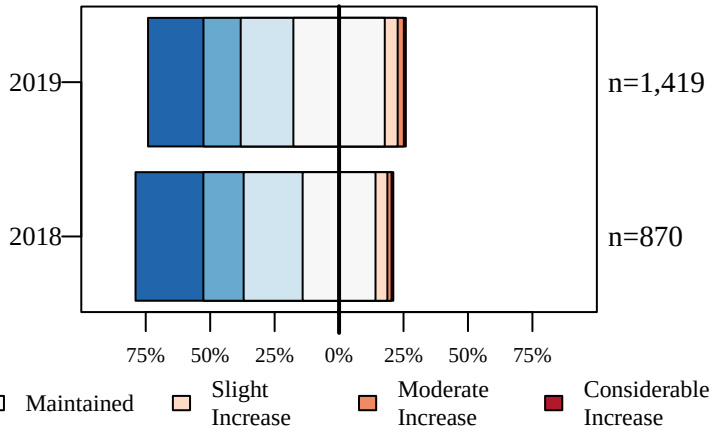


Figure 13. Opinion of hunters on how their personal number of harvested deer has changed over the last five years.

Buck Quality

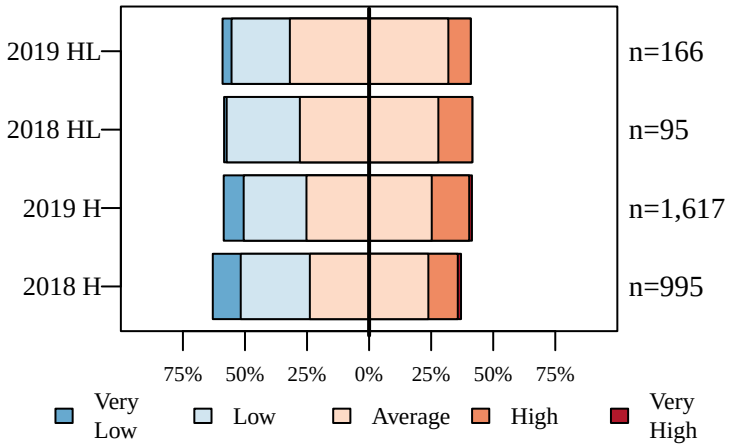


Figure 14. Hunters describe the quality of bucks where they live (HL) and where they hunt (H).

Hunter Opinion

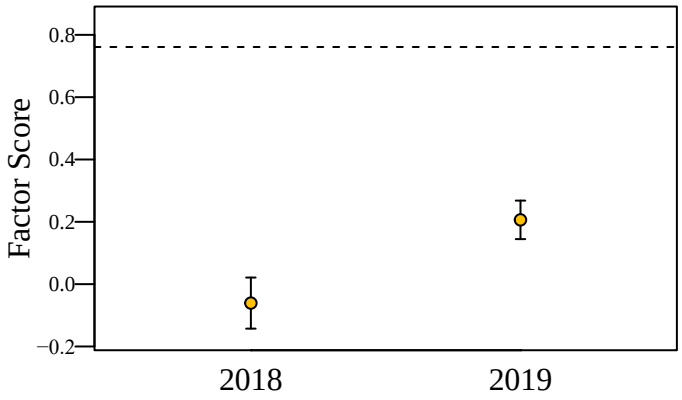


Figure 15. Hunter opinon score over two years of the deer management survey. The score was aggregated using factor analysis of questions asked only to hunters. The dashed line represents the score if all questions were answered neutrally.

DMU 6: South

6/26/2019

Total Square Miles: 6,367
Square Miles of Deer Habitat: 4,703
Percent Deer Habitat: 73

Table 1. Total harvest, buck harvest, and doe harvest (error approximately 1 percent). Damage permits are issued by DNR to landowners to control deer damage. Deer vehicle collisions (DVC) are reported by the Indiana Department of Transporation. Mean CBAQ is the average county bonus antlerless quota of all counties in the DMU. The trend in total harvest, buck harvest, doe harvest, and DVCs are in standard deviations (SD) and are equivalent to effect size. A change greater than 2 SD is considered both a large and statistically significant effect size.

Year	Total	Total Trend in SD	Buck Harvest	Buck Trend in SD	Buck Harvest per SQ MI Habitat	Doe Harvest	Doe Trend in SD	Doe Harvest per SQ MI Habitat	% Doe in Harvest	Damage Permit Deer Taken	Total DVC	DVC Trend in SD	Mean CBAQ
2009	28,970		14,840		3.16	14,130		3.00	48.77		2,209		5.00
2010	28,143	-0.38	14,197	-0.54	3.02	13,946	-0.05	2.97	49.55		2,096	-0.74	5.44
2011	29,468	1.30	14,809	0.89	3.15	14,659	1.42	3.12	49.75		2,177	-0.49	5.69
2012	31,458	3.19	14,485	0.33	3.08	16,973	5.21	3.61	53.95		2,240	0.62	5.62
2013	33,888	3.53	16,201	4.91	3.44	17,687	2.32	3.76	52.19		2,509	6.14	5.31
2014	30,442	0.02	14,599	-0.40	3.10	15,843	0.21	3.37	52.04		2,317	0.45	6.06
2015	32,927	1.03	16,736	2.40	3.56	16,191	0.24	3.44	49.17		2,626	2.28	5.88
2016	30,912	-0.40	16,282	0.89	3.46	14,630	-1.43	3.11	47.33	675	2,382	0.04	5.94
2017	31,371	-0.38	15,532	-0.12	3.30	15,839	-0.37	3.37	50.49	749	2,735	2.14	5.69
2018	27,745	-2.87	14,273	-1.92	3.03	13,472	-2.34	2.86	48.56	722	2,518	0.45	4.69

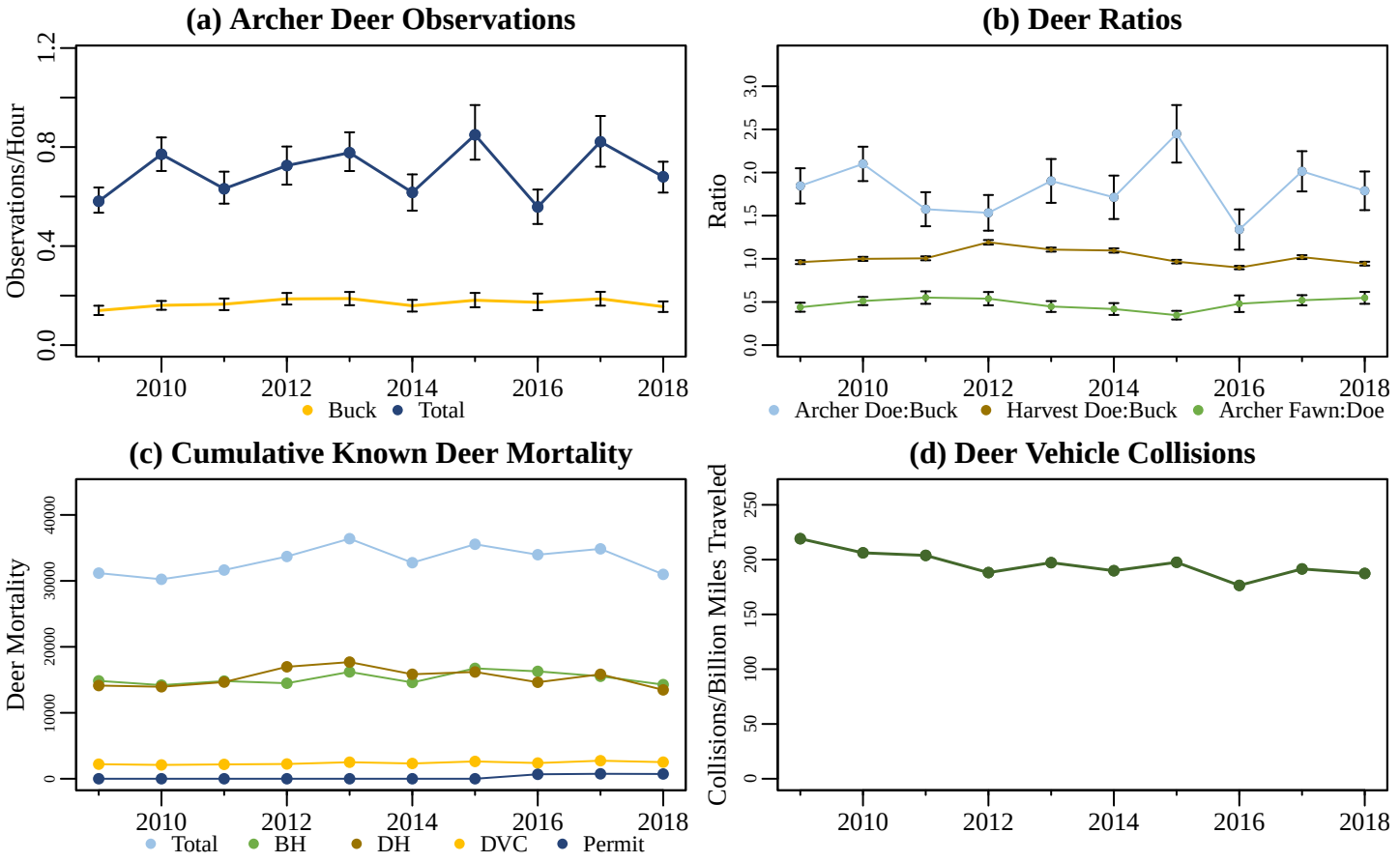


Figure 1. (a) Total deer and buck observations based on the Archer Index. (b) Annual doe:buck ratios and fawn:doe ratios based on the Archer Index and harvest records. (c) The total known annual deer mortality based on buck harvests (BH), doe harvests (DH), deer vehicle collisions (DVC), and deer permit takes. (d) Deer vehicle collisions per billion miles traveled.

DMU 6: South

6/26/2019

Total Square Miles: 6,367
Square Miles of Deer Habitat: 4,703
Percent Deer Habitat: 73

Table 2. Estimated number of antlered (A) and antlerless (AL) deer harvested per hunter. Estimated totals may not match exactly with total number of deer harvested. Reporting errors are examined and investigated as they are located; therefore, subsequent reports may contain corrected totals.

Year	Total Hunters	0 A	1 A	2 A	3 A	0 AL	1 AL	2 AL	3 AL	4 AL	5 AL	6 AL	7 AL	8 AL	9 AL	10 AL
2015	23,371	10,149	13,123	98	1	9,356	10,148	2,794	705	206	95	30	24	10	3	0
2016	22,362	9,259	12,962	132	8	9,476	9,523	2,487	571	182	72	24	17	6	1	1
2017	21,951	9,870	11,929	146	6	8,420	9,628	2,858	660	244	73	37	13	11	5	1
2018	19,882	8,689	11,084	101	8	7,989	8,610	2,458	557	170	58	28	8	0	2	0

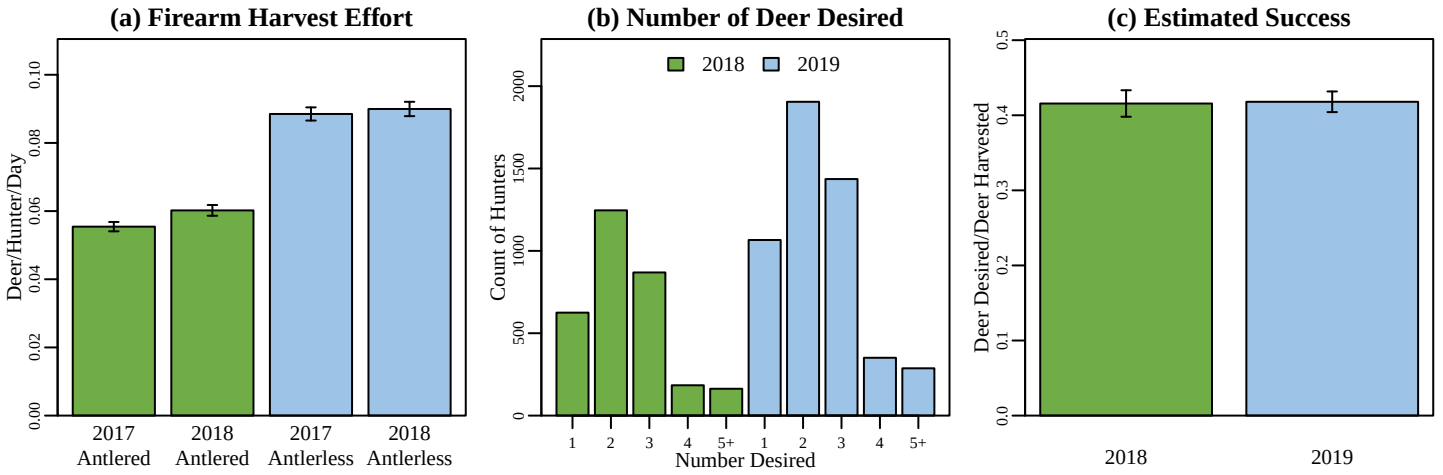


Figure 2. (a) Firearm harvest/effort is the number of deer killed by firearms per hunter divided by the mean number of days hunted per hunter during the firearm season based on data reported in the deer management survey. (b) The annual count of hunters wishing to harvest each number of deer reported in the deer management survey. (c) Success rate is estimated from the deer management survey as the Number of Harvested Deer/Number of Deer Desired (reported only; does not account for attempts that were not made).

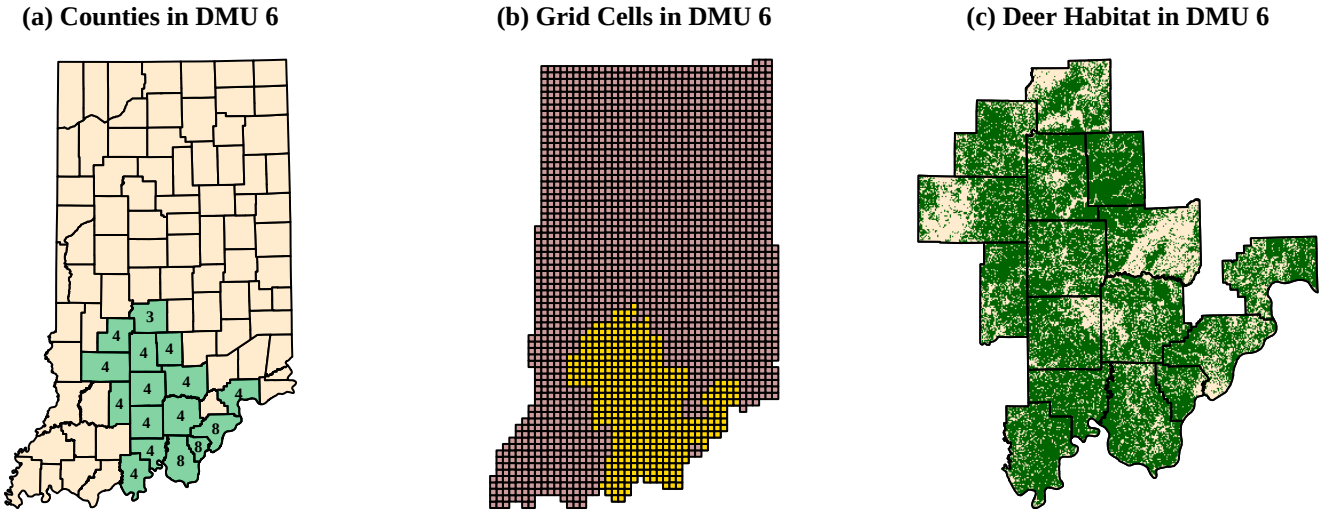


Figure 3. (a) Counties included in DMU 6 for summarizing harvest statistics. Labels are the 2018 county bonus anterless quotas. (b) 4 x 4 mile grid cells included in DMU 6 for summarizing annual deer management survey statistics. (c) Green represents the land use types classified as deer habitat in DMU 6.

DMU 6: South

6/26/2019

Deer Management Survey Results

DNR Management Satisfaction: State

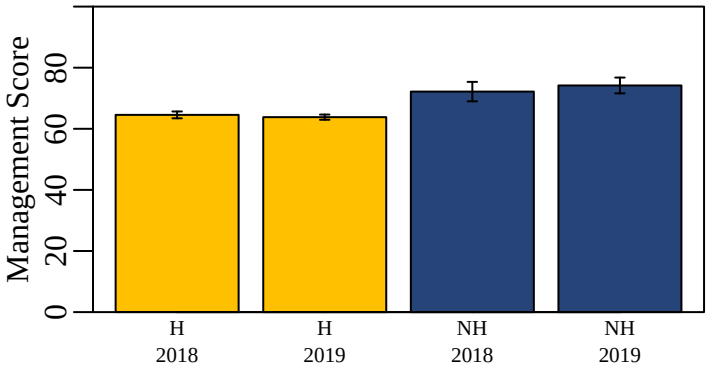


Figure 4. Hunters (H) and nonhunters (NH) were asked to score the DNR's statewide deer management on a scale of 0 (poor) to 100 (excellent).

DNR Management Satisfaction: County

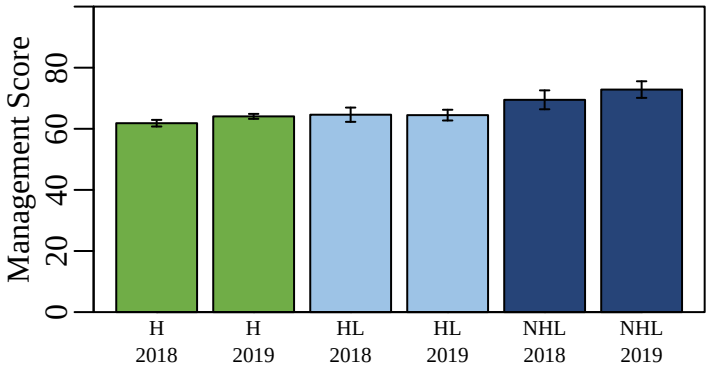


Figure 5. Opionion of county deer management on a scale of 0 (poor) to 100 (excellent) from individuals who hunt in a county (H), individuals that live in a county but hunt elsewhere (HL), and nonhunters that live in a county (NHL).

County Bonus Antlerless Quota

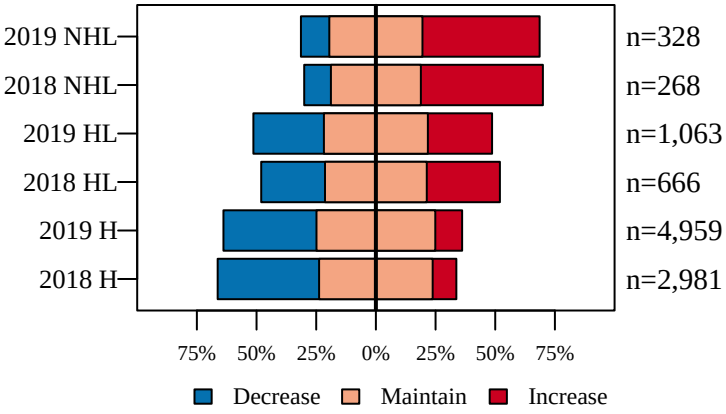


Figure 6. Opinion on how the County Bonus Antlerless Quota should change from nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Deer Population Size

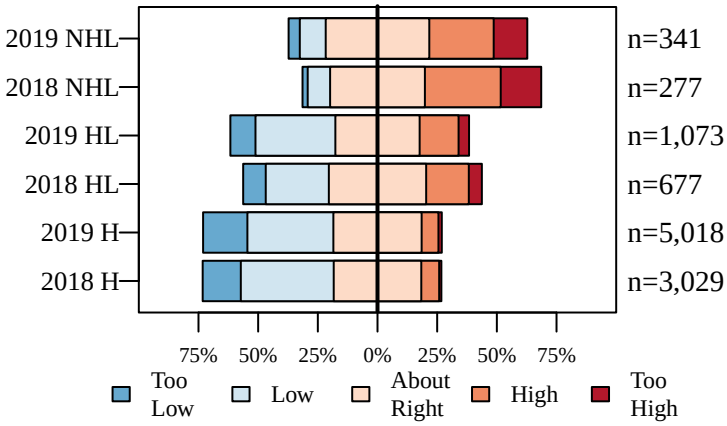


Figure 7. The current size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Perceived Population Change

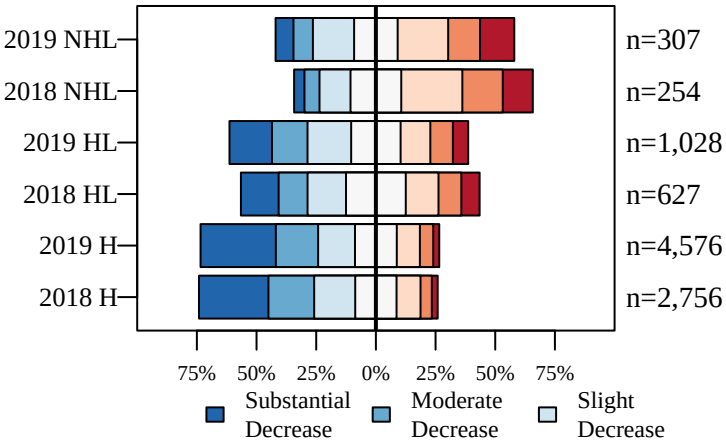


Figure 8. The number of deer seen compared to five years ago described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Desired Population Change

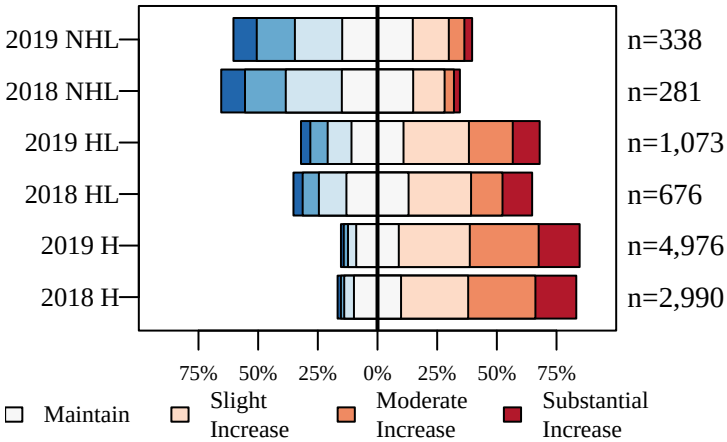


Figure 9. The desired change in the size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

DMU 6: South

6/26/2019

Deer Management Survey Results

Population Size Opinion

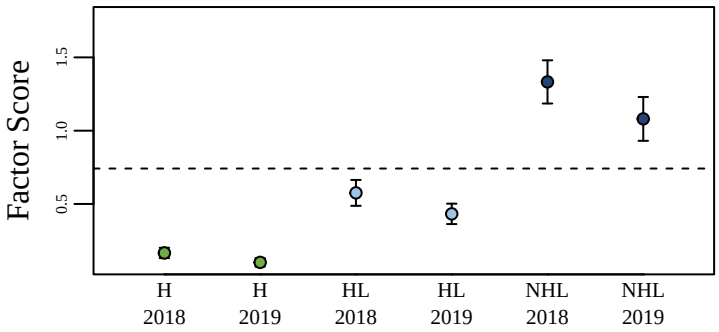


Figure 10. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on the deer population size. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

Management Opinion

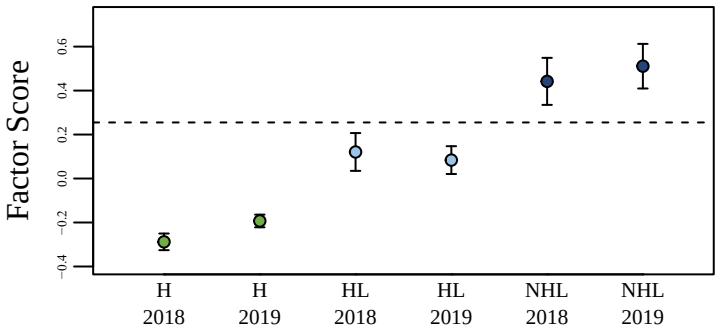


Figure 11. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on deer management. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

Total Harvest Change

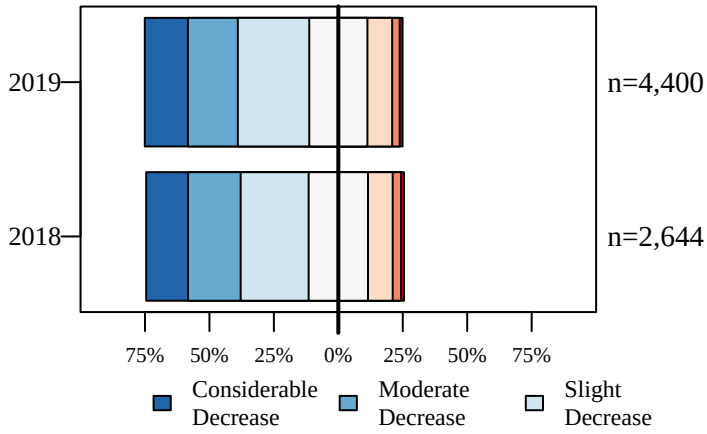


Figure 12. Opinion of hunters on how the total number of harvested deer has changed over the last five years.

Personal Harvest Change

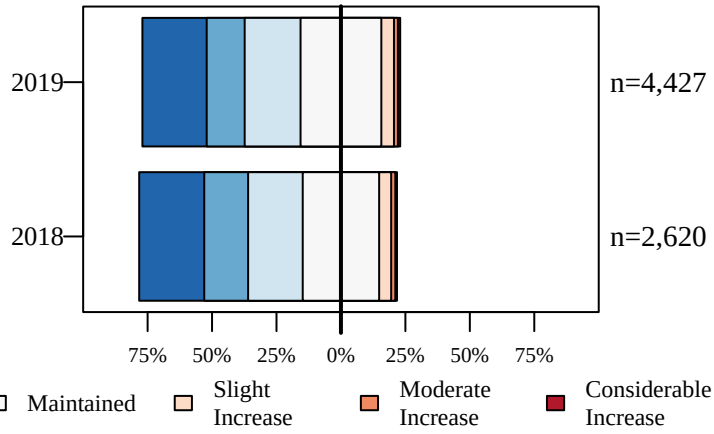


Figure 13. Opinion of hunters on how their personal number of harvested deer has changed over the last five years.

Buck Quality

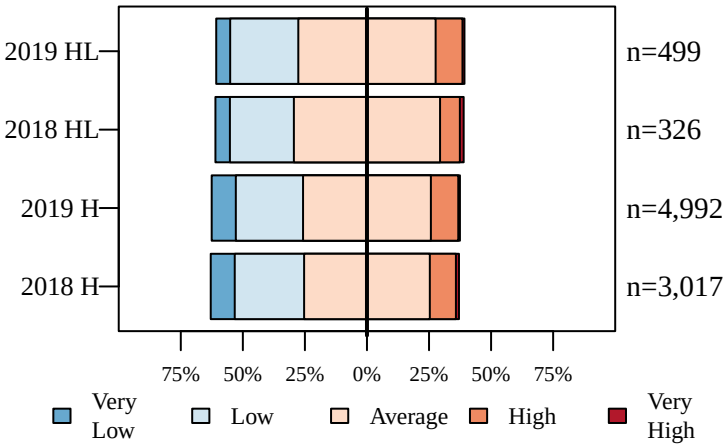


Figure 14. Hunters describe the quality of bucks where they live (HL) and where they hunt (H).

Hunter Opinion

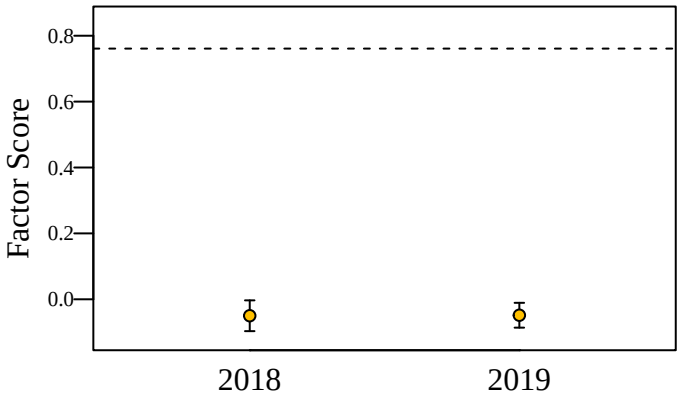


Figure 15. Hunter opinon score over two years of the deer management survey. The score was aggregated using factor analysis of questions asked only to hunters. The dashed line represents the score if all questions were answered neutrally.

DMU 7: Muscatatuck

6/26/2019

Total Square Miles: 1,629
Square Miles of Deer Habitat: 851
Percent Deer Habitat: 60

Table 1. Total harvest, buck harvest, and doe harvest (error approximately 1 percent). Damage permits are issued by DNR to landowners to control deer damage. Deer vehicle collisions (DVC) are reported by the Indiana Department of Transporation. Mean CBAQ is the average county bonus antlerless quota of all counties in the DMU. The trend in total harvest, buck harvest, doe harvest, and DVCs are in standard deviations (SD) and are equivalent to effect size. A change greater than 2 SD is considered both a large and statistically significant effect size.

Year	Total	Total Trend in SD	Buck Harvest	Buck Trend in SD	Buck Harvest per SQ MI Habitat	Doe Harvest	Doe Trend in SD	Doe Harvest per SQ MI Habitat	% Doe in Harvest	Damage Permit Deer Taken	Total DVC	DVC Trend in SD	Mean CBAQ
2009	7,794		3,828		4.50	3,966		4.66	50.89		309		6
2010	7,970	1.53	3,890	1.36	4.57	4,080	1.71	4.79	51.19		331	1.07	6
2011	7,747	0.72	3,790	0.69	4.45	3,957	0.74	4.65	51.08		354	2.33	7
2012	8,797	1.90	3,948	0.89	4.64	4,849	3.00	5.70	55.12		318	-0.28	8
2013	8,185	0.48	3,895	0.62	4.58	4,290	0.41	5.04	52.41		347	1.20	7
2014	7,639	-1.08	3,643	-3.68	4.28	3,996	-0.62	4.70	52.31		350	0.96	7
2015	8,380	0.68	4,219	3.20	4.96	4,161	-0.20	4.89	49.65		401	4.04	7
2016	7,641	-1.07	4,040	0.66	4.75	3,601	-1.80	4.23	47.13	117	430	2.54	7
2017	7,333	-1.60	3,612	-1.60	4.24	3,721	-1.01	4.37	50.74	138	478	2.72	7
2018	6,878	-2.22	3,462	-1.62	4.07	3,416	-1.85	4.01	49.67	81	403	0.36	4

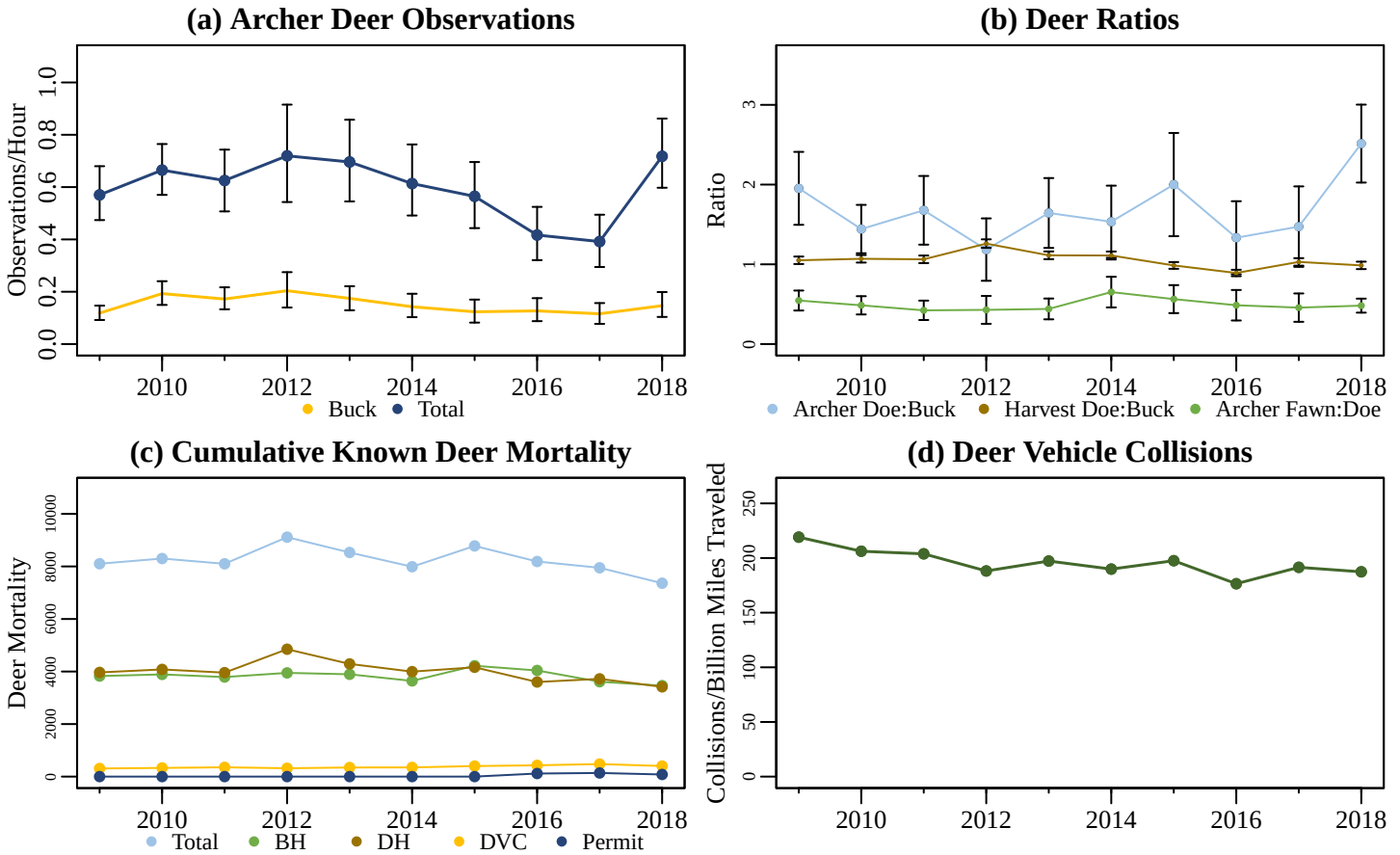


Figure 1. (a) Total deer and buck observations based on the Archer Index. (b) Annual doe:buck ratios and fawn:doe ratios based on the Archer Index and harvest records. (c) The total known annual deer mortality based on buck harvests (BH), doe harvests (DH), deer vehicle collisions (DVC), and deer permit takes. (d) Deer vehicle collisions per billion miles traveled.

DMU 7: Muscatatuck

6/26/2019

Total Square Miles: 1,629
Square Miles of Deer Habitat: 851
Percent Deer Habitat: 60

Table 2. Estimated number of antlered (A) and antlerless (AL) deer harvested per hunter. Estimated totals may not match exactly with total number of deer harvested. Reporting errors are examined and investigated as they are located; therefore, subsequent reports may contain corrected totals.

Year	Total Hunters	0 A	1 A	2 A	3 A	0 AL	1 AL	2 AL	3 AL	4 AL	5 AL	6 AL	7 AL	8 AL	9 AL	10 AL
2015	6,008	2,827	3,153	28	0	2,284	2,730	697	195	72	17	9	1	0	2	1
2016	5,473	2,360	3,036	77	0	2,254	2,329	659	168	33	21	5	2	0	1	1
2017	5,203	2,496	2,678	27	2	1,976	2,313	641	167	64	24	12	3	2	0	0
2018	4,935	2,343	2,571	19	2	1,835	2,238	633	175	43	7	2	1	1	0	0

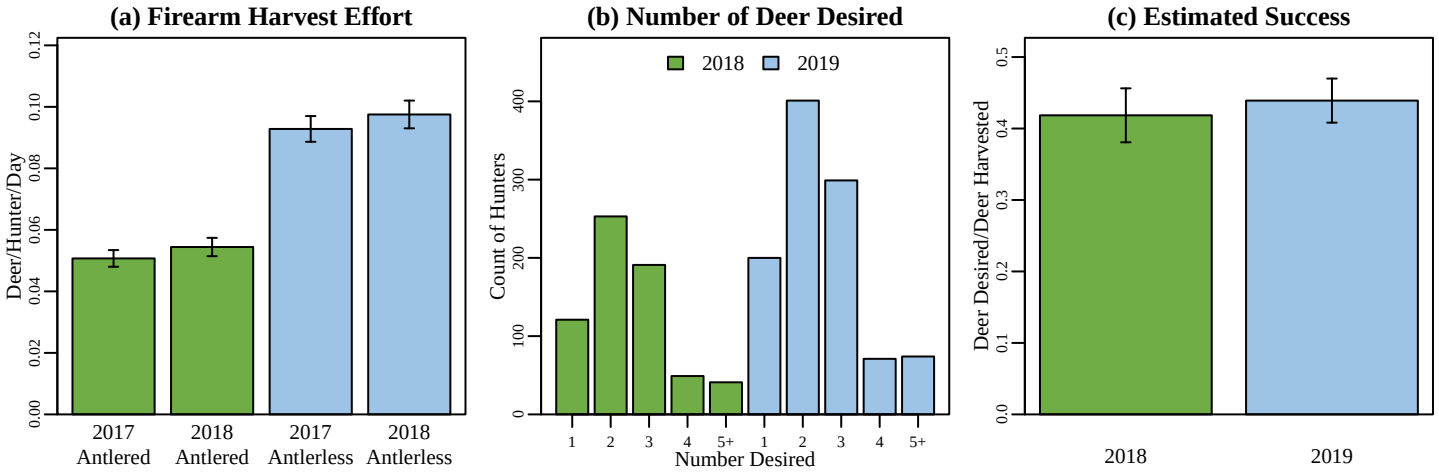


Figure 2. (a) Firearm harvest/effort is the number of deer killed by firearms per hunter divided by the mean number of days hunted per hunter during the firearm season based on data reported in the deer management survey. (b) The annual count of hunters wishing to harvest each number of deer reported in the deer management survey. (c) Success rate is estimated from the deer management survey as the Number of Harvested Deer/Number of Deer Desired (reported only; does not account for attempts that were not made).

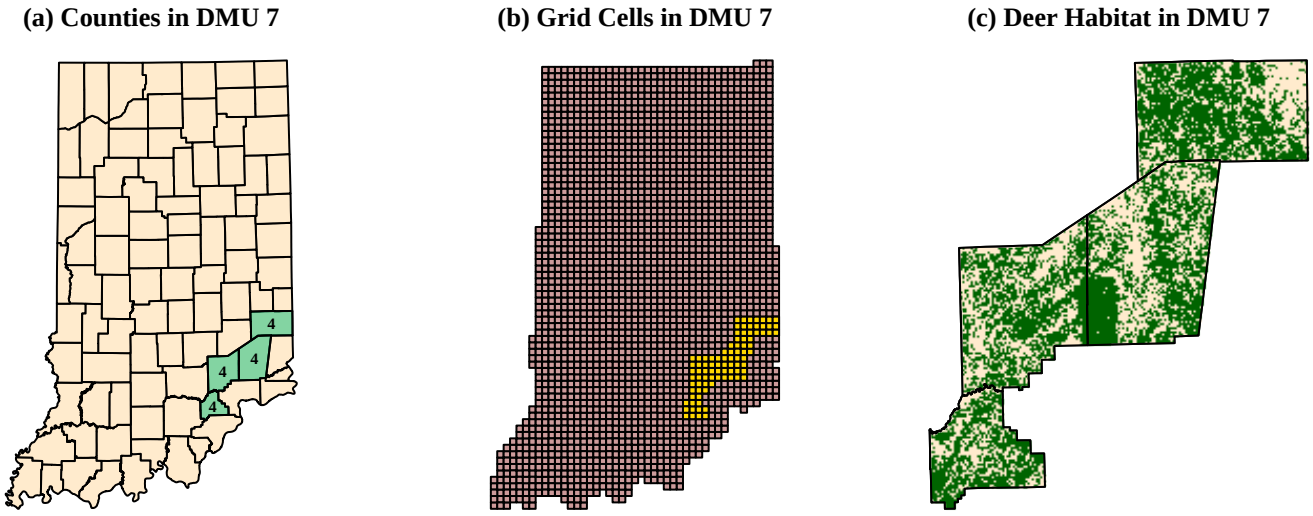


Figure 3. (a) Counties included in DMU 7 for summarizing harvest statistics. Labels are the 2018 county bonus anterless quotas. (b) 4 x 4 mile grid cells included in DMU 7 for summarizing annual deer management survey statistics. (c) Green represents the land use types classified as deer habitat in DMU 7.

DMU 7: Muscatatuck

6/26/2019

Deer Management Survey Results

DNR Management Satisfaction: State

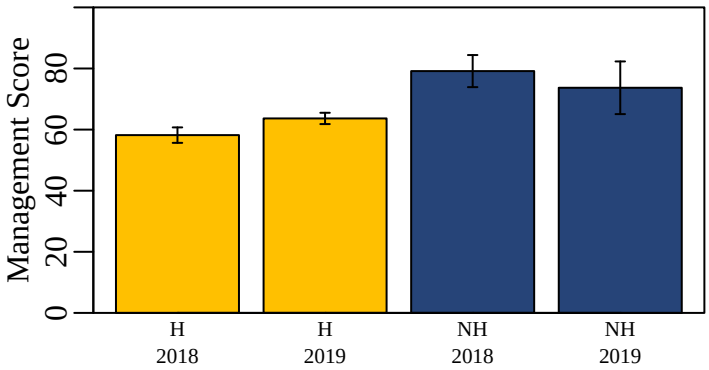


Figure 4. Hunters (H) and nonhunters (NH) were asked to score the DNR's statewide deer management on a scale of 0 (poor) to 100 (excellent).

DNR Management Satisfaction: County

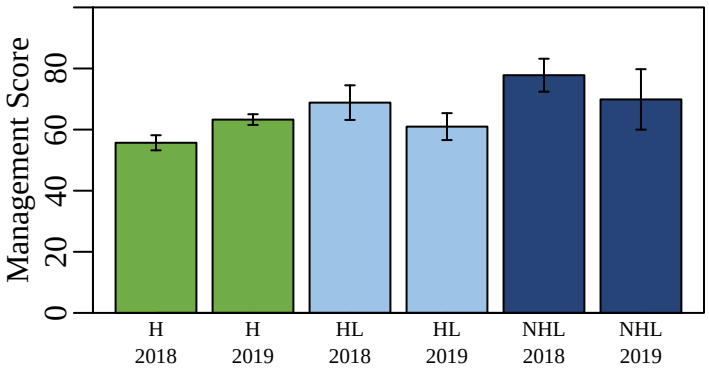


Figure 5. Opionion of county deer management on a scale of 0 (poor) to 100 (excellent) from individuals who hunt in a county (H), individuals that live in a county but hunt elsewhere (HL), and nonhunters that live in a county (NHL).

County Bonus Antlerless Quota

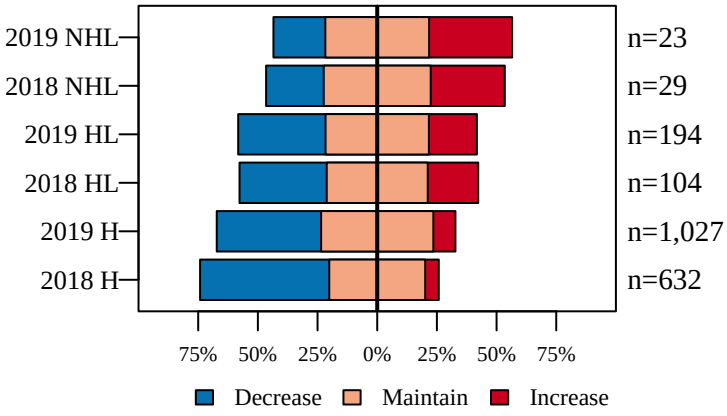


Figure 6. Opinion on how the County Bonus Antlerless Quota should change from nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Deer Population Size

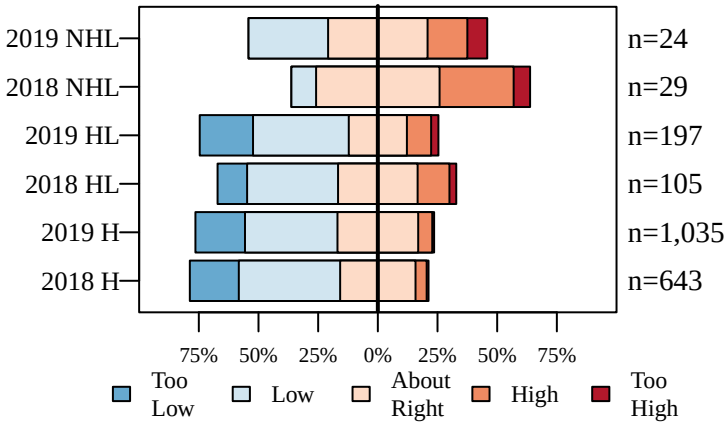


Figure 7. The current size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Perceived Population Change

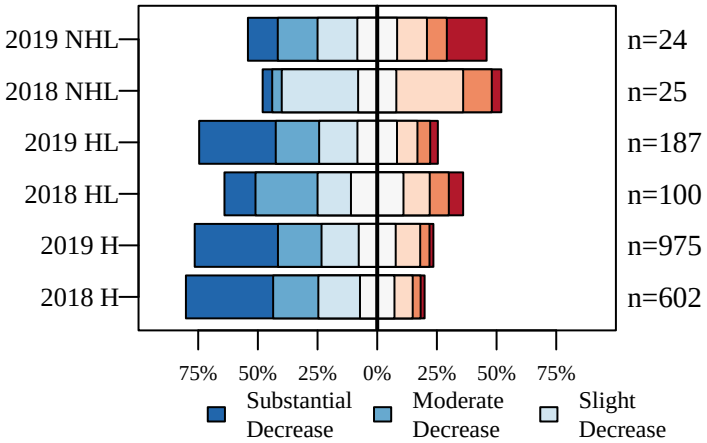


Figure 8. The number of deer seen compared to five years ago described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Desired Population Change

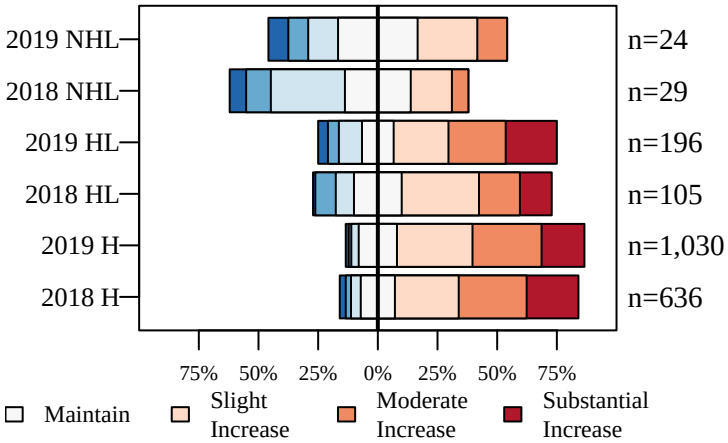


Figure 9. The desired change in the size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

DMU 7: Muscatatuck

6/26/2019

Deer Management Survey Results

Population Size Opinion

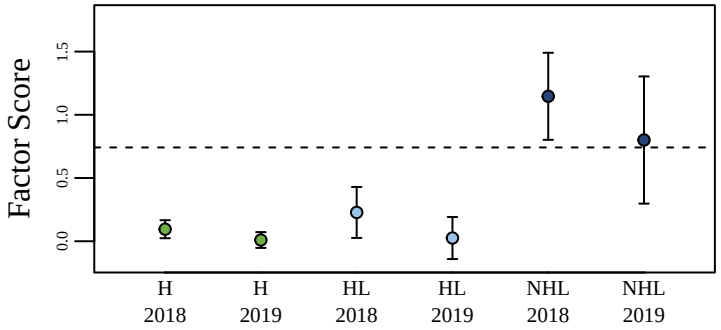


Figure 10. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on the deer population size. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

Management Opinion

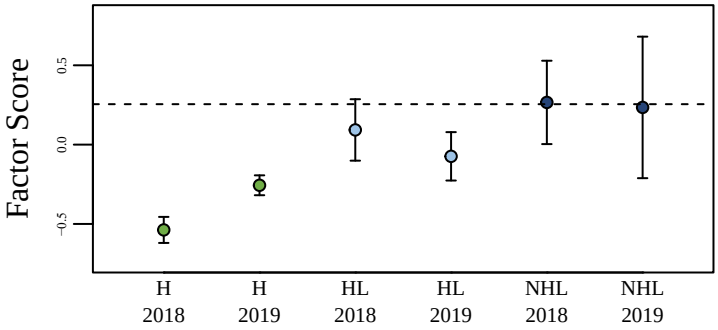


Figure 11. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on deer management. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

Total Harvest Change

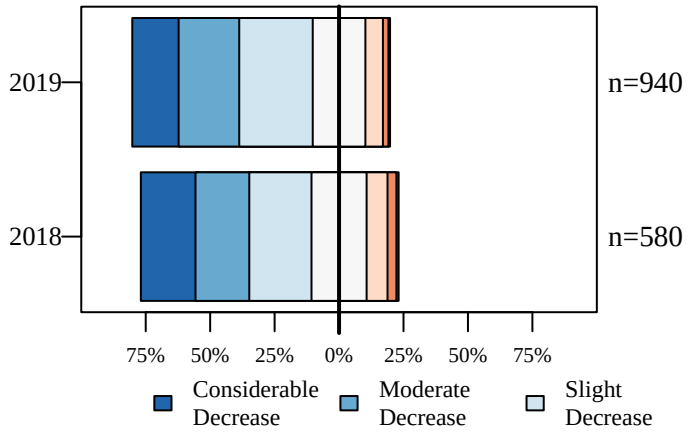


Figure 12. Opinion of hunters on how the total number of harvested deer has changed over the last five years.

Personal Harvest Change

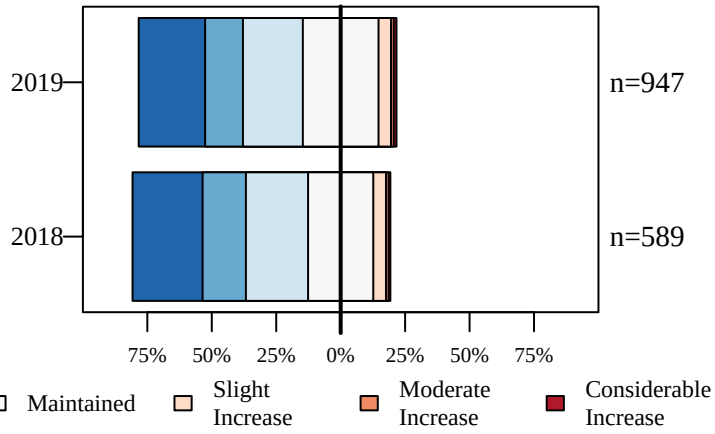


Figure 13. Opinion of hunters on how their personal number of harvested deer has changed over the last five years.

Buck Quality

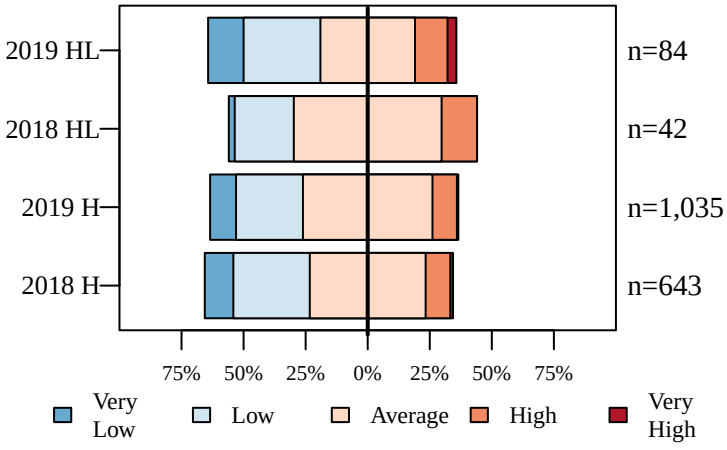


Figure 14. Hunters describe the quality of bucks where they live (HL) and where they hunt (H).

Hunter Opinion

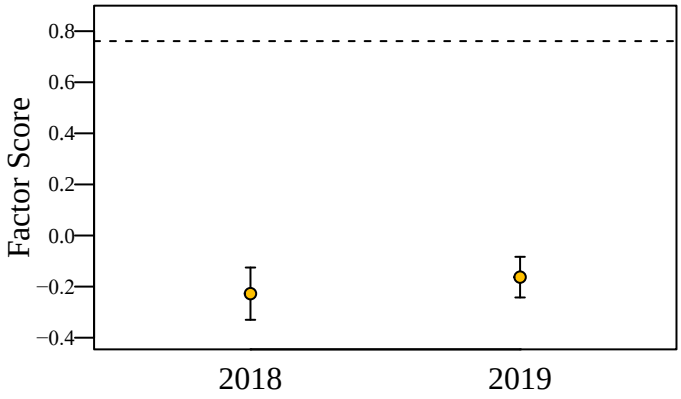


Figure 15. Hunter opinon score over two years of the deer management survey. The score was aggregated using factor analysis of questions asked only to hunters. The dashed line represents the score if all questions were answered neutrally.

DMU 8: Dearborn

6/26/2019

Total Square Miles: 618
Square Miles of Deer Habitat: 520
Percent Deer Habitat: 84

Table 1. Total harvest, buck harvest, and doe harvest (error approximately 1 percent). Damage permits are issued by DNR to landowners to control deer damage. Deer vehicle collisions (DVC) are reported by the Indiana Department of Transporation. Mean CBAQ is the average county bonus antlerless quota of all counties in the DMU. The trend in total harvest, buck harvest, doe harvest, and DVCs are in standard deviations (SD) and are equivalent to effect size. A change greater than 2 SD is considered both a large and statistically significant effect size.

Year	Total	Total Trend in SD	Buck Harvest	Buck Trend in SD	Buck Harvest per SQ MI Habitat	Doe Harvest	Doe Trend in SD	Doe Harvest per SQ MI Habitat	% Doe in Harvest	Damage Permit Deer Taken	Total DVC	DVC Trend in SD	Mean CBAQ
2009	7,264		3,444		6.62	3,820		7.35	52.59		453		8.00
2010	7,333	1.56	3,403	1.26	6.54	3,930	1.88	7.56	53.59		446	-0.35	8.00
2011	7,323	1.05	3,353	0.84	6.45	3,970	1.38	7.63	54.21		418	-1.19	8.00
2012	7,849	2.05	3,333	0.48	6.41	4,516	5.20	8.68	57.54		399	-1.26	8.00
2013	6,226	-2.00	2,789	-1.83	5.36	3,437	-1.63	6.61	55.20		418	-0.59	8.00
2014	6,077	-1.89	2,733	-1.97	5.26	3,344	-1.52	6.43	55.03		376	-2.28	6.67
2015	6,023	-1.22	3,108	-0.04	5.98	2,915	-1.96	5.61	48.40		437	0.99	5.33
2016	5,519	-1.42	2,970	-0.32	5.71	2,549	-1.76	4.90	46.19	175	342	-2.93	4.00
2017	5,216	-1.27	2,548	-1.80	4.90	2,668	-0.92	5.13	51.15	130	359	-1.14	4.00
2018	4,684	-2.65	2,353	-2.20	4.53	2,331	-1.64	4.48	49.77	174	333	-1.72	3.33

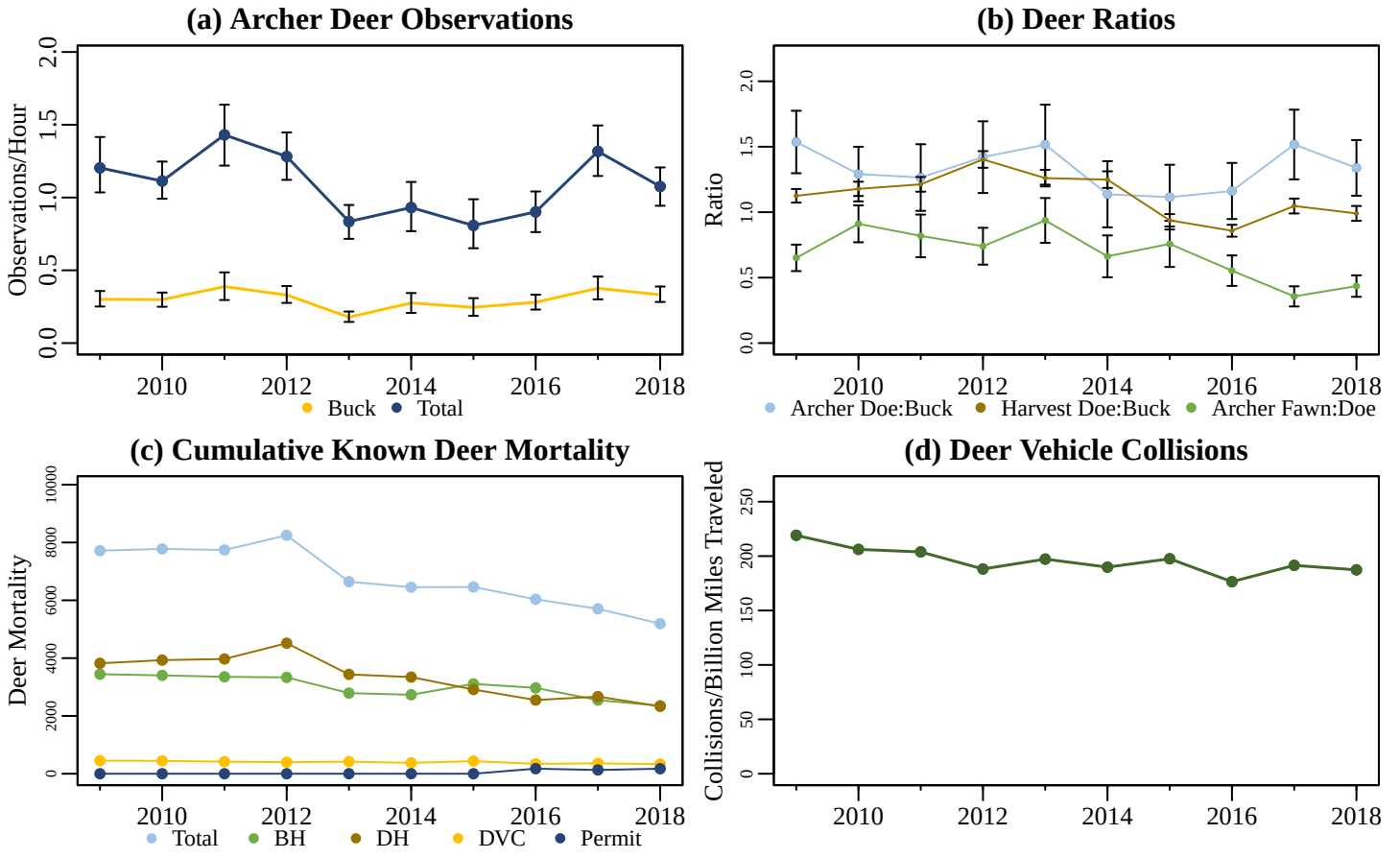


Figure 1. (a) Total deer and buck observations based on the Archer Index. (b) Annual doe:buck ratios and fawn:doe ratios based on the Archer Index and harvest records. (c) The total known annual deer mortality based on buck harvests (BH), doe harvests (DH), deer vehicle collisions (DVC), and deer permit takes. (d) Deer vehicle collisions per billion miles traveled.

DMU 8: Dearborn

6/26/2019

Total Square Miles: 618
Square Miles of Deer Habitat: 520
Percent Deer Habitat: 84

Table 2. Estimated number of antlered (A) and antlerless (AL) deer harvested per hunter. Estimated totals may not match exactly with total number of deer harvested. Reporting errors are examined and investigated as they are located; therefore, subsequent reports may contain corrected totals.

Year	Total Hunters	0 A	1 A	2 A	3 A	0 AL	1 AL	2 AL	3 AL	4 AL	5 AL	6 AL	7 AL	8 AL	9 AL	10 AL
2015	4,442	1,960	2,477	4	1	1,851	1,885	527	135	33	9	0	2	0	0	0
2016	4,083	1,658	2,385	39	1	1,818	1,684	435	102	34	4	5	1	0	0	0
2017	3,698	1,713	1,968	17	0	1,440	1,578	483	144	38	8	4	2	1	0	0
2018	3,369	1,494	1,868	7	0	1,331	1,470	423	112	25	3	2	2	0	1	0

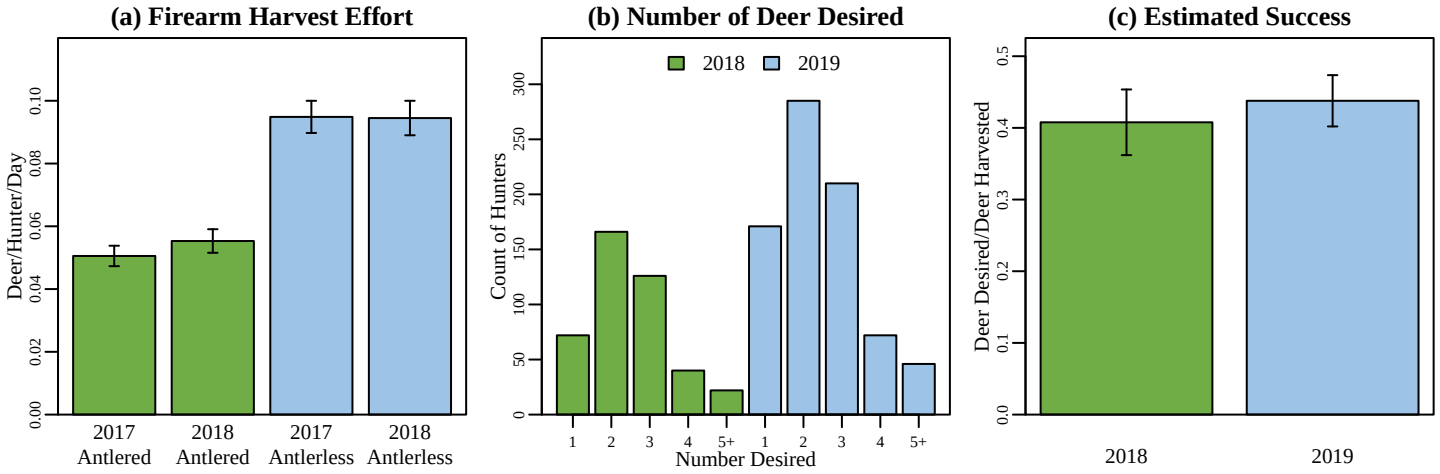


Figure 2. (a) Firearm harvest/effort is the number of deer killed by firearms per hunter divided by the mean number of days hunted per hunter during the firearm season based on data reported in the deer management survey. (b) The annual count of hunters wishing to harvest each number of deer reported in the deer management survey. (c) Success rate is estimated from the deer management survey as the Number of Harvested Deer/Number of Deer Desired (reported only; does not account for attempts that were not made).

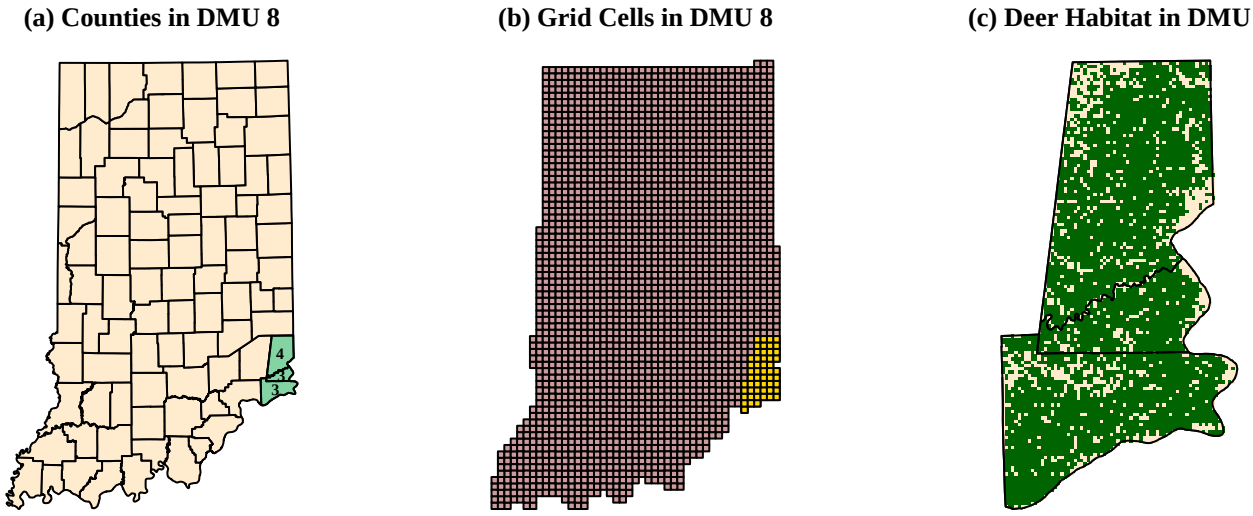
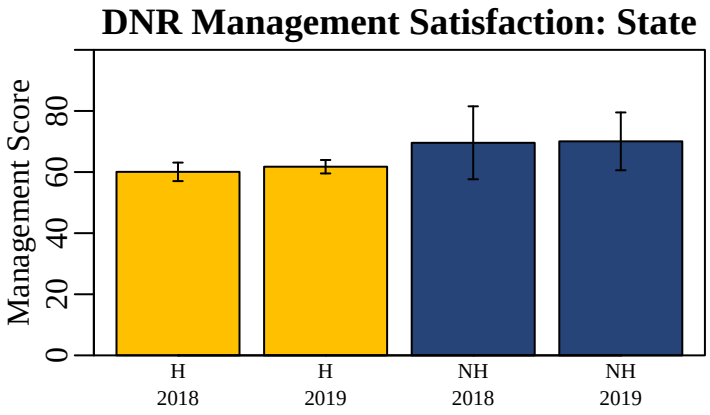


Figure 3. (a) Counties included in DMU 8 for summarizing harvest statistics. Labels are the 2018 county bonus anterless quotas. (b) 4 x 4 mile grid cells included in DMU 8 for summarizing annual deer management survey statistics. (c) Green represents the land use types classified as deer habitat in DMU 8.

DMU 8: Dearborn

6/26/2019

Deer Management Survey Results



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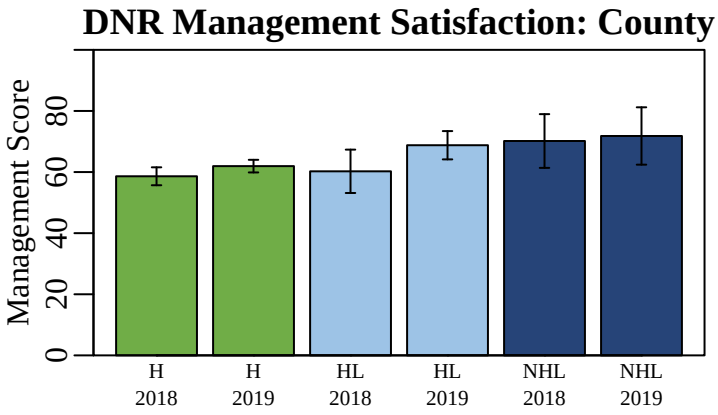

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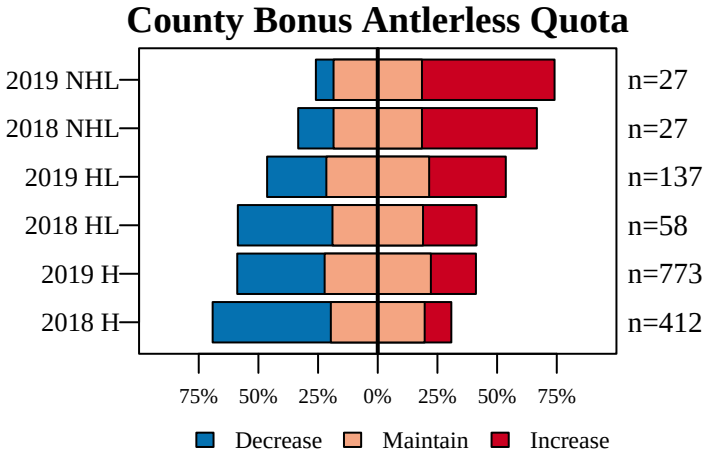


Figure 6. Opinion on how the County Bonus Antlerless Quota should change from nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

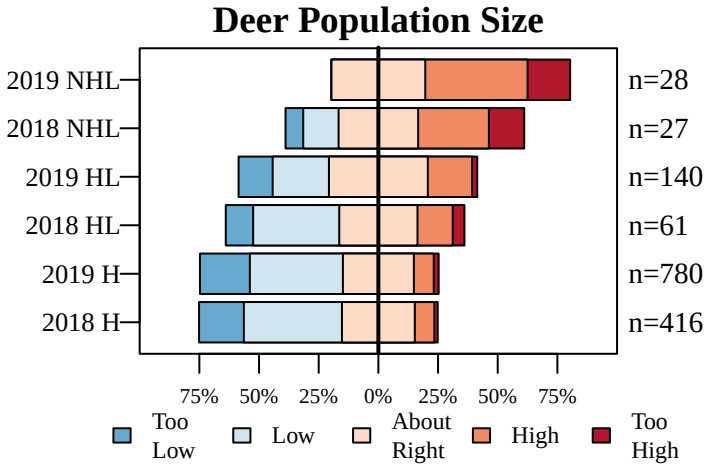


Figure 7. The current size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

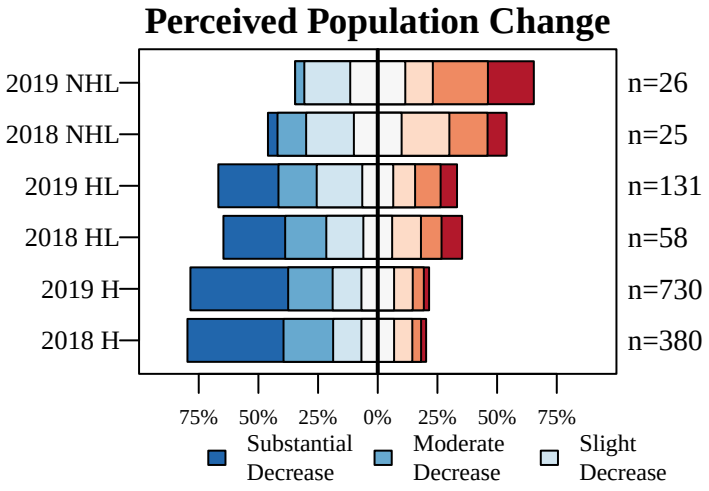


Figure 8. The number of deer seen compared to five years ago described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

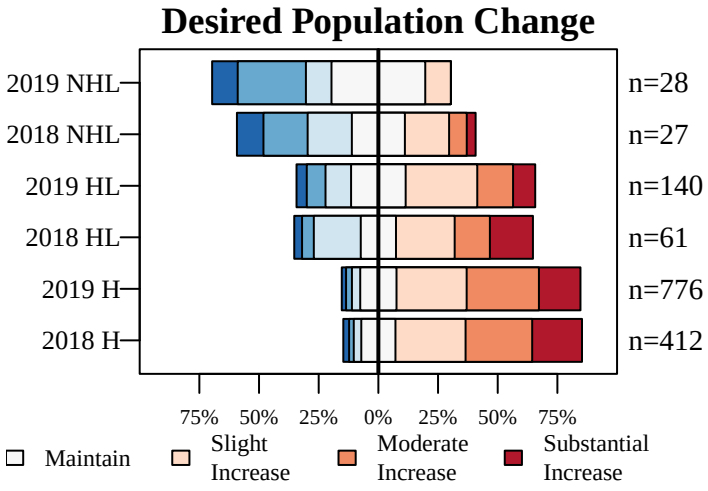


Figure 9. The desired change in the size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

DMU 8: Dearborn

6/26/2019

Deer Management Survey Results

Population Size Opinion

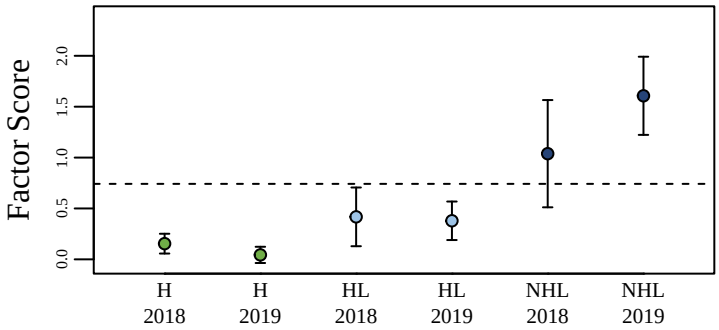


Figure 10. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on the deer population size. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

Management Opinion

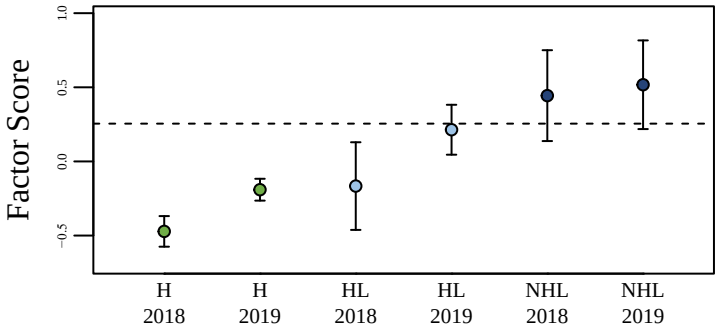


Figure 11. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on deer management. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

Total Harvest Change

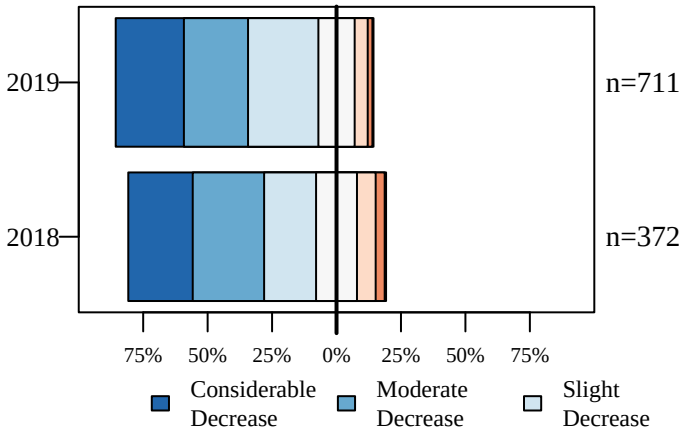


Figure 12. Opinion of hunters on how the total number of harvested deer has changed over the last five years.

Personal Harvest Change

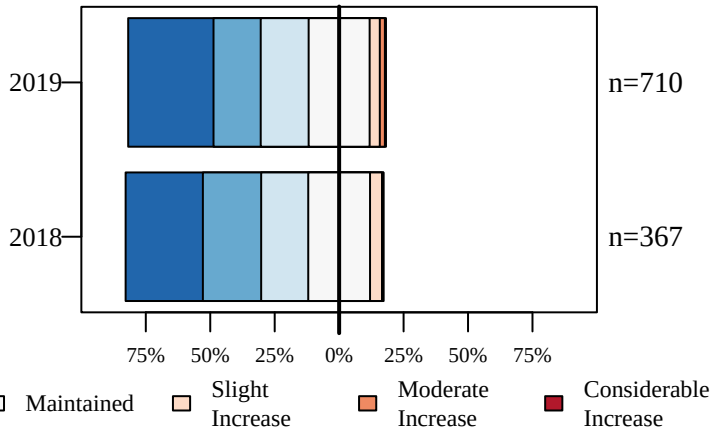


Figure 13. Opinion of hunters on how their personal number of harvested deer has changed over the last five years.

Buck Quality

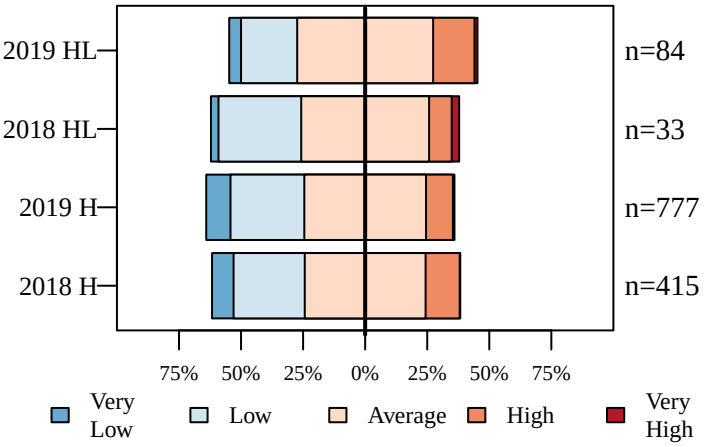


Figure 14. Hunters describe the quality of bucks where they live (HL) and where they hunt (H).

Hunter Opinion

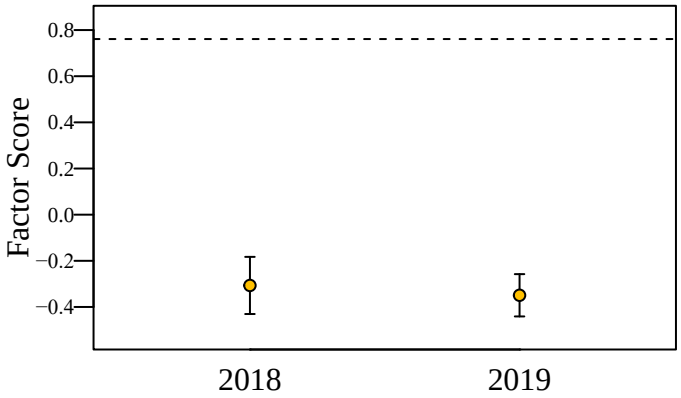


Figure 15. Hunter opinon score over two years of the deer management survey. The score was aggregated using factor analysis of questions asked only to hunters. The dashed line represents the score if all questions were answered neutrally.

DMU 9: Southwest

6/26/2019

Total Square Miles: 3,742
Square Miles of Deer Habitat: 1,214
Percent Deer Habitat: 33

Table 1. Total harvest, buck harvest, and doe harvest (error approximately 1 percent). Damage permits are issued by DNR to landowners to control deer damage. Deer vehicle collisions (DVC) are reported by the Indiana Department of Transporation. Mean CBAQ is the average county bonus antlerless quota of all counties in the DMU. The trend in total harvest, buck harvest, doe harvest, and DVCs are in standard deviations (SD) and are equivalent to effect size. A change greater than 2 SD is considered both a large and statistically significant effect size.

Year	Total	Total Trend in SD	Buck Harvest	Buck Trend in SD	Buck Harvest per SQ MI Habitat	Doe Harvest	Doe Trend in SD	Doe Harvest per SQ MI Habitat	% Doe in Harvest	Damage Permit Deer Taken	Total DVC	DVC Trend in SD	Mean CBAQ
2009	11,818		6,178		5.09	5,640		4.65	47.72		1,148		4.78
2010	11,780	-0.54	6,075	-0.46	5.00	5,705	-0.60	4.70	48.43		1,118	0.30	4.67
2011	11,747	-0.34	6,019	-0.33	4.96	5,728	-0.33	4.72	48.76		1,206	2.00	4.67
2012	12,409	1.65	5,802	-0.89	4.78	6,607	4.02	5.44	53.24		1,141	-0.01	4.67
2013	12,172	0.60	5,888	-1.05	4.85	6,284	0.83	5.18	51.63		1,336	3.92	4.44
2014	11,929	-0.19	5,891	-0.68	4.85	6,038	0.11	4.97	50.62		1,361	1.95	3.89
2015	11,589	-1.49	5,883	-0.47	4.85	5,706	-0.96	4.70	49.24		1,426	1.74	3.89
2016	10,834	-3.46	5,718	-2.30	4.71	5,116	-2.50	4.21	47.22	107	1,146	-1.26	3.56
2017	10,675	-1.81	5,492	-4.54	4.52	5,183	-1.34	4.27	48.55	128	1,264	-0.04	2.56
2018	10,377	-1.61	5,531	-1.40	4.56	4,846	-1.59	3.99	46.70	65	1,255	-0.12	2.00

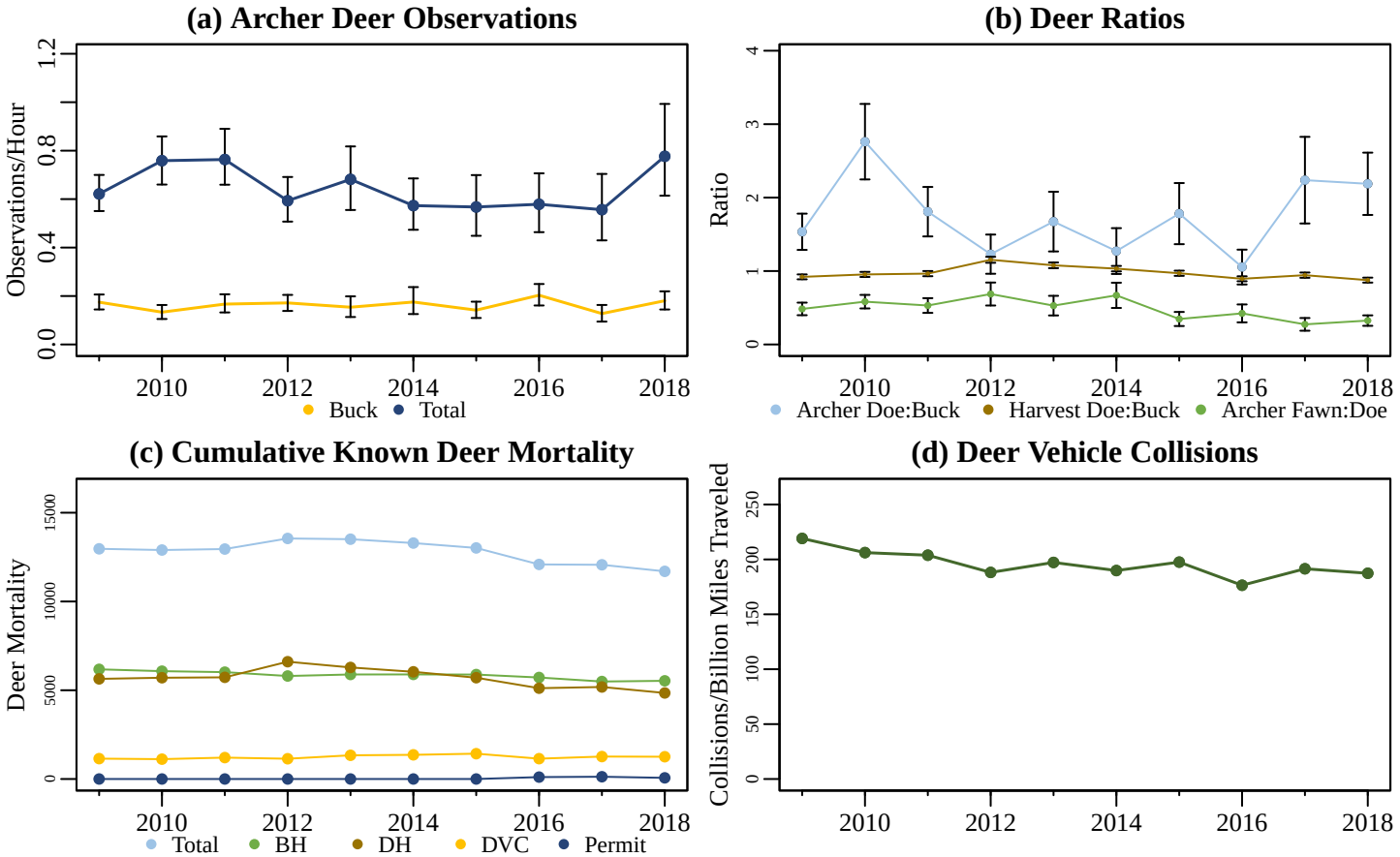


Figure 1. (a) Total deer and buck observations based on the Archer Index. (b) Annual doe:buck ratios and fawn:doe ratios based on the Archer Index and harvest records. (c) The total known annual deer mortality based on buck harvests (BH), doe harvests (DH), deer vehicle collisions (DVC), and deer permit takes. (d) Deer vehicle collisions per billion miles traveled.

DMU 9: Southwest

6/26/2019

Total Square Miles: 3,742
Square Miles of Deer Habitat: 1,214
Percent Deer Habitat: 33

Table 2. Estimated number of antlered (A) and antlerless (AL) deer harvested per hunter. Estimated totals may not match exactly with total number of deer harvested. Reporting errors are examined and investigated as they are located; therefore, subsequent reports may contain corrected totals.

Year	Total Hunters	0 A	1 A	2 A	3 A	0 AL	1 AL	2 AL	3 AL	4 AL	5 AL	6 AL	7 AL	8 AL	9 AL	10 AL
2015	8,624	3,740	4,835	49	0	3,539	3,892	923	194	54	14	7	0	1	0	0
2016	8,187	3,415	4,729	42	0	3,532	3,580	859	162	39	13	2	0	0	0	0
2017	7,916	3,536	4,326	52	2	3,095	3,698	904	165	41	6	5	2	0	0	0
2018	7,856	3,284	4,529	41	2	3,312	3,511	886	117	25	4	1	0	0	0	0

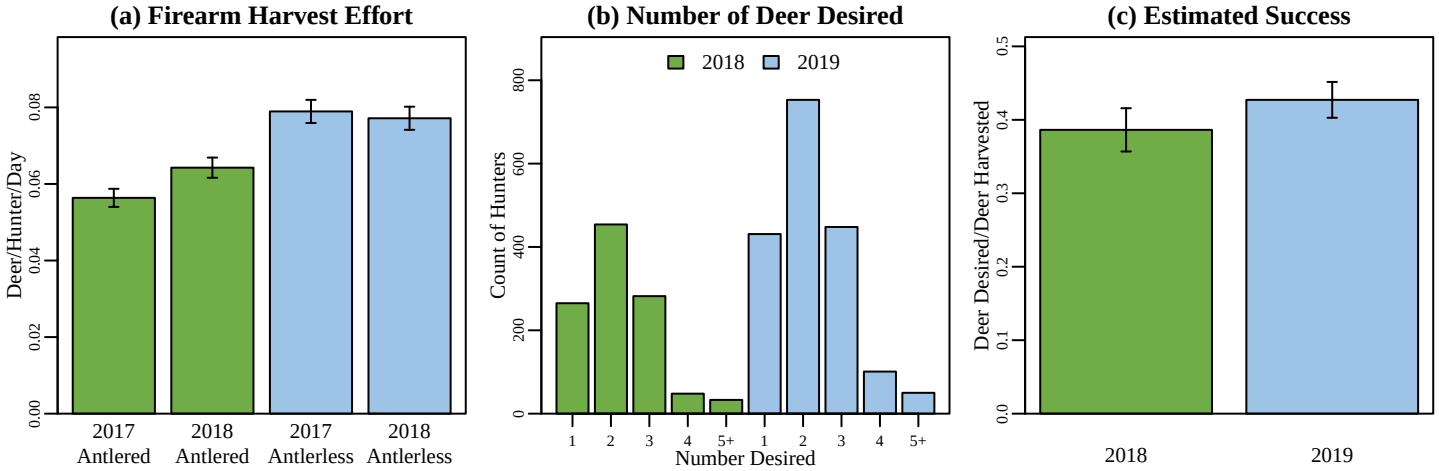


Figure 2. (a) Firearm harvest/effort is the number of deer killed by firearms per hunter divided by the mean number of days hunted per hunter during the firearm season based on data reported in the deer management survey. (b) The annual count of hunters wishing to harvest each number of deer reported in the deer management survey. (c) Success rate is estimated from the deer management survey as the Number of Harvested Deer/Number of Deer Desired (reported only; does not account for attempts that were not made).

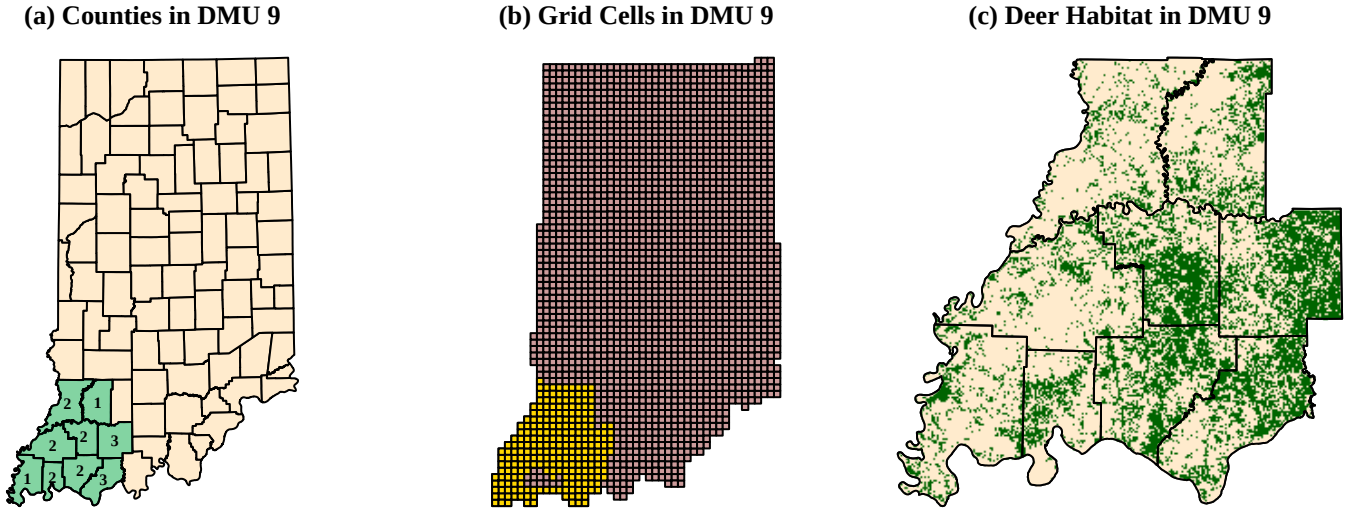


Figure 3. (a) Counties included in DMU 9 for summarizing harvest statistics. Labels are the 2018 county bonus anterless quotas. (b) 4 x 4 mile grid cells included in DMU 9 for summarizing annual deer management survey statistics. (c) Green represents the land use types classified as deer habitat in DMU 9.

DMU 9: Southwest

6/26/2019

Deer Management Survey Results

DNR Management Satisfaction: State

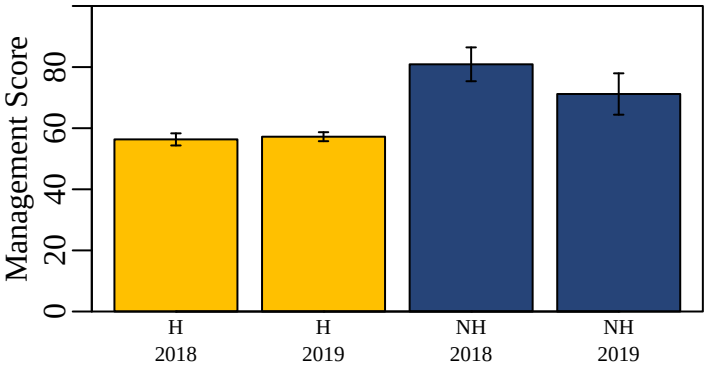


Figure 4. Hunters (H) and nonhunters (NH) were asked to score the DNR's statewide deer management on a scale of 0 (poor) to 100 (excellent).

DNR Management Satisfaction: County

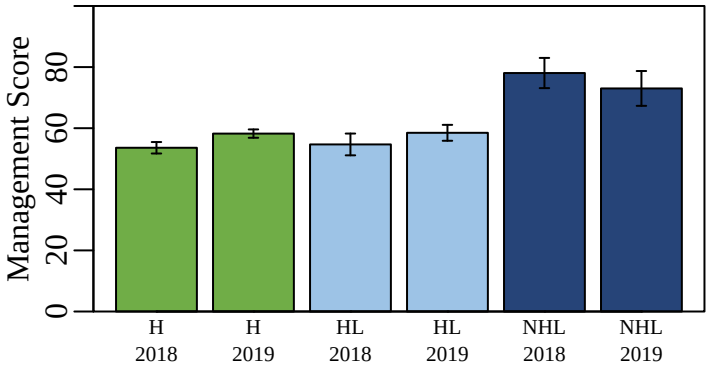


Figure 5. Opionion of county deer management on a scale of 0 (poor) to 100 (excellent) from individuals who hunt in a county (H), individuals that live in a county but hunt elsewhere (HL), and nonhunters that live in a county (NHL).

County Bonus Antlerless Quota

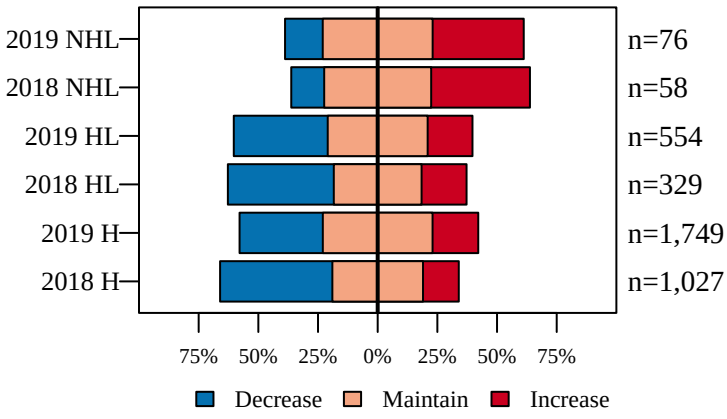


Figure 6. Opinion on how the County Bonus Antlerless Quota should change from nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Deer Population Size

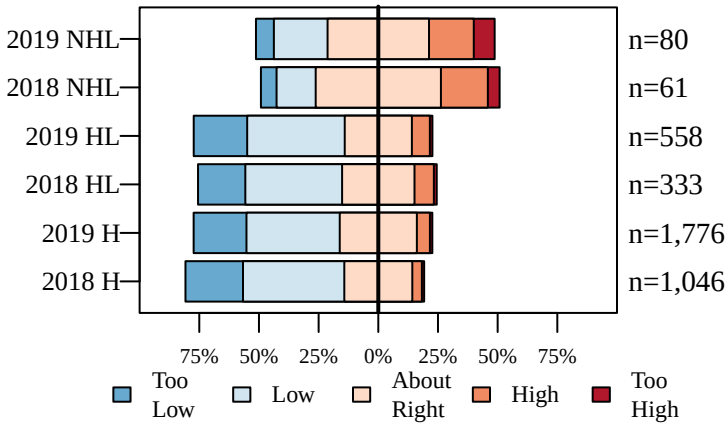


Figure 7. The current size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Perceived Population Change

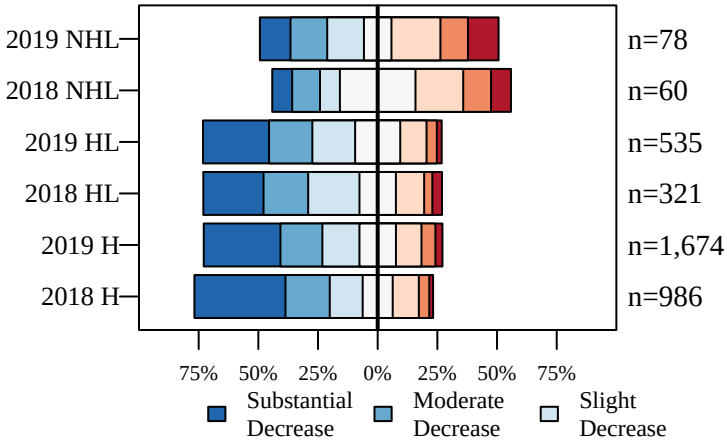


Figure 8. The number of deer seen compared to five years ago described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

Desired Population Change

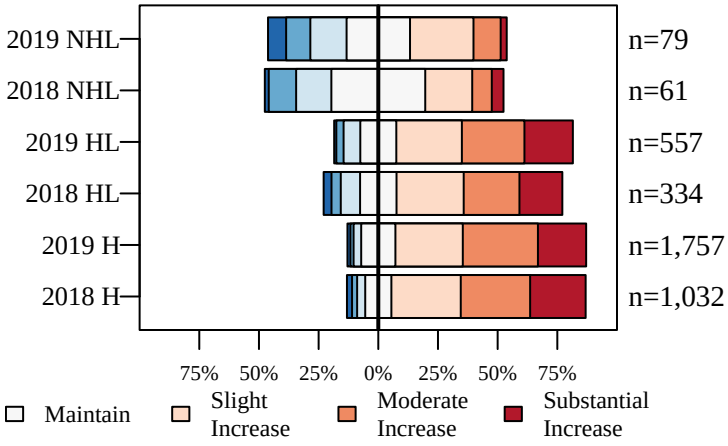


Figure 9. The desired change in the size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

DMU 9: Southwest

6/26/2019

Deer Management Survey Results

Population Size Opinion

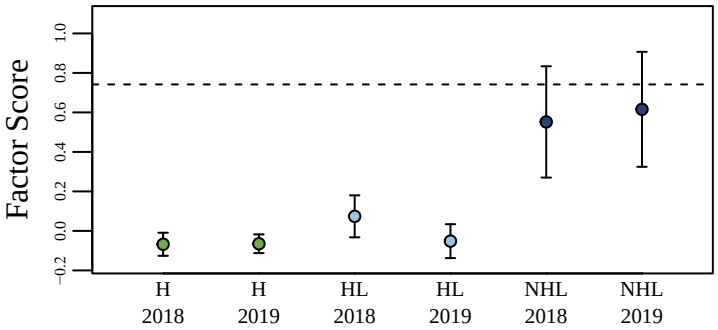


Figure 10. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on the deer population size. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

Management Opinion

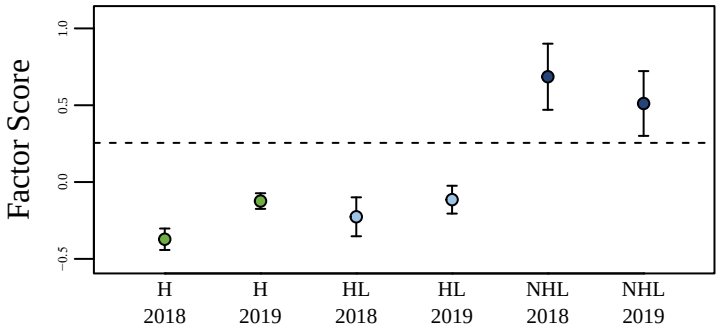


Figure 11. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on deer management. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

Total Harvest Change

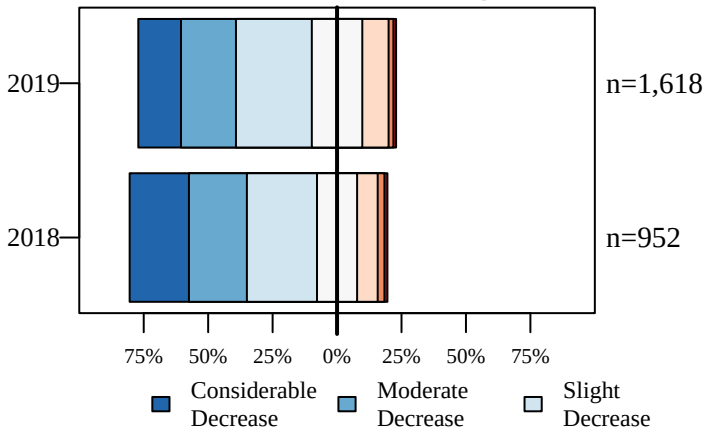


Figure 12. Opinion of hunters on how the total number of harvested deer has changed over the last five years.

Personal Harvest Change

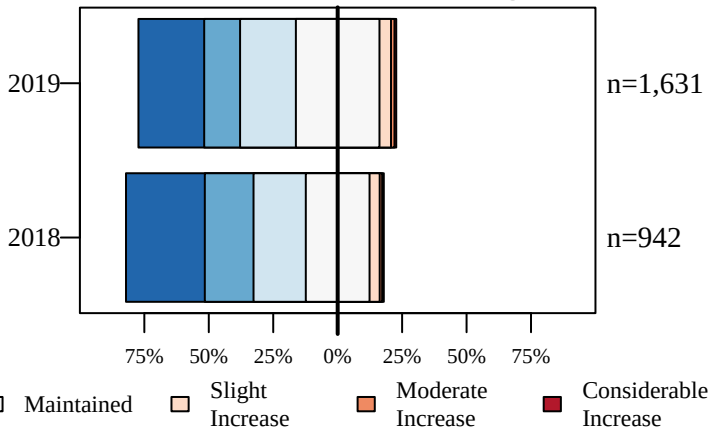


Figure 13. Opinion of hunters on how their personal number of harvested deer has changed over the last five years.

Buck Quality

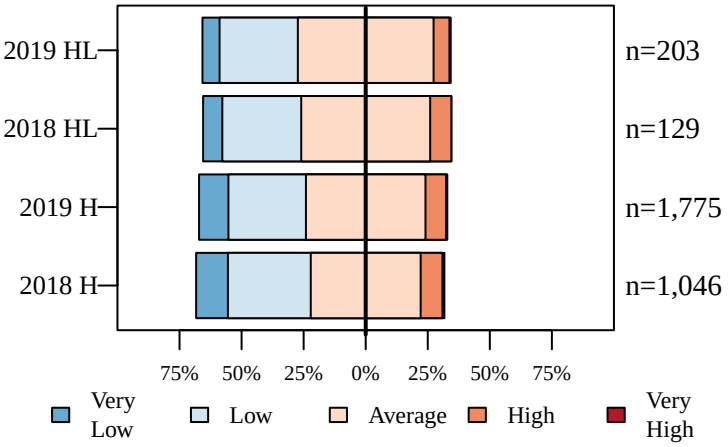


Figure 14. Hunters describe the quality of bucks where they live (HL) and where they hunt (H).

Hunter Opinion

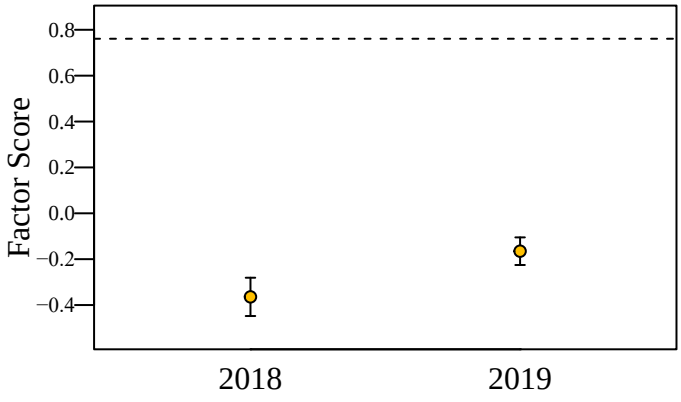


Figure 15. Hunter opinon score over two years of the deer management survey. The score was aggregated using factor analysis of questions asked only to hunters. The dashed line represents the score if all questions were answered neutrally.

DMU 10: Urban

6/26/2019

Total Square Miles: 403
Square Miles of Deer Habitat: 35
Percent Deer Habitat: 9

Table 1. Total harvest, buck harvest, and doe harvest (error approximately 1 percent). Damage permits are issued by DNR to landowners to control deer damage. Deer vehicle collisions (DVC) are reported by the Indiana Department of Transporation. Mean CBAQ is the average county bonus antlerless quota of all counties in the DMU. The trend in total harvest, buck harvest, doe harvest, and DVCs are in standard deviations (SD) and are equivalent to effect size. A change greater than 2 SD is considered both a large and statistically significant effect size.

Year	Total	Total Trend in SD	Buck Harvest	Buck Trend in SD	Buck Harvest per SQ MI Habitat	Doe Harvest	Doe Trend in SD	Doe Harvest per SQ MI Habitat	% Doe in Harvest	Damage Permit Deer Taken	Total DVC	DVC Trend in SD	Mean CBAQ
2005	201		125		3.57	76		2.17	37.81		144		4
2006	264		162		4.63	102		2.91	38.64		134		8
2007	324		208		5.94	116		3.31	35.80		94		8
2008	328		192		5.49	136		3.89	41.46		113		8
2009	351		224		6.40	127		3.63	36.18		124		8
2010	352	0.96	191	0.22	5.46	161	2.11	4.60	45.74		117	-0.25	8
2011	375	1.43	207	0.50	5.91	168	1.78	4.80	44.80		127	0.71	8
2012	501	7.50	179	-1.87	5.11	322	8.12	9.20	64.27		95	-1.54	8
2013	510	1.87	203	0.25	5.80	307	1.56	8.77	60.20		119	0.30	8
2014	469	0.63	166	-2.05	4.74	303	0.95	8.66	64.61		102	-1.14	8
2015	444	0.04	167	-1.31	4.77	277	0.31	7.91	62.39		114	0.15	8
2016	416	-0.81	166	-0.94	4.74	250	-0.41	7.14	60.10	3	108	-0.26	8
2017	449	-0.49	188	0.74	5.37	261	-1.08	7.46	58.13	174	131	1.74	8
2018	435	-0.65	170	-0.48	4.86	265	-0.58	7.57	60.92	123	113	-0.05	3

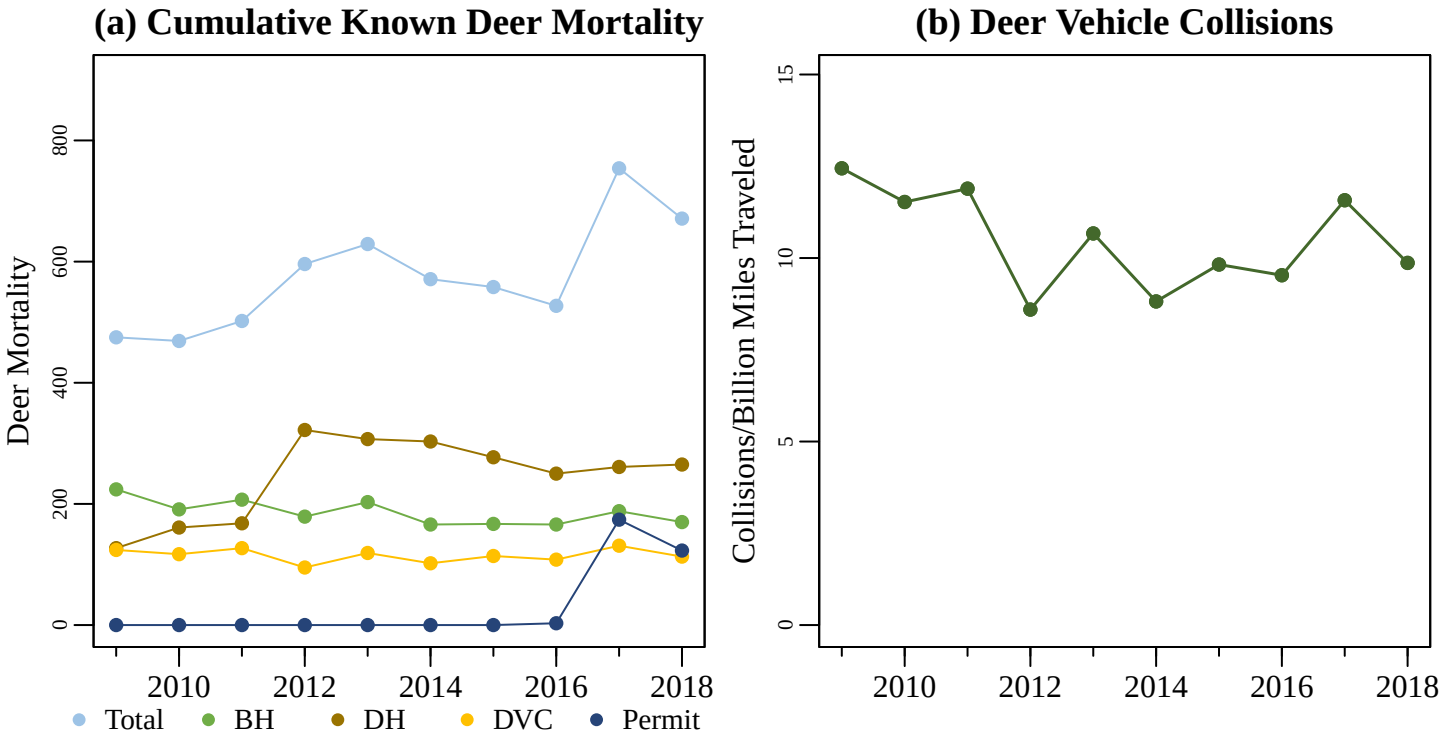


Figure 1. (a) Total deer and buck observations based on the Archer Index. (b) Annual doe:buck ratios and fawn:doe ratios based on the Archer Index and harvest records.

DMU 10: Urban

6/26/2019

Total Square Miles: 403
Square Miles of Deer Habitat: 35
Percent Deer Habitat: 9

Table 2. Estimated number of antlered (A) and antlerless (AL) deer harvested per hunter. Estimated totals may not match exactly with total number of deer harvested. Reporting errors are examined and investigated as they are located; therefore, subsequent reports may contain corrected totals.

Year	Total Hunters	0 A	1 A	2 A	3 A	0 AL	1 AL	2 AL	3 AL	4 AL	5 AL	6 AL	7 AL	8 AL	9 AL	10 AL
2015	327	220	97	10	0	53	232	36	4	0	1	1	0	0	0	0
2016	313	182	127	4	0	71	211	24	6	1	0	0	0	0	0	0
2017	316	187	119	10	0	65	206	35	8	0	2	0	0	0	0	0
2018	303	179	120	4	0	63	188	40	10	1	1	0	0	0	0	0

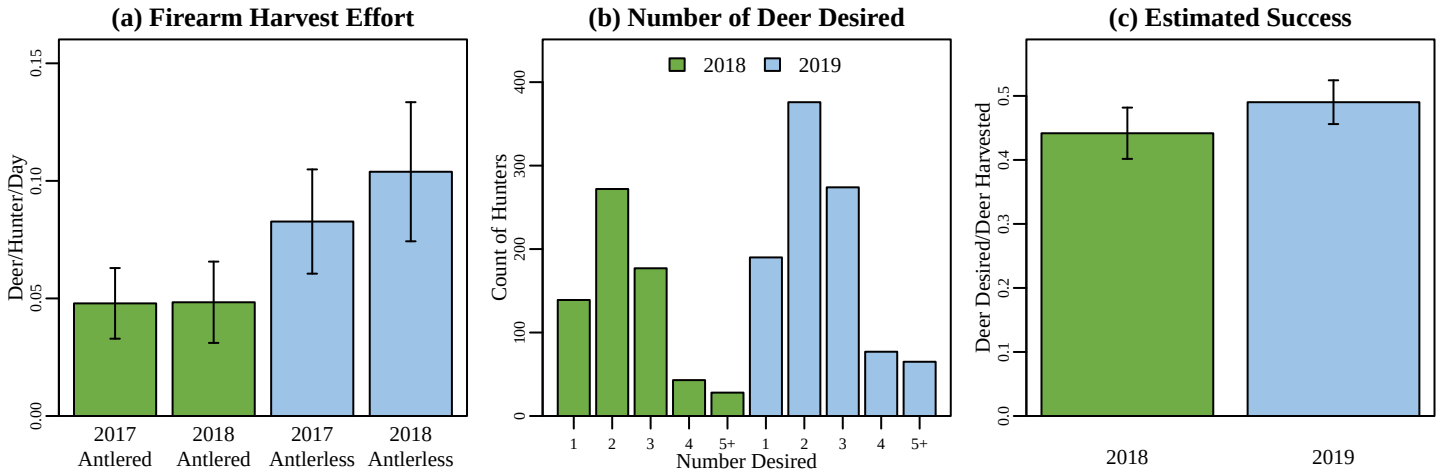


Figure 2. (a) Firearm harvest/effort is the number of deer killed by firearms per hunter divided by the mean number of days hunted per hunter during the firearm season based on data reported in the deer management survey. (b) The annual count of hunters wishing to harvest each number of deer reported in the deer management survey. (c) Success rate is estimated from the deer management survey as the Number of Harvested Deer/Number of Deer Desired (reported only; does not account for attempts that were not made).

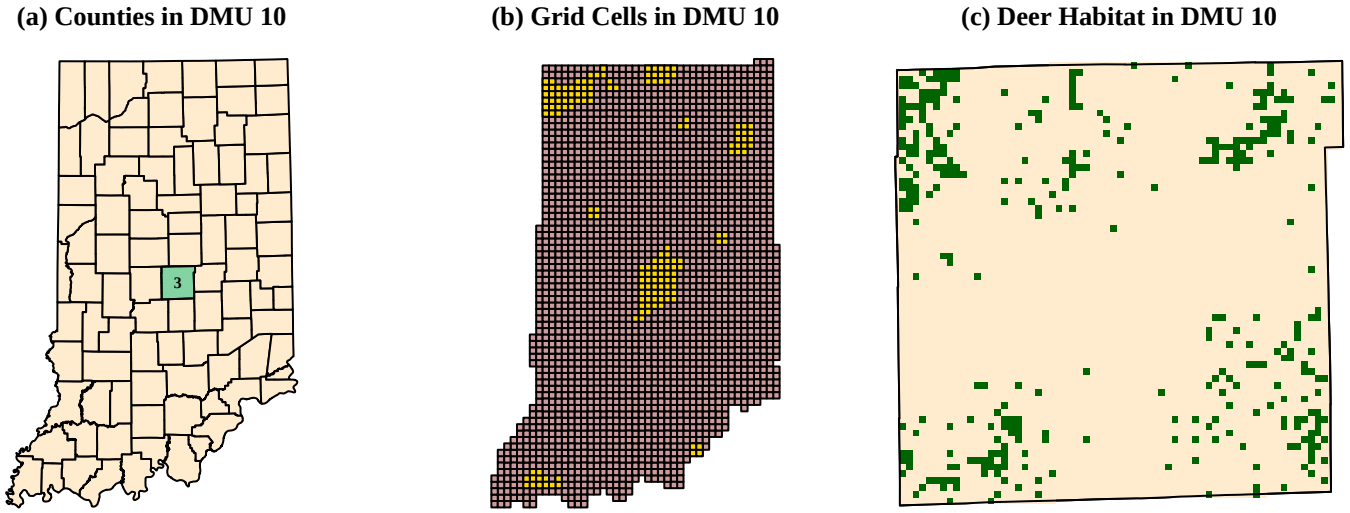
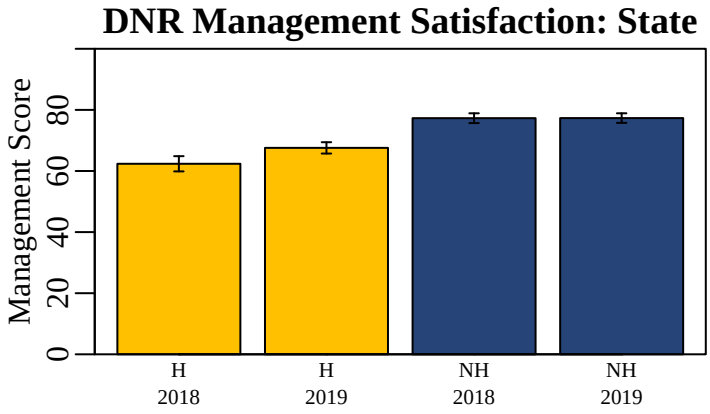


Figure 3. (a) Counties included in DMU 10 for summarizing harvest statistics. Labels are the 2018 county bonus anterless quotas. (b) 4 x 4 mile grid cells included in DMU 10 for summarizing annual deer management survey statistics. (c) Green represents the land use types classified as deer habitat in DMU 10.

DMU 10: Urban

6/26/2019

Deer Management Survey Results



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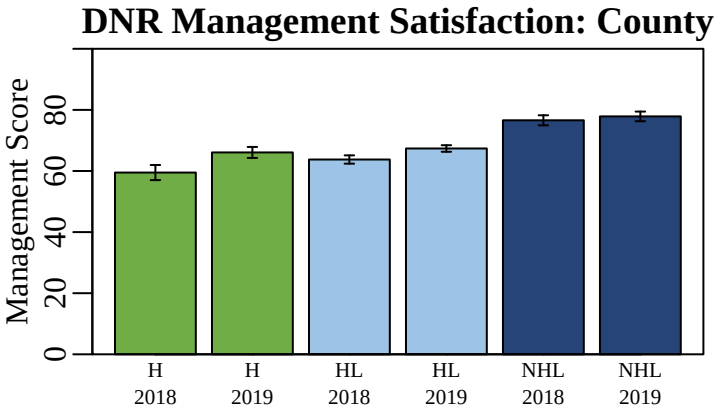

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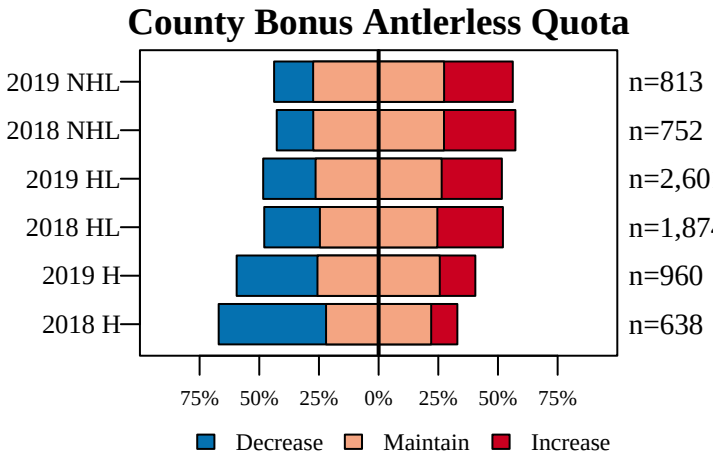

Figure 6. Opinion on how the County Bonus Antlerless Quota should change from nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

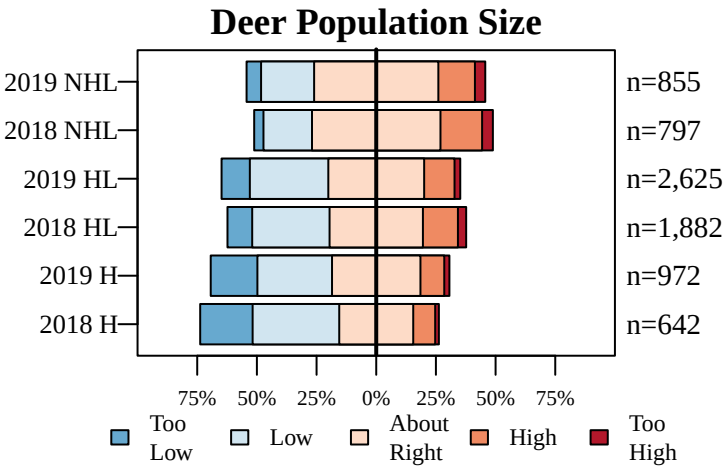

Figure 7. The current size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

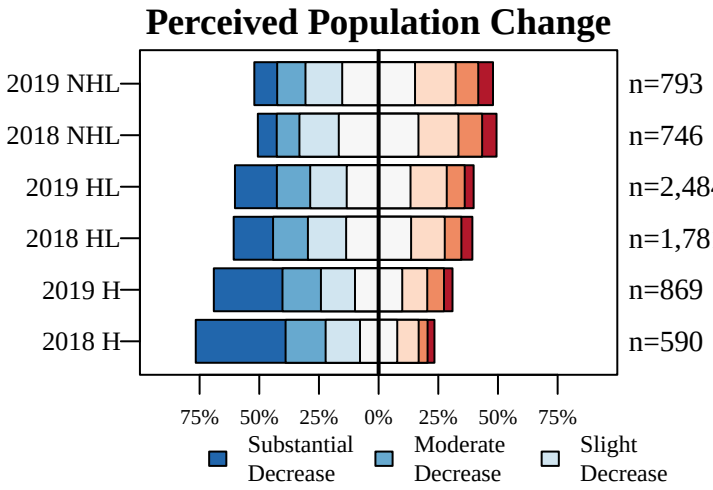

Figure 8. The number of deer seen compared to five years ago described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

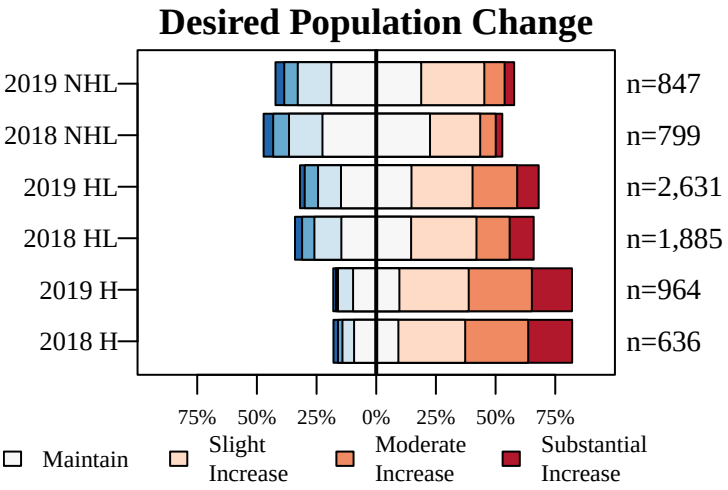

Figure 9. The desired change in the size of the deer population described by nonhunters (NHL) and hunters in the county where they live (HL) and hunters in county where they hunt (H).

DMU 10: Urban

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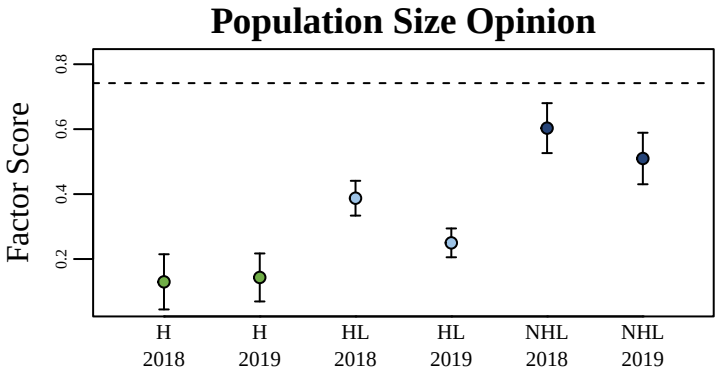

Figure 10. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on the deer population size. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

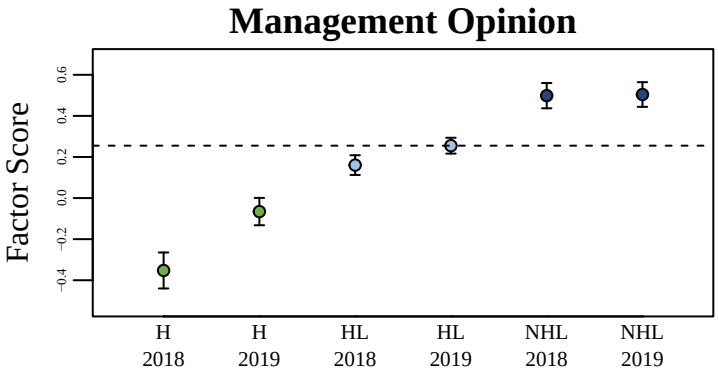

Figure 11. The opinion of nonhunters (NHL) and hunters in the county where they live (HL) and hunters in the county where they hunt (H) on deer management. The score was aggregated using factor analysis of questions asked to all participants. The dashed line represents the score if all questions were answered neutrally.

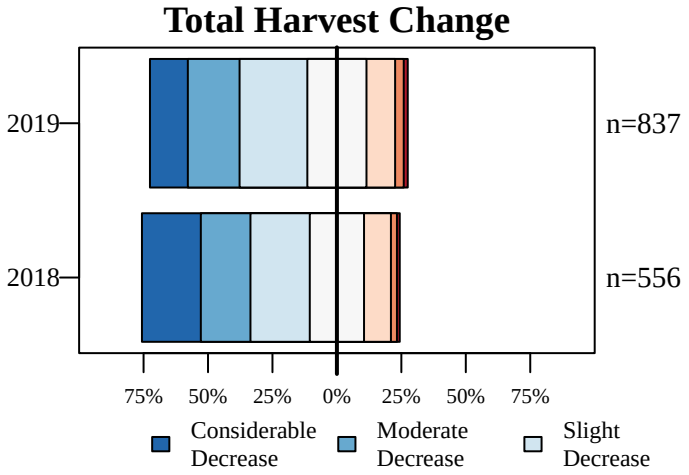

Figure 12. Opinion of hunters on how the total number of harvested deer has changed over the last five years.

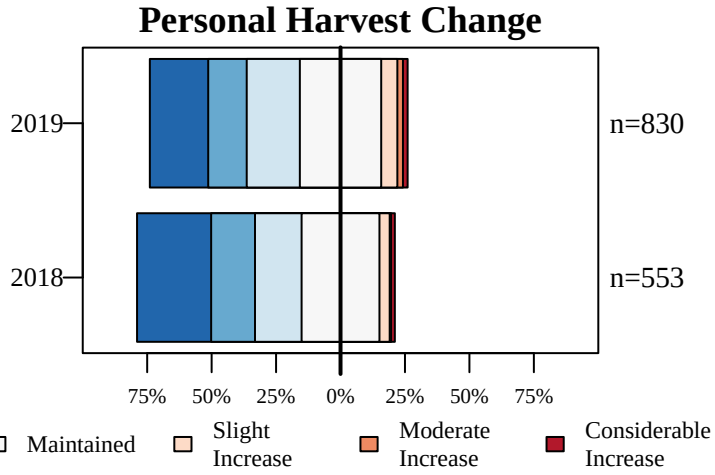

Figure 13. Opinion of hunters on how their personal number of harvested deer has changed over the last five years.

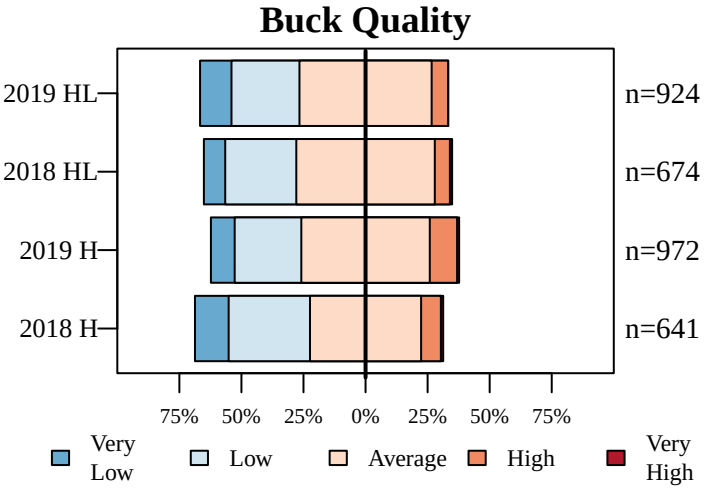

Figure 14. Hunters describe the quality of bucks where they live (HL) and where they hunt (H).

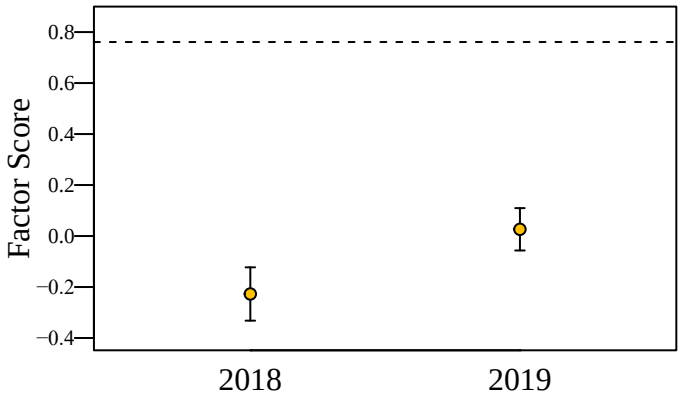

Figure 15. Hunter opinon score over two years of the deer management survey. The score was aggregated using factor analysis of questions asked only to hunters. The dashed line represents the score if all questions were answered neutrally.

APPENDIX C_COUNTY DEER DATA SHEETS 2018

PDFs of the County Deer Data Sheets can be found at www.IN.gov/dnr/fishwild/9812.htm