2020

INDIANA WHITE-TAILED DEER REPORT

DNR
Indiana Department
of Natural Resources

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.

Suggested Citation—Boggess, C.M., and O.D.L. Vaught, editors. 2021. 2020 Indiana White-tailed Deer Report. Indiana Department of Natural Resources, Bloomington, Indiana.

Cover Photo: Moriah Boggess

Table of Contents

“Harmony with land is like harmony with a friend; you cannot cherish his right hand and chop off his left. That is to say, you cannot love game and hate predators... The land is one organism.” — Aldo Leopold

DNR File Photo

CHAPTER 1. OVERVIEW

Welcome to the 2020 Indiana White-tailed Deer Report. Every year, Indiana DNR publishes 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. Historical reports are available at on.IN.gov/INdeerreport.

2020-2021 Deer Hunting Season

The 2020 deer hunting season was composed of four statewide seasons: Youth (Sept. 26 and 27), Archery (Oct. 1 to Jan. 3), Firearms (Nov. 14 to Nov. 29), and Muzzleloader (Dec. 5-20). In addition to the four statewide seasons, the Special Antlerless Firearms season was open from Dec. 26 to Jan. 3 in 90 counties, with additional date restrictions for counties with "A" designated quotas. Most resident deer licenses could be purchased for $24 and 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 Deer Reduction Zone season, allows hunters 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 may be either two antlerless and one antlered, or three antlerless deer. A hunter may take only one antlered deer during all statewide seasons combined (Archery, Firearms, Muzzleloader, and Youth seasons). Resident landowners and lessees who own and/or work Indiana farmland are 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 of their deer.

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. 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 before 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. Reserve draw locations change annually. In 2020, reserve draw locations included Muscatatuck National Wildlife Refuge, Big Oaks National Wildlife Refuge, and Camp Atterbury Joint Maneuver Training Center, among others. For a complete list of reserve draw deer hunts, please visit 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 (i.e., county, coordinates, intersection, etc.) and road type (i.e., 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

Indiana DNR monitors deer health for major outbreaks of diseases such as epizootic hemorrhagic disease (EHD), bovine tuberculosis (bTB), and chronic wasting disease (CWD). In 2020, Indiana experienced minimal EHD occurrences across the state. This was a change from the widespread 2019 EHD outbreak. Hunters and other residents reported 258 deer potentially infected with EHD. Indiana DNR confirmed EHD in five counties. Indiana DNR did not conduct bTB surveillance in Franklin County in 2020 because the level of bTB in the area was likely low to non-existent. A total of 855 hunter-harvested deer, 13 road-killed deer, and 15 targeted deer were tested for CWD statewide in 2020. Our ability to detect the disease in the targeted surveillance areas ranged from 1.27 to 9.30% in the northwest targeted area, and from 1.42 to 4.71% in the northeast targeted area (Table 6-2). To date, no wild deer from Indiana have tested positive for CWD.

Snapshot IN Photo

Surveys and Volunteer Monitoring

Surveys of hunters, landowners, and other people are tools Indiana DNR uses to manage the state's deer herd. Before 2017, paper surveys were mailed to a subset of Indiana hunters and landowners every three or four years to ask questions about harvest, deer damage, and opinions on the size and management of deer in Indiana. In 2020, 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 (e.g., sex, age, approximate size, etc.), the hunting experience associated with those deer (e.g., 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 solicits hunter and public participation in volunteer monitoring 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. IMPROVEMENTS IN DEER MANAGEMENT

Moriah Boggess and Olivia Vaught, *Indiana Department of Natural Resources*

State Deer Biologist

In October 2020, Indiana DNR welcomed Moriah Boggess as the state's new deer biologist. Moriah grew up in Elkin, North Carolina, a small town in the foothills of the Appalachian Mountains. There, he developed a love for the outdoors, deer hunting, and wildlife management. Through high school and college, Moriah spent his spare time making deer habitat improvements on his family's property using prescribed fire and forest stand improvement. He attended North Carolina State University, where he studied Fisheries, Wildlife, and Conservation Biology and later earned his master's degree in the Deer Ecology and Management Lab at Mississippi State University. Moriah's master's thesis examined the effects of prescribed fire and deer browsing on oak reproduction and plant communities. As a master's student, Moriah also managed social media channels for the MSU Deer Lab and conducted additional research on prescribed fire effects on tick numbers.

Moriah's professional work experience was diverse and included research and extension positions on warm-season grass management, waterfowl banding, Bachman's sparrow habitat use, impacts of trail construction on wildlife, and various aspects of deer ecology. During the 2020 summer he also worked as a habitat technician for Purdue University's Integrated Deer Management project.

Moriah brought with him a passion for the inter-relationships of habitat management, plant communities, and wildlife populations. In September 2021, Moriah left Indiana DNR in pursuit of opportunities in his home state. Joe Caudell has since resumed the position of State Deer Biologist.

State Deer Biologist, Moriah Boggess.

Modifications to the Special Antlerless Firearms Season

In 2020, Indiana DNR made temporary changes to the Special Antlerless Firearms season regulations to open the season in most counties during the 2020-2021 hunting season. Indiana Administrative Code (312 IAC 9-3-4) dictates the Special Antlerless Firearms season is only available in counties with a county bonus antlerless quota (CBAQ) of four or more; however, after the major epizootic hemorrhagic disease (EHD) outbreak in 2019, the 2020 CBAQs were reduced to three or fewer in all counties, which unqualified all counties for the season. Faced with this issue, Indiana DNR signed a temporary regulation change to open the Special Antlerless Firearms season in all counties, except those with a CBAQ designation of "A", to provide hunters with additional opportunities to harvest deer. The CBAQs still applied in each participating county regardless of the additional Special Antlerless Firearms season.

Before making this temporary change, Indiana DNR evaluated the impact the Special Antlerless Firearms season has had on overall deer harvest since its creation and determined the season's

contribution to the total harvest was minimal (Caudell and Vaught 2020). During the 2020-2021 hunting season, Indiana DNR collected public opinion data on the changes to the Special Antlerless Firearms season through an online survey and assessed its effect on statewide harvest. An in-depth analysis of these results is reported in Chapter 9 of this report.

New Look to Sick or Dead Wildlife Report

Indiana DNR updated the Sick or Dead Wildlife Reporting System in 2020 to streamline service and location data associated with these reports. The report now operates through Survey123 for ArcGIS, which allows biologists to review reports and their spatial distribution across the state in real time. Survey participants receive an automated email notification that the report was received and that a biologist will contact them if more information is needed.

Indiana DNR encourages people to submit reports of incidents involving the death of five or more animals, recurring deaths of animals over time in the same locations, deer with signs of chronic wasting disease (CWD) or EHD (see Chapter 6), and incidents involving threatened or endangered species. Reports of road killed animals, requests for removal services, and reports of orphaned and injured animals are discouraged. For information on reporting these incidents, visit on.IN.gov/sickwildlife.

Literature Cited

Caudell, J. N., and O. D. L. Vaught. 2020. 2019 Indiana White-tailed Deer Report. Indiana Department of Natural Resources, Bloomington, USA.

Advancements in Data Sharing

County and Deer Management Unit (DMU) data are now shared through interactive online dashboards to make deer information more transparent and accessible to everyone. These dashboards provide access to data, allow data filtering, and meet 508 Accessibility standards for people with visual impairments. The interactive dashboards replace the PDF county and DMU datasheets once published by DNR and serve as supplements to the 2020 Indiana White-tailed Deer Report and future reports.

- Data from the Deer Management Survey are now available in a new interactive dashboard available at wildlife.in.gov/wildlife-resources/animals/white-tailed-deer/deer-management-survey-results/
- Realtime and historical county and statewide harvest data are available at wildlife.in.gov/wildlife-resources/animals/white-tailed-deer/deer-harvest-data/.
- DNR is working on a third dashboard that will share historical data on harvest, deer-vehicle collisions, hunter success, and the Archer's Index for all counties and DMUs. This dashboard will be published in 2022.

If you would like a PDF copy of the 2020 county or DMU datasheets traditionally produced by Indiana DNR, please send a request to INDeerHotline@dnr.IN.gov.

CHAPTER 3. 2020-2021 DEER HUNTING SEASON

Moriah Boggess, Olivia Vaught, Emily McCallen, and Patrick Mayer, *Indiana Department of Natural Resources*

Errors in Reporting

Since 2015, Indiana hunters have reported their deer harvests electronically through CheckIN Game. The electronic system provides real-time harvest information that is published daily (wildlife.IN.gov/wildlife-resources/animals/white-tailed-deer/deer-harvest-data/). Hunters occasionally make errors in reporting their harvest, such as reporting the incorrect sex or license under a harvest or checking in the same deer multiple times. Indiana DNR works throughout deer season to correct errors to optimize the accuracy of harvest numbers. For this reason, data in the 2020 Indiana White-tailed Deer Report contains an amount of reporting error, and the numbers reported in future Indiana White-tailed Deer Reports may change slightly when errors are corrected. These expectations also apply to harvest data available online.

Two error rates were calculated for harvest data in this report: 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 the Indiana White-tailed Deer Report fluctuate only by the unreconciled error rate because the reconciled errors have already been removed from the dataset. Because error rates are relatively low, they do not affect management decisions.

Harvest totals for the 2020 deer hunting season are current as of March 5, 2021. Additionally, harvest totals for the 2016, 2017, 2018, and 2019 seasons have been updated since previous reports. In this report, the updated totals are used in analyses and comparisons between years.

Table 3-1. Error rates of hunter-reported deer harvests, 2016-2021. Total error includes reconciled and unreconciled errors. Reconciled errors have already been removed from the dataset.

	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
% total error	0.67%	1.3%	0.57%	0.23%	0.26%
% unreconciled error	0.2%	0.17%	0.13%	0.13%	0.16%

Harvest by Season

A note about data analyses. For harvest data analyses, antlered and shed bucks are grouped as antlered deer, while does and button bucks are grouped as antlerless deer, unless otherwise specified. Deer harvested with archery equipment during the Deer Reduction Zone season were incorporated into the Archery season totals, while deer harvested with firearm equipment during the Deer Reduction Zone season were incorporated into the Firearms season totals.

In Indiana, approximately 4 million deer have been harvested and reported during the past 68 deer hunting seasons. In 2020, hunters reported 124,180 harvested deer (Figure 3-1). The total harvest was 8.1% greater than in the 2019 season, making it the 13th highest all-time harvest since 1951.

The 2020 antlered deer harvest increased by 7.4% from the 2019 harvest to 55,446 deer (Figure 3-2). This was the highest recorded antlered deer harvest in Indiana history. Hunters harvested 1.5 antlered deer per square mile of land in Indiana. This was comparable to the harvest in surrounding Midwest states, including Kentucky (1.9 antlered/sq.mi.; Kentucky 2021), Ohio (1.8 antlered/sq.mi.; Ohio 2021), and Illinois (1.4 antlered/sq.mi.; Schlichting 2020), but much less than Michigan (2.2 antlered/sq.mi.; Frawley 2020).

A total of 68,734 antlerless deer were harvested in 2020, which was 8.7% greater than the 2019 total (Figure 3-2). The antlerless harvest ranked the 14th highest on record. The antlerless harvest per square mile of land in Indiana was 1.9 in 2020, compared to 1.6 in Kentucky (Kentucky 2021), 2.6 in Ohio (Ohio 2021), 1.7 in Michigan (Frawley 2020), and 1.2 in Illinois (Schlichting 2020).

The 2020-2021 harvest per day peaked on opening day of Firearms season with smaller peaks associated with other season-opening days and weekends (Figure 3-3). Harvest increased in all seasons except Muzzleloader, as compared to 2019. Youth season experienced a large increase of 44.4%, accounting for 2,256 deer (Figure 3-4). Archery season harvest increased by 5.1% to 34,581 deer and accounted for

Snapshot IN Photo

27.8% of the total 2020 harvest (Figure 3-4). Over half of the deer harvested with archery equipment were antlerless (Figure 3-5). The 2020 Firearms season harvest accounted for 72,998 deer, which was 58.8% of the total harvest (Figure 3-4). Firearms season was the only season in which bucks accounted for more than 50% of the harvest (Figure 3-5). Muzzleloader season harvest was 8.9% lower than in 2019, the only season to experience a decrease in harvest in 2020. Antlerless deer accounted for over 70% of the Muzzleloader harvest (Figure 3-5). The 2020 Special Antlerless Firearms season was first to be available in all counties except those with a county bonus antlerless designation of “A”. There were 5,065 deer harvested in 90 participating counties, resulting in a 162% increase in the number of deer harvested during this season compared to 2019. Over 99% of harvested deer were antlerless (Figures 3-4 and 3-5).

Opening weekend of Firearms season contributed 22.7% of the statewide total harvest for 2020. More antlered deer than antlerless deer were harvested during the seven days leading up to Firearms season and the first seven days of Firearms season. Then antlerless harvest exceeded the antlered harvest through the remaining days of the 2020 season (Figure 3-6).

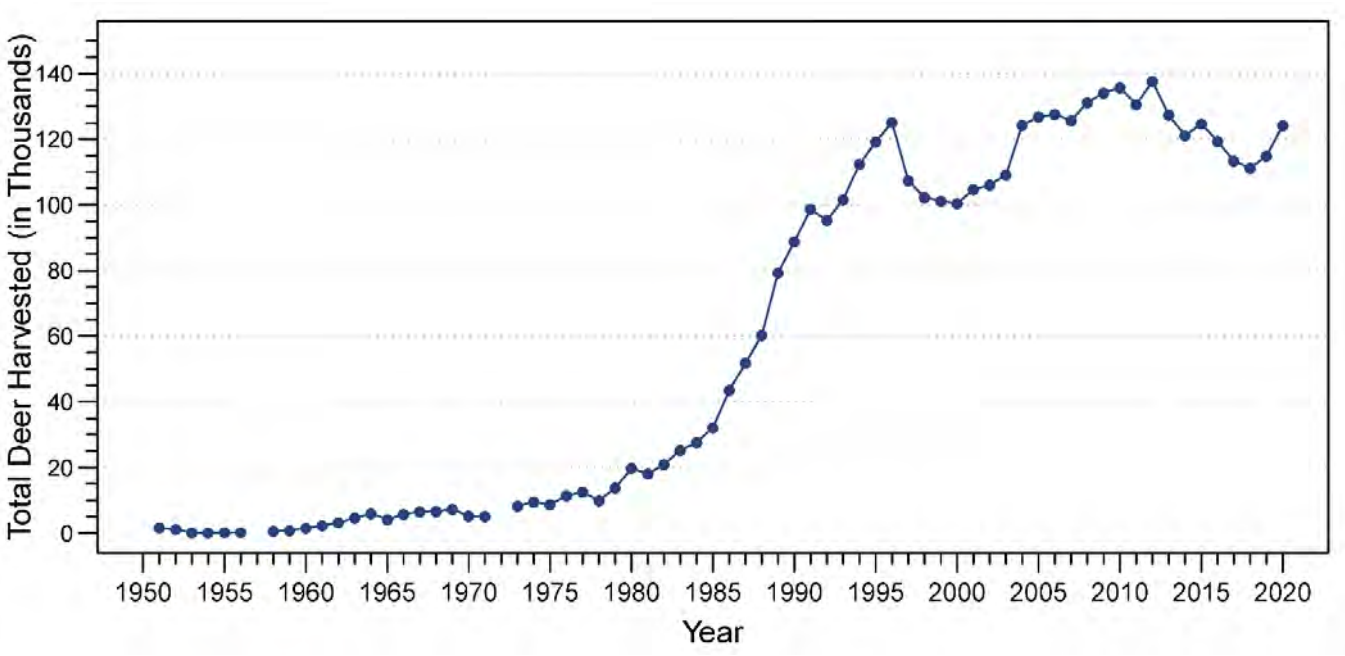

Figure 3-1. The total number of deer harvested in each Indiana deer season, 1951-2020. Totals include deer harvested in State Park Reduction Hunts, 1993-2020. Reporting error rates: ±0.26% (2020), ±0.23% (2019), ±0.57% (2018), ±1.30% (2017), and ±0.67% (2016).

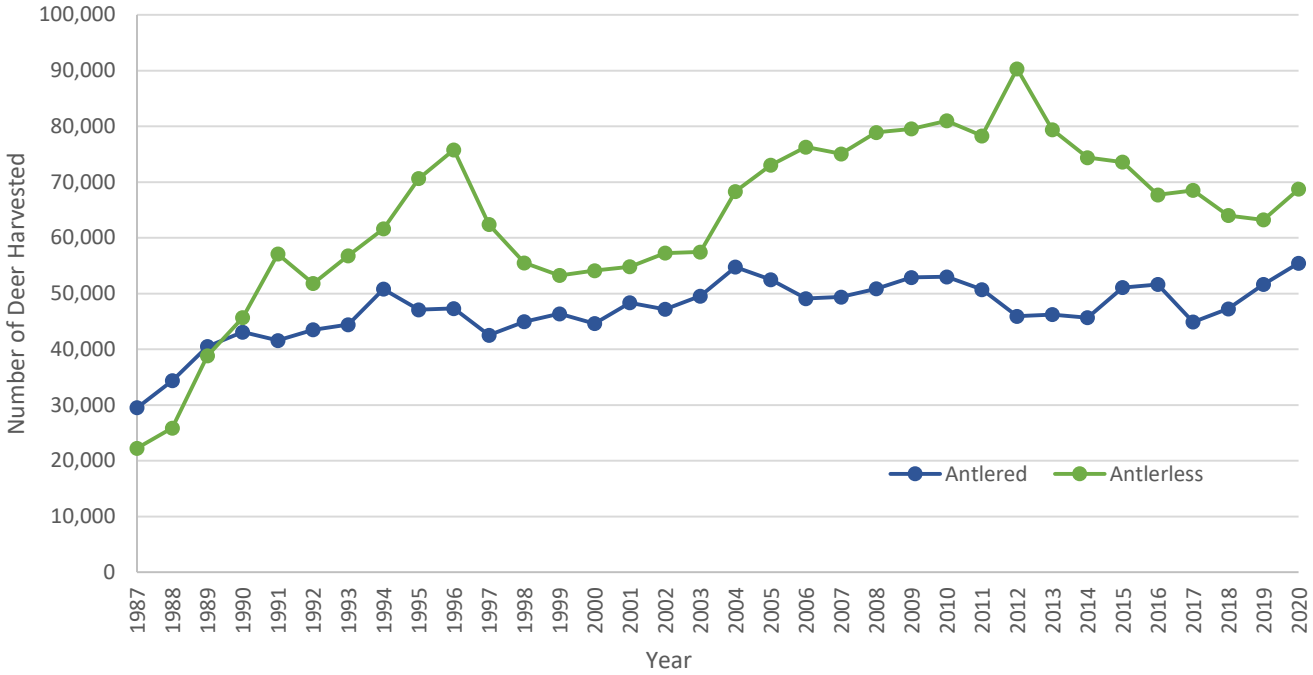

Figure 3-2. The number of antlered and antlerless deer harvested across all Indiana deer hunting seasons, 1987-2020.

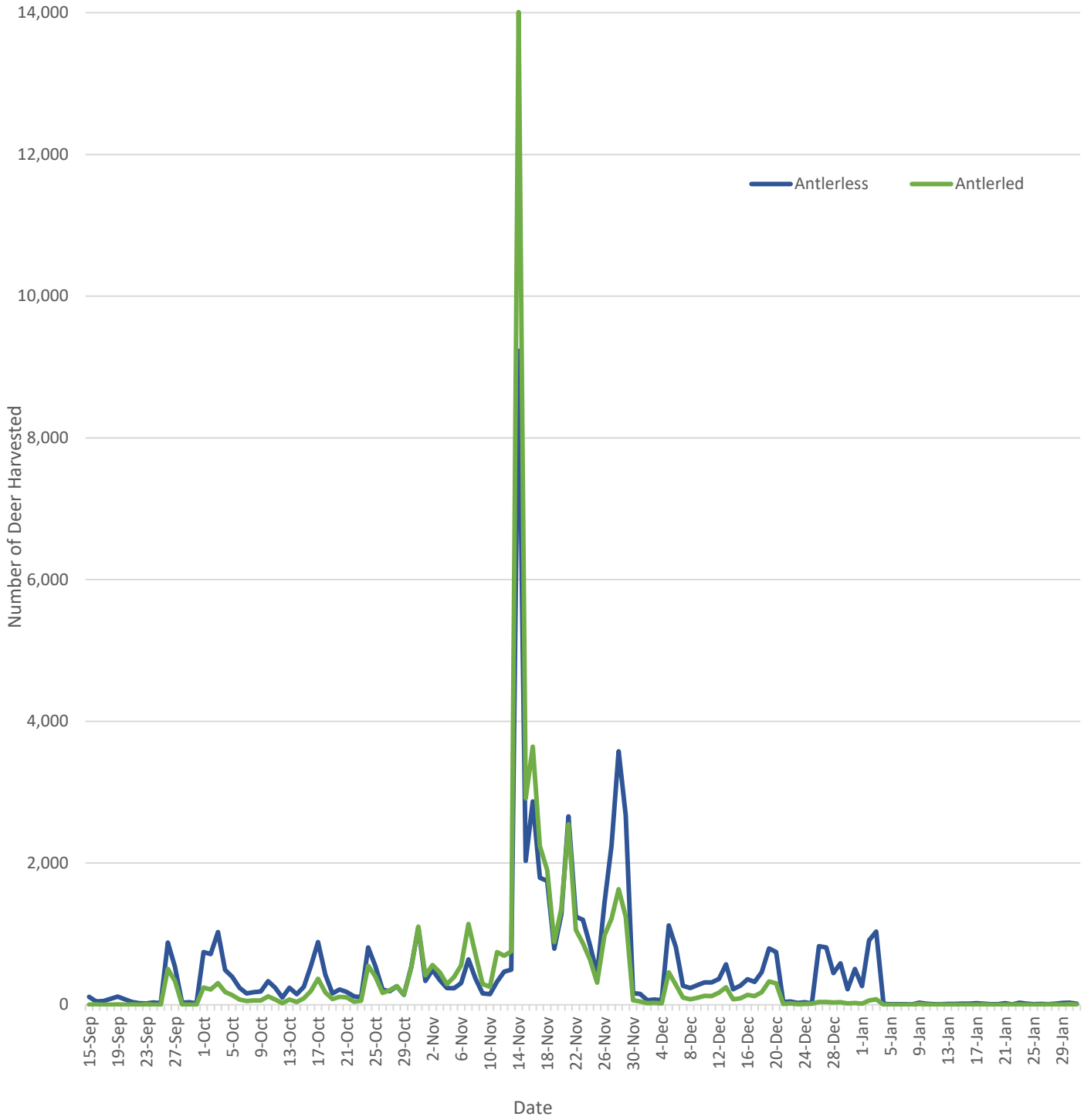

Figure 3-3. The number of antlered and antlerless deer harvested each day of the 2020-2021 Indiana deer hunting season. Reporting error rates: ±0.26% (2020).

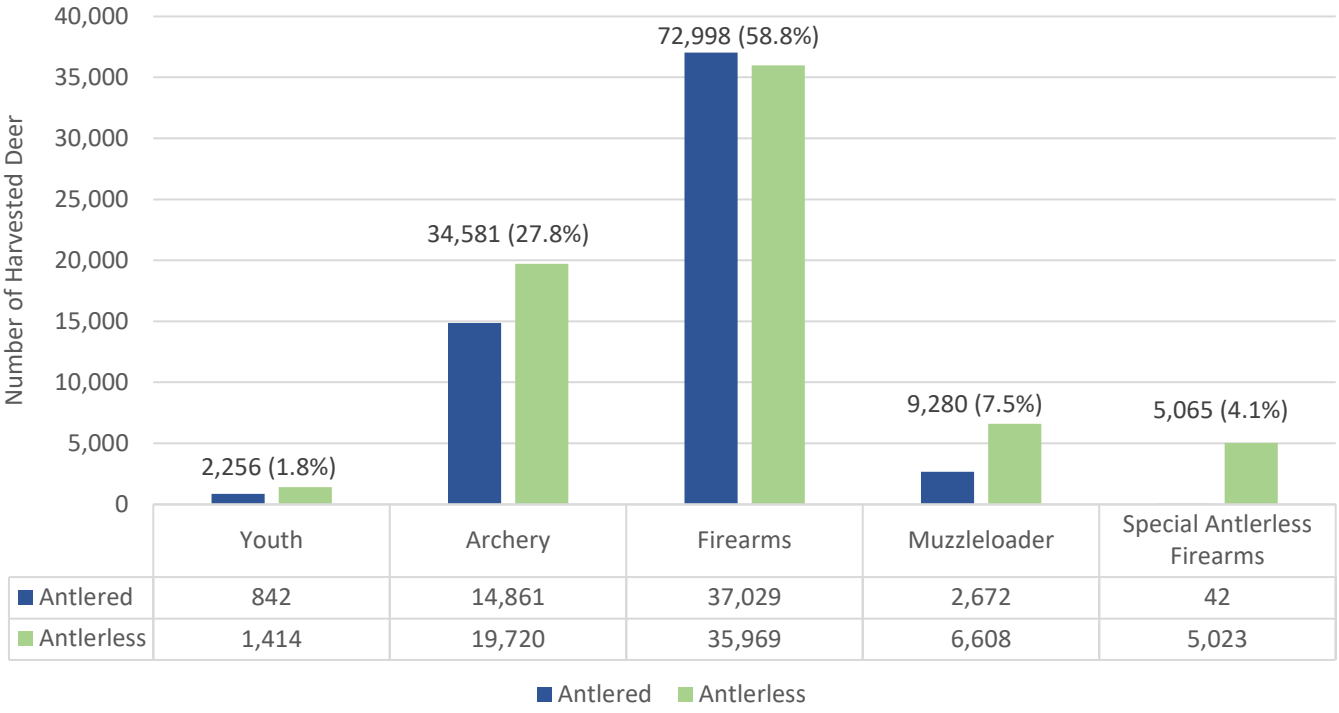

Figure 3-4. Number of deer harvested by season during the 2020 Indiana deer hunting season. Total harvest and percent of total harvest are labeled above each season. Values may not total 100 due to rounding. Reporting error rate: ±0.26% (2020).

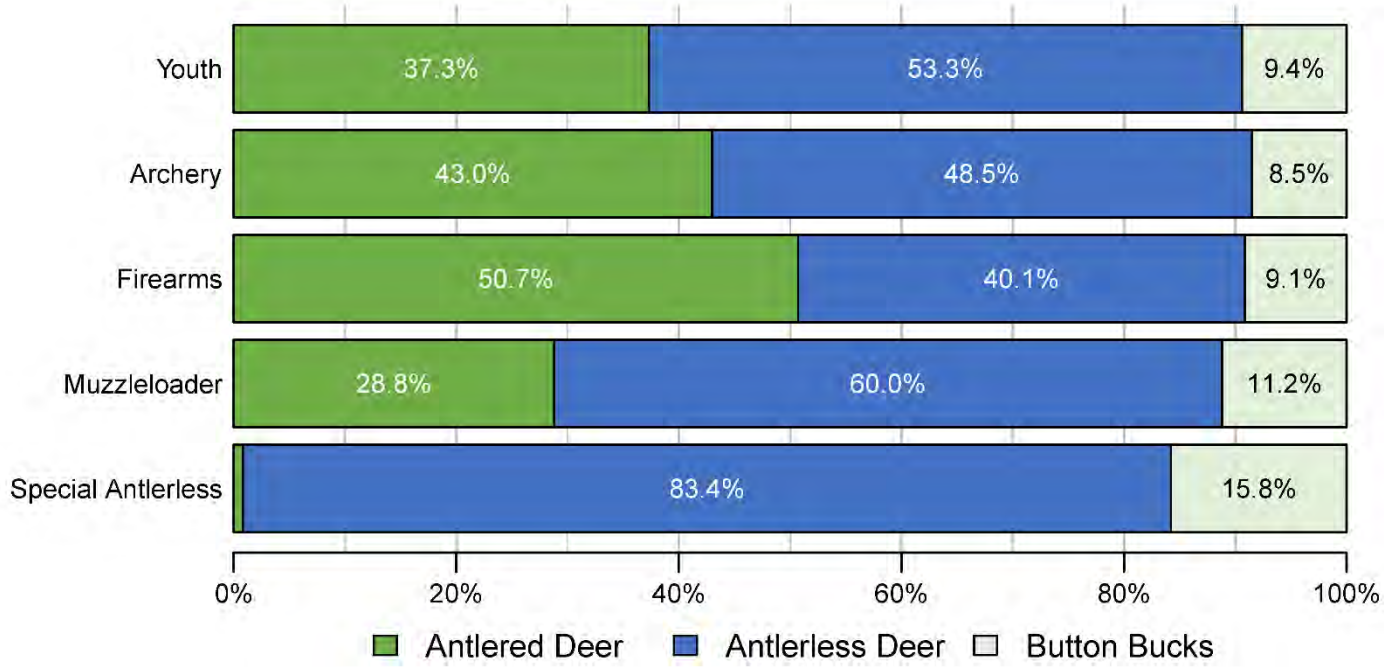

Figure 3-5. Composition of individual season harvests during the 2020 Indiana deer season. Reporting error rate: ±0.26% (2020).

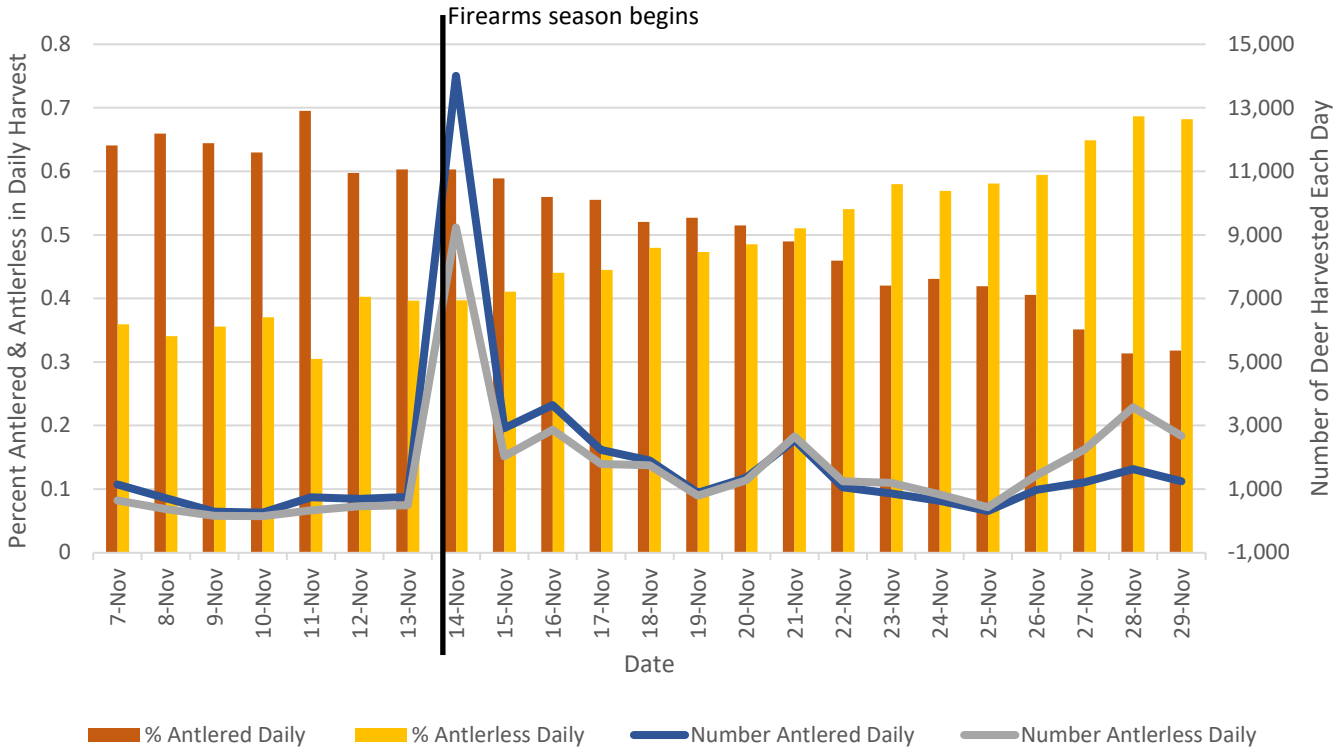

Figure 3-6. Antlered and antlerless daily harvest the week leading up to Firearms season through the end of Firearms season, Nov. 7-29. Bars represent the proportion of antlered and antlerless deer harvested each day (includes deer taken by bow and arrow, crossbow, shotgun, handgun, rifle, and muzzleloader). Line values represent the number of antlered and antlerless deer harvested each day. Reporting error rate: ±0.26% (2020).

Harvest by County

In 2020, the number of deer harvested in individual counties ranged from 128 in Benton County to 3,116 in Noble County (Table 3-2). Total harvest exceeded 1,000 deer in 60 counties and 2,000 deer in 14 counties. Comparatively, antlered buck harvest exceeded 1,000 in 10 counties while the antlerless harvest exceeded 1,000 in 23 counties. Antlerless deer accounted for at least 50% of the total harvest in 84 of the state's 92 counties in 2020. The five counties with the highest antlerless harvests were, in descending order: Noble, Steuben, Kosciusko, Dearborn, and Franklin. The five counties with the lowest harvests were, beginning with the lowest: Benton, Tipton, Hancock, Rush, Shelby.

Counties with the highest number of deer harvested per square mile were clustered in the northeast and southeast corners of the state (Figure 3-7). Central counties had the lowest number of deer harvested per square mile. County doe-to-buck harvest ratios varied across the state. Marion County had the highest doe-to-buck harvest ratio of 2.18, followed by Vanderburgh, Porter, and Saint Joseph counties (Figure 3-8). These four counties contain Deer Reduction Zones, which promote higher antlerless deer harvest to address concerns of elevated deer populations in localized areas.

Snapshot IN Photo

Table 3-2. Deer harvest by county during the 2020 Indiana deer hunting season. Reporting error rate: ±0.26% (2020).

County	Antlered	Antlerless	Total	County	Antlered	Antlerless	Total
Adams	336	424	760	Lawrence	1,021	1,294	2,315
Allen	798	1,205	2,003	Madison	272	332	604
Bartholomew	438	551	989	Marion	155	338	493
Benton	87	41	128	Marshall	920	1,243	2,163
Blackford	205	283	488	Martin	677	849	1,526
Boone	248	218	466	Miami	628	778	1,406
Brown	656	956	1,612	Monroe	685	837	1,522
Carroll	413	579	992	Montgomery	500	560	1,060
Cass	641	685	1,326	Morgan	628	748	1,376
Clark	660	655	1,315	Newton	459	475	934
Clay	556	613	1,169	Noble	1,262	1,854	3,116
Clinton	237	257	494	Ohio	319	321	640
Crawford	814	864	1,678	Orange	873	1,014	1,887
Daviess	518	707	1,225	Owen	811	813	1,624
Dearborn	1,040	1,447	2,487	Parke	1,056	1,150	2,206
Decatur	357	504	861	Perry	774	808	1,582
Dekalb	1,019	1,374	2,393	Pike	759	1,013	1,772
Delaware	378	464	842	Porter	609	1,017	1,626
Dubois	838	1,143	1,981	Posey	612	676	1,288
Elkhart	737	1,061	1,798	Pulaski	855	1,106	1,961
Fayette	407	549	956	Putnam	1,008	991	1,999
Floyd	315	346	661	Randolph	317	362	679
Fountain	637	724	1,361	Ripley	676	1,024	1,700
Franklin	953	1,527	2,480	Rush	177	222	399
Fulton	666	854	1,520	Saint Joseph	551	900	1,451
Gibson	598	646	1,244	Scott	325	413	738
Grant	459	508	967	Shelby	232	232	464
Greene	953	1,024	1,977	Spencer	602	686	1,288
Hamilton	207	280	487	Starke	723	946	1,669
Hancock	167	137	304	Steuben	1,380	1,696	3,076
Harrison	1,128	1,262	2,390	Sullivan	980	987	1,967
Hendricks	345	362	707	Switzerland	777	1,017	1,794
Henry	301	371	672	Tippecanoe	526	621	1,147
Howard	220	272	492	Tipton	103	42	145
Huntington	501	540	1,041	Union	257	416	673
Jackson	705	850	1,555	Vanderburgh	287	491	778
Jasper	713	789	1,502	Vermillion	568	617	1,185
Jay	479	679	1,158	Vigo	814	763	1,577
Jefferson	741	831	1,572	Wabash	729	837	1,566
Jennings	703	889	1,592	Warren	551	721	1,272
Johnson	268	360	628	Warrick	640	740	1,380
Knox	469	502	971	Washington	951	1,096	2,047
Kosciusko	1,128	1,500	2,628	Wayne	535	725	1,260
Lagrange	1,001	1,472	2,473	Wells	369	429	798
Lake	599	969	1,568	White	446	516	962
LaPorte	837	1,211	2,048	Whitley	571	533	1,104

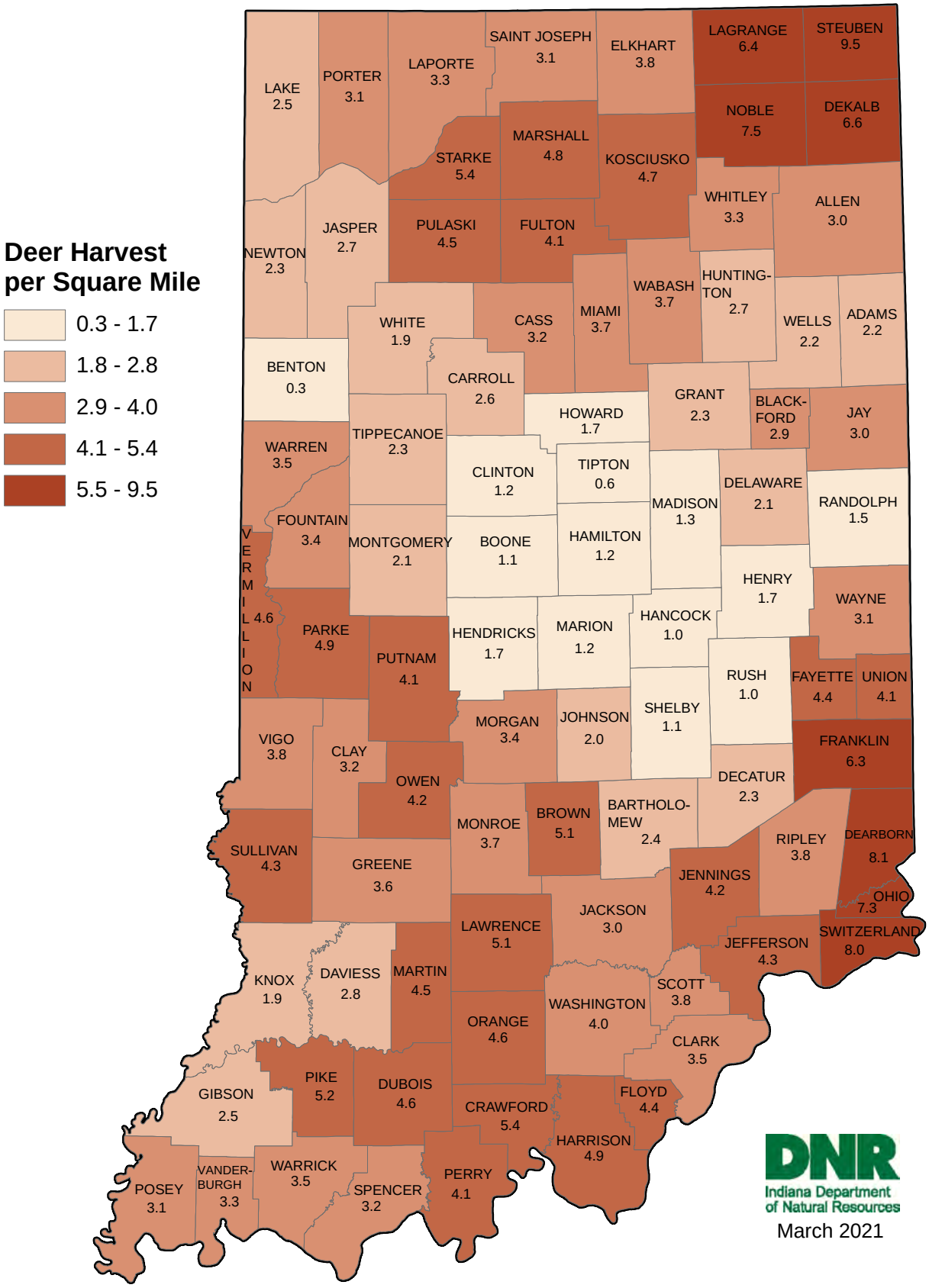

Figure 3-7. Deer harvest per square mile of total county area in Indiana during the 2020 deer hunting season. Reporting error rate: ±0.26% (2020).

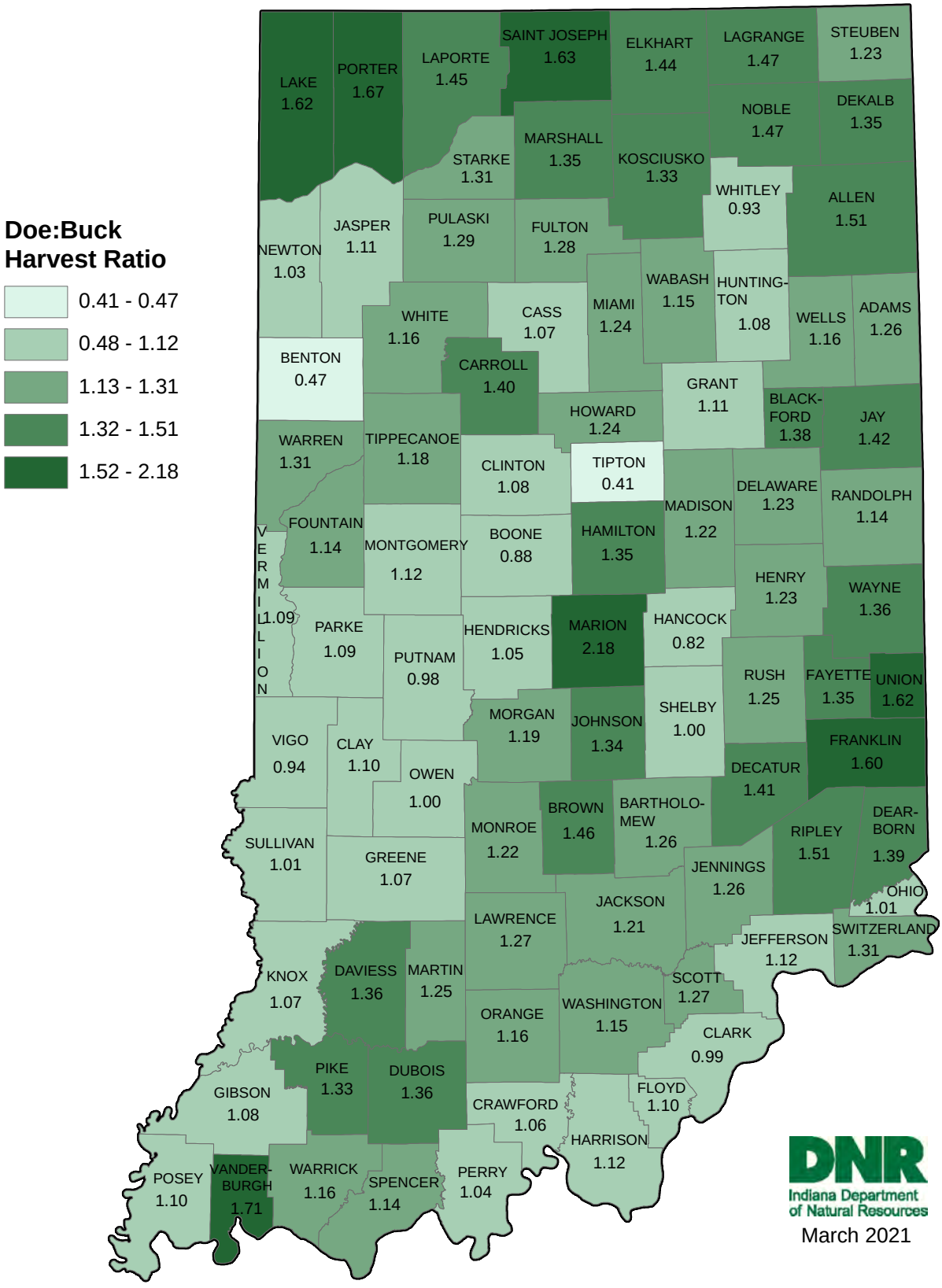

Figure 3-8. Doe:buck harvest ratios in Indiana counties during the 2020 deer hunting season. Reporting error rate: ±0.26% (2020).

Harvest per Hunter

Most successful hunters (70.0%, n=61,439) in Indiana harvested one deer during the 2020 deer season (Table 3-3). Only 0.7% (n=620) of hunters statewide harvested more than four deer in 2020 compared to 0.62% (n=522) in 2019.

Table 3-3. Number of deer harvested by individual successful hunters during the 2019 and 2020 Indiana deer seasons. Reporting error rates: ±0.26% (2020) and ±0.23% (2019).

	2019		2020	
Number of Deer	Hunters	% of Total	Hunters	% of Total
1	58,175	70.8	61,439	70.0
2	17,604	21.4	18,919	21.6
3	4,779	5.8	5,536	6.3
4	1,056	1.3	1,198	1.4
5	339	0.4	388	0.4
6	109	0.1	136	0.2
7	39	0.1	59	0.1
8	22	0.0	21	0.0
9	5	0.0	8	0.0
10	3	0.0	5	0.0
11	2	0.0	1	0.0
12	1	0.0	0	0.0
13	0	0.0	0	0.0
14	1	0.0	0	0.0
15	0	0.0	1	0.0
16	0	0.0	0	0.0
17	1	0.0	0	0.0
18	0	0.0	1	0.0

Harvest by Equipment Type

Six types of equipment were legal for hunting deer during 2020 (Figure 3-9): archery (traditional and compound bows), crossbows, handguns, muzzleloaders, rifles, and shotguns. Harvest decreased from 2019 for muzzleloader (-5.4%) and shotgun (-5.1%), which have both been trending downward over recent years (Table 3-4). Harvest increased for crossbow (10.6%) and rifle (18.2%), both of which have been trending upward over recent years. Harvests with bow and arrow and handgun were mostly unchanged from 2019. Similar to other Midwestern states, more than half of the total deer harvest was taken using a rifle or shotgun (QDMA 2020).

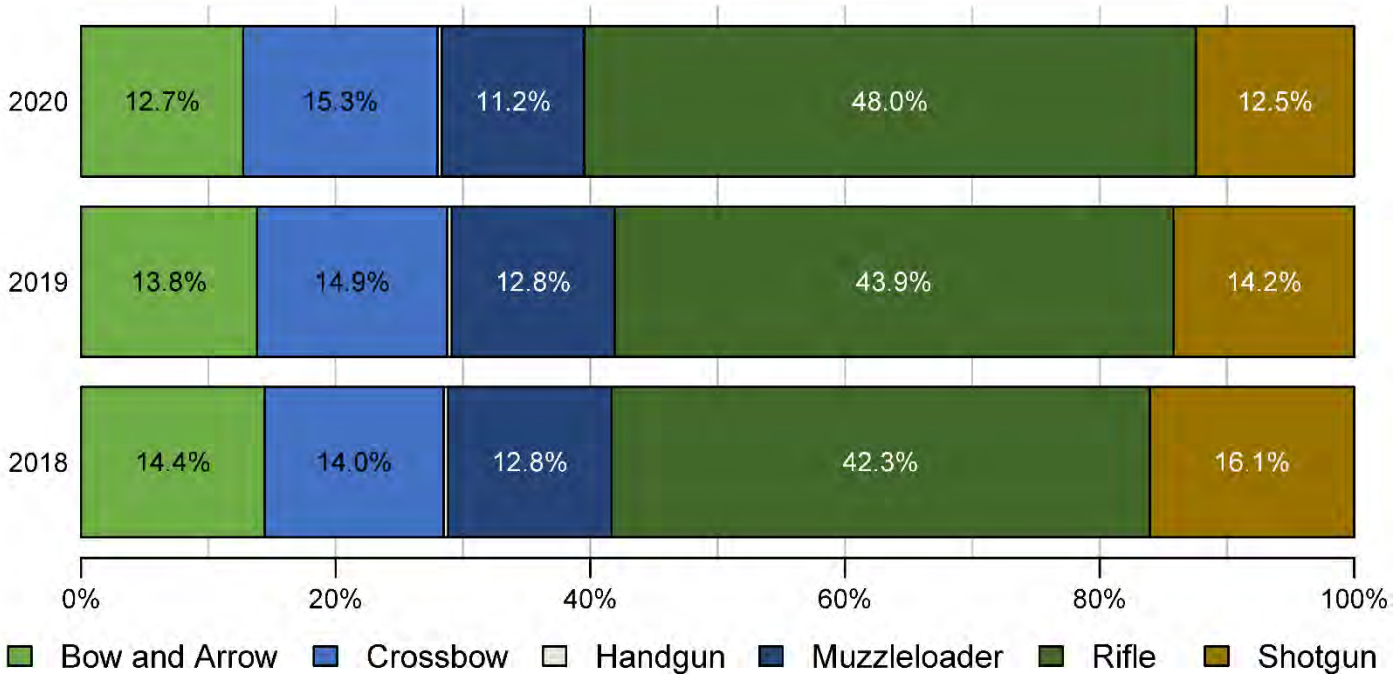

Figure 3-9. Percent harvest by equipment type, 2018-2020. Reporting error rates: ±0.26% (2020), ±0.23% (2019), and ±0.57% (2018).

Table 3-4. Number of deer harvested by type of legal hunting equipment across seasons, 2016-2020. Values within this table do not exactly equal those tallied by season (Figure 3-4) because multiple equipment types can be used during the Firearms season. Reporting error rates: ±0.26% (2020), ±0.23% (2019), ±0.57% (2018), ±1.30% (2017), and ±0.67% (2016).

	Number of deer harvested (% of total harvest)				
Equipment	2016	2017	2018	2019	2020
Bow and Arrow	16,996	17,034	16,069	15,884	15,819
Crossbow	11,260	14,747	15,623	17,136	18,950
Handgun	604	392	388	415	412
Muzzleloader	16,676	15,304	14,279	14,706	13,906
Rifle	44,628	45,653	47,015	50,449	59,630
Shotgun	29,178	20,256	17,878	16,292	15,463
Total	119,342	113,386	111,252	114,882	124,180

DNR file photo

Public Lands Harvest

A total of 7,214 deer were harvested on 130 public lands in Indiana during the 2020-2021 season, which accounted for 5.8% of the total deer harvest. This was a 9.3% increase in harvest on public lands from 2019. Public lands included state Fish & Wildlife areas (FWAs), state nature preserves, state parks, state forests, national wildlife refuges, national forests, conservation areas, and military lands (Tables 3-5, 3-6, 3-7, and 3-8). About 23% of the deer harvested on public lands were taken from across 25 FWAs, of which Pigeon River FWA had the highest harvest with 313 deer. Hoosier National Forest accounted for 15.5% of the total public lands harvest. Together, state park (16.5%) and state forest (17.1%) lands contributed 33.6% to public lands harvest.

Harvest per square mile was calculated across all public hunting properties by dividing area harvest by the total area of the property boundaries (including water and developed areas). Often these harvest rates appear inflated in comparison to county harvest rates; however, most public hunting lands have a high percentage of deer habitat in comparison with the landscape surrounding them, making their harvest per square mile exceptionally high. Care should also be taken when comparing harvest per square mile of small public properties (<100 acres) as these calculations are inflated due to small acreages.

The percentage of antlered (45.1%) and antlerless (54.9 %) deer harvested on public lands was similar to the composition of the total harvest (44.6% antlered, 55.4% antlerless). The rate of deer harvested per square mile varied across properties. Together, the state park properties had the highest rate of deer harvest per square mile at 13.8 deer. Most properties can be found on the Where to Hunt map available at on.IN.gov/where2hunt.

Table 3-5. Deer harvested during the 2020-2021 deer hunting season on public lands managed by Indiana DNR Division of Fish & Wildlife, including the number of antlered and antlerless deer and the number of deer harvested per square mile of property. Reporting error rate: ±0.26% (2020).

Property	Antlered	Antlerless	Total	Deer Harvested/ Sq. Mi.	Property	Antlered	Antlerless	Total	Deer Harvested/Sq. Mi.
FISH &WILDLIFE AREA	**824**	**837**	**1,661**	**8.4**	**WILDLIFE CONSERVATION AREA**	**60**	**62**	**122**	**11.3**
Atterbury	24	31	55	7.9	Aukiki	1	4	5	7.1
Blue Grass	8	6	14	3.5	Badal*	1	1	2	42.7
Chinook	10	6	16	4.8	Bittern Bog*	1	1	2	17.8
Crosley	24	15	39	5.9	Cedar Swamp	16	9	25	41.9
Deer Creek	15	11	26	7.7	Dick Blythe	3	0	3	9.9
Fairbanks Landing	50	33	83	7.4	Durham Lake	7	5	12	56.5
Glendale	36	55	91	7.2	Fish Lake	0	3	3	8.0
Goose Pond	23	18	41	2.9	Galena	0	1	1	3.9
Hillenbrand	22	9	31	5.3	Goose Lake*	1	0	1	15.8
Hovey Lake	22	27	49	4.3	Little Pigeon Creek	6	1	7	2.8
J.E. Roush	52	51	103	7.8	Lost Hill	1	1	2	3.6
Jasper Pulaski	60	53	113	10.6	Mallard Roost	1	10	11	10.0
Kankakee	5	7	12	1.7	Manitou Lake Islands	3	0	3	4.4
Kankakee Sands (TNC)	26	19	45	4.0	Marsh Lake	4	7	11	10.7
Kingsbury	52	69	121	12.2	Maxincukee*	1	1	2	16.8
Lasalle	36	32	68	11.3	Menominee	5	10	15	10.0
Pigeon River	121	192	313	17.4	Province Pond	1	0	1	3.0
Splinter Ridge	13	10	23	5.6	Swamper Bend	2	1	3	18.3
Stucker Fork	0	2	2	2.1	Tern Bar Slough	1	2	3	2.3
Sugar Ridge	47	19	66	5.3	Turkey Creek*	0	3	3	240.0
Tri-County	25	37	62	10.8	Turkey Foot	1	2	3	13.0
Wabashiki	33	6	39	7.0	Whirledge*	4	1	5	82.1
Wilbur Wright	5	6	11	6.8	**WILDLIFE MANAGEMENT AREA**	**22**	**24**	**46**	**9.8**
Willow Slough	62	78	140	9.0	Ashcraft*	0	1	1	10.3
Winamac	53	45	98	12.9	Elk Creek	4	7	11	10.1
GAMEBIRD AREA	**18**	**13**	**31**	**6.5**	Hindostan	2	1	3	16.1
Cartmell	1	0	1	4.2	Howat 80*	1	2	3	23.7
Hufford Trust	6	7	13	60.3	Modoc	0	2	2	7.7
Iroquois	1	0	1	4.1	Morgan Bluff	1	1	2	2.8
Mud Pine	1	0	1	N/A	Oak Grove*	2	0	2	19.9
Pine Creek	3	0	3	2.4	Randolph County	4	5	9	11.2
Place Trail	1	2	3	5.1	White Oak	2	1	3	15.1
Prudential*	1	0	1	8.7	White River Bend	6	4	10	9.0
Reynolds Creek	3	2	5	2.6	**CONSERVATION AREA**	**56**	**39**	**95**	**7.7**
Sandy Ridge*	1	0	1	8.0	Austin Bottoms	31	23	54	7.4
White County One	0	2	2	9.6	Sugar Creek	8	10	18	8.8
PUBLIC FISHING AREAS	**2**	**4**	**6**	**3.7**	Wabash River	17	6	23	7.5
Driftwood	2	0	2	1.4	**RESOURCE AREA**	**3**	**2**	**5**	**10.7**
Green Valley	0	4	4	17.3	Deniston	3	2	5	10.7

*Property areas are less than 100 acres or 0.15 sq.mi. The Deer Harvested/Sq.Mi calculation may not be comparable to larger properties.

Table 3-6. Deer harvested during the 2020-2021 deer hunting season on public lands managed by Indiana DNR Division of State Parks, including the number of antlered and antlerless deer and the number of deer harvested per square mile of property. Deer harvested in state parks were taken during special state park reduction draw hunts. Reporting error rate: ±0.26% (2020).

Property	Antlered	Antlerless	Total	Deer Harvested/Sq. Mi.
STATE PARKS	**432**	**759**	**1,191**	**13.8**
Brown County	64	85	149	6.0
Chain O'Lakes	38	89	127	30.3
Charlestown	25	19	44	8.8
Fort Harrison	23	33	56	21.1
Harmonie	26	29	55	10.2
Lincoln	15	27	42	15.4
McCormick's Creek	8	18	26	9.1
Ouabache	14	35	49	28.5
Pokagon	7	33	40	21.4
Potato Creek	33	95	128	21.3
Prophetstown	13	12	25	10.9
Shades	29	35	64	13.3
Spring Mill	17	42	59	29.5
Tippecanoe River	1	0	1	0.2
Turkey Run	29	42	71	19.0
Versailles	72	128	200	21.4
Whitewater Memorial	18	37	55	23.3
NATURAL AREA	**3**	**0**	**3**	**6.0**
Cave River Valley	3	0	3	6.0
STATE RECREATION AREAS	**42**	**77**	**119**	**8.8**
Deam Lake	3	2	5	5.0
Interlake	15	28	43	75.6
Lieber (Cagles Mill Lake)	14	29	43	3.9
Raccoon Lake	3	6	9	25.2
Starve Hollow	5	6	11	25.3
Trine	2	6	8	27.5
STATE RESERVOIRS	**342**	**558**	**900**	**6.4**
Brookville Lake	76	184	260	9.7
Hardy Lake	4	12	16	4.1
Mississinewa Lake	102	98	200	10.2
Monroe Lake	35	69	104	3.4
Patoka Lake	81	142	223	5.5
Salamonie Lake	44	53	97	5.2

Table 3-7. Deer harvested during the 2020-2021 deer hunting season on public lands managed by Indiana DNR divisions of Forestry and Nature Preserves, including the number of antlered and antlerless deer and the number of deer harvested per square mile of property. Reporting error rate: ±0.26% (2020).

Property	Antlered	Antlerless	Total	Deer Harvested/Sq. Mi.
STATE FORESTS	**554**	**681**	**1,235**	**5.2**
Clark	57	61	118	3.1
Ferdinand	21	24	45	3.7
Frances Slocum	3	5	8	10.5
Greene-Sullivan	40	31	71	6.6
Harrison-Crawford	103	126	229	6.5
Jackson-Washington	36	50	86	3.0
Martin	48	67	115	9.5
Morgan-Monroe	96	107	203	5.2
Owen-Putnam	30	24	54	5.2
Pike	29	39	68	8.8
Salamonie River	11	11	22	14.8
Selmier	1	3	4	7.3
Yellowwood	79	133	212	5.4
NATURE PRESERVES	**26**	**24**	**50**	**13.3**
Beaver Lake	3	2	5	4.9
Bob Kern	1	2	3	11.5
Conrad Savanna	6	2	8	11.4
Judy Burton	0	2	2	10.0
Round Lake Wetland	1	0	1	4.6
Section Six Southern Flatwoods	3	8	11	29.0
Twin Swamps	6	4	10	10.3
Wabash Lowlands	6	4	10	14.9

Table 3-8. Deer harvested during the 2020-2021 deer hunting season on public lands managed by federal agencies, including the number of antlered and antlerless deer and the number of deer harvested per square mile of property. Special draw hunts were held on the military lands and national wildlife refuge properties. Reporting error rate: ±0.26% (2020).

Property	Antlered	Antlerless	Total	Deer Harvested/Sq. Mi.
MILITARY LANDS	**150**	**208**	**358**	**2.4**
Camp Atterbury	58	135	193	3.5
Crane	92	73	165	1.7
NATIONAL FOREST	**559**	**556**	**1,115**	**3.6**
Hoosier	559	556	1,115	3.6
NATIONAL WILDLIFE REFUGE	**158**	**119**	**277**	**2.7**
Big Oaks	109	62	171	2.1
Muscatatuck	18	17	35	2.9
Patoka River	31	40	71	7.5

DNR file photo

Deer Reduction Zones Harvest

Indiana Deer Reduction Zones (DRZs) are designated to target areas within the state that have high deer populations and high human densities, where the cultural carrying capacity has been exceeded due to concerns over local ecosystem function, deer-vehicle collisions, or damage to personal property. DRZs aim to reduce deer-human conflict in these areas through increased hunting opportunity, rather than by eliminating the deer population. Hunters may harvest up to 10 deer in the DRZs (additional to regular bag limits), one of which may be antlered if a doe is harvested first in a DRZ (earn-a-buck). An interactive map of the current DRZs along with information and a video about how DRZs are developed can be found online at wildlife.IN.gov/wildlife-resources/animals/white-tailed-deer/deer-reduction-zones/.

Approximately 5,298 deer were harvested in DRZs in 2020 (Table 3-9), a 24.1% increase from 2019. 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.

The DRZ harvest has steadily increased over the last three years (Figure 3-10). In 2020, antlerless deer made up 82.0% of the DRZ harvest, accounting for 6.3% of statewide antlerless harvest. A total of 959 antlered deer were taken in DRZs in 2020, which accounted for 1.7% of statewide antlered harvest. Across counties containing these zones, DRZ harvest accounted for between 2.2% and 63.7% of each county's total harvest (Table 3-10).

Table 3-9. The number of antlered and antlerless deer harvested within a Deer Reduction Zone (DRZ) in 2020, 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. Also reported: the percentages of the statewide total harvest, statewide antlered harvest, and statewide antlerless harvest that were reported as harvested in a DRZ. Reporting error rate: ±0.26% (2020).

County	Antlered	Antlerless	Total
Allen	93	413	505
Boone	7	23	30
Brown	11	71	82
Dearborn	40	155	194
Dekalb	23	94	117
Delaware	14	42	56
Elkhart	21	108	129
Fulton	5	29	34
Hamilton	41	135	176
Hendricks	13	49	62
Johnson	5	27	32
Kosciusko	29	180	209
LaGrange	42	179	221
Lake	146	622	768
LaPorte	52	211	263
Madison	1	14	15
Marion	55	260	314
Monroe	17	72	89
Morgan	31	125	156
Porter	126	633	758
Saint Joseph	29	142	171
Steuben	40	248	288
Tippecanoe	15	82	97
Vanderburgh	76	322	398
Wabash	9	51	60
Warrick	18	56	74
Total	959	4,343	5,298
Percent of Statewide Harvest Totals	1.7	6.3	4.6

Table 3-10. Proportion of each Deer Reduction Zone (DRZ) county's total deer harvest that was counted as deer harvested in the DRZ in 2020. 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 rate: ±0.26% (2020).

County	DRZ Harvest	Total County Harvest	% DRZ Harvest
Allen	505	2,003	25.2
Boone	30	466	6.4
Brown	82	1,612	5.1
Dearborn	194	2,487	7.8
Dekalb	117	2,393	4.9
Delaware	56	842	6.7
Elkhart	129	1,798	7.2
Fulton	34	1,520	2.2
Hamilton	176	487	36.1
Hendricks	62	707	8.8
Johnson	32	628	5.1
Kosciusko	209	2,628	8.0
LaGrange	221	2,473	8.9
Lake	768	1,568	49.0
LaPorte	263	2,048	12.8
Madison	15	604	2.5
Marion	314	493	63.7
Monroe	89	1,522	5.8
Morgan	156	1,376	11.3
Porter	758	1,626	46.6
Saint Joseph	171	1,451	11.8
Steuben	288	3,076	9.4
Tippecanoe	97	1,147	8.5
Vanderburgh	398	778	51.2
Wabash	60	1,566	3.8
Warrick	74	1,380	5.4

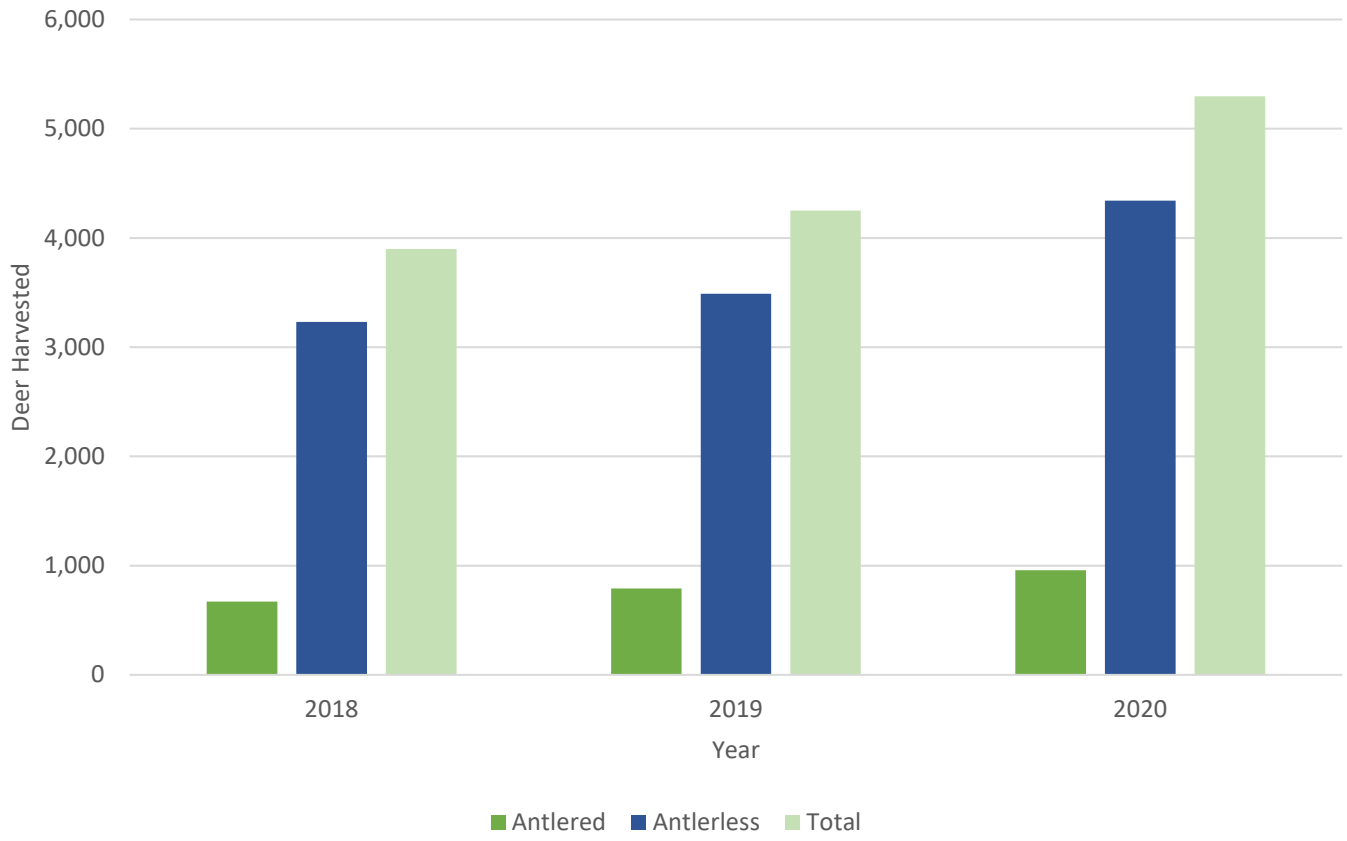

Figure 3-10. Number of antlered, antlerless, and total deer harvested within Deer Reduction Zones in 2018, 2019, and 2020. Reporting error rates: ±0.26% (2020), ±0.23% (2019), and ±0.57% (2018).

Community Hunting Access Program (CHAP)

The Division of Fish & Wildlife created the Community Hunting Access Program (CHAP) in 2017 to assist communities with the use of hunting as an effective deer management tool. This innovative program provides community partners with financial assistance and a list of trained coordinators to manage and oversee recreational deer hunting. The program serves as a practical and economical method for reducing deer numbers to balance ecological and societal needs. Benefits to residents include reduced levels of deer damage, new hunting opportunities, decreased deer-vehicle collision risk, fewer potential sharpshooting permits, and stronger state government-private sector partnerships.

CHAP provides community partners oversight and flexibility to identify when and where managed hunts occur. In 2020, one-year agreements were offered instead of the traditional two-year agreements. Two applicants applied and were funded to conduct hunts during the 2020-2021 deer hunting season. One applicant submitted five different applications for five individual properties, and all five properties were treated as one application. Four applicants were previously under two-year agreements and concluded their CHAP hunts during the 2020-2021 deer hunting season. In total, six applicants conducted CHAP hunts during the 2020-2021 deer hunting season on seven different properties. As outlined within each approved agreement, to receive the agreed-upon funding, each applicant with a CHAP agreement is required to submit a final report, in writing, within 30 days after the completion of the last hunt. The six applicants who successfully conducted CHAP hunts in 2020-20201 were awarded $82,500 cumulatively. These six applicants made 3,353 acres available for hunter access, culminating in 843 hunting opportunities and harvesting 90 deer. The cost per acre for creating hunting opportunities during the 2020-2021 CHAP hunting timeframe was $24.60.

The CHAP committee made a substantial change to the eligibility criteria for communities applying during the 2021-2022 application period. Now, for an application to qualify for funding, the applicant will need to provide funding for a 25% acreage match of the total acres offered for deer hunting opportunities. CHAP will assist by funding opportunities on the remaining 75% of the available acres open for deer hunting opportunities, as identified on the application, up to a maximum of $25,000. CHAP will be accepting one-year agreements for the 2021-2022 deer hunting season. Submissions will continue to be scored and ranked by the CHAP committee based on the following criteria: documentation of past and current human-deer conflicts, number of hunting opportunities offered, coordinator involvement, and the objectives and impact of deer management to the local community. It is anticipated that the program will not accept applications after the 2021-2022 hunting season. At that time the committee will evaluate the success of the program and determine how many participating communities have continued their hunting program without CHAP financial assistance. Additional information regarding CHAP is available at on.IN.gov/dnrchap.

DNR file photo

Harvest by License Status

Resident hunters accounted for 95% of the total deer harvested in Indiana during the 2020-2021 season, while nonresidents harvested the remaining 5% (Table 3-11). Of resident Indiana hunters, annual license holders (license types purchased every year) took 67.5% of the total harvest. Lifetime license holders harvested 16.3% and landowner-exempt (landowners and lessees who hunted on their own farmland or rented farmland without a license) and military exempt hunters harvested 10.9% of deer in 2020. A large proportion of hunters harvested deer using a deer license bundle (42.7% of resident hunters, 2.6% nonresident hunters).

DNR file photo

Table 3-11. Number of deer harvested by resident and nonresident license types during the 2020 deer hunting season. Reporting error rate: ±0.26% (2020).

License Type	Resident Harvest	% of Total Harvest (Res)	Non-Resident Harvest	% of Total Harvest (Non-Res)	Total
Bonus Antlerless	4,251	3.4	197	0.2	4,448
Deer Archery	2,147	1.7	507	0.4	2,654
Deer Bundle	53,033	42.7	3,185	2.6	56,218
Deer Crossbow	1,843	1.5	271	0.2	2,114
Deer Firearm	6,292	5.1	1,285	1.0	7,577
Deer Military/Refuge	286	0.2	14	0.0	300
Deer Muzzleloader	592	0.5	89	0.1	681
Deer Reduction Zone	3,236	2.6	52	0.0	3,288
Early State Park Reduction	811	0.7	3	0.0	814
Landowner Exemption	13,440	10.8	320	0.3	13,760
Late State Park Reduction	213	0.2	0	0.0	213
Lifetime License	20,239	16.3	318	0.3	20,557
Military Exempt - IC 14-22-11-11	81	0.1	1	0.0	82
Youth Free Hunt Days	188	0.2	5	0.0	193
Youth Hunt/Trap	11,167	9.0	114	0.1	11,281
Total	117,819	94.9	6,361	5.1	124,180

Deer License Sales

In 2020, 132,966 individual hunters purchased an annual deer hunting license of some kind (Table 3-12), an increase of 6.52% from 2019. The number of deer licenses sold to those hunters increased by 6.0% from 2019 (Table 3-13). As a result, the number of privileges (number of deer legally allowed to be harvested on those licenses, excluding youth) was 10.0% greater than in 2019. Each deer license bundle included three deer privileges. Both the number of hunters purchasing a license and the number of licenses sold steadily declined from 2015 to 2019. The increase in 2020 numbers may be a result of increased time and resources (i.e., stay-at-home orders, stimulus money) available to hunters during the COVID-19 pandemic. Despite the increase in hunters purchasing a license in 2020, the total was still more than 3% less than the 2015 total.

DNR file photo

Table 3-12. Number of individual hunters who purchased an annual deer hunting license and the percent change in the total from the previous year, 2015-2020.

Season	Number of hunters that purchased an annual license	Percent change from previous year
2015	137,246	--
2016	135,382	-1.36%
2017	130,938	-3.28%
2018	127,233	-2.83%
2019	124,827	-1.89%
2020	132,966	6.52%

Table 3-13. Deer license sales in Indiana by license type, 2016-2020. Total license sale numbers are subject to change slightly as refunds or voids are made.

License Type	2016	2017	2018	2019	2020
Resident Deer License Bundle	68,997	67,731	67,963	69,683	79,881
Resident Archery/Crossbow/ Reduction Zone	24,796	25,044	24,794	24,512	25,380
Resident Firearm	40,577	37,254	34,575	29,627	26,671
Resident Muzzleloader	4,669	4,376	3,898	3,607	3,715
Resident Military/Refuge	1,343	1,355	1,611	1,613	1,081
Resident Bonus Antlerless	18,065	16,188	13,866	15,149	14,378
Nonresident	11,386	11,671	11,540	11,779	12,631
Youth	33,006	30,503	28,506	27,283	30,427
Total Licenses (Excluding Youth)	169,833	163,619	158,247	155,970	163,737
Total Privileges (Excluding Youth)*	314,351	305,599	300,427	302,046	331,595

* Includes additional privileges from nonresident bundle licenses

County Bonus Antlerless Quotas and Deer Population Indices

County Bonus Antlerless Quotas 2020-2021. In 2020, Indiana DNR maintained county bonus antlerless quotas (CBAQ) at three or less in all counties in continued response to a widespread epizootic hemorrhagic disease (EHD) outbreak in southern and south-central Indiana in 2019 (Table 3-14). Seventeen counties increased from a one or two to a two or three from 2019 quotas. Because the Special Antlerless Firearms season has traditionally only been open in counties with a CBAQ of four or more, Indiana DNR made a temporary rule change to open the season in all counties (except those with a CBAQ designation of "A") to continue providing late hunting opportunities. CBAQs still applied in each county during the Special Antlerless Firearms season. In counties with an "A" designation, hunters could take only one antlerless deer from Nov. 26, 2020 through Jan. 3, 2021. The number of antlerless deer harvested in each county can be found at wildlife.in.gov/wildlife-resources/animals/ white-tailed-deer/deer-harvest-data/.

Deer Population Indices. Since 2012, CBAQs have been gradually lowered across the state as the deer-management goals of Indiana DNR have shifted from that of herd reduction to population maintenance (Figure 3-11). This approach integrated with strategic harvest in Deer Reduction Zones (DRZ) has been adopted to provide a healthy deer population across the state while addressing human safety concerns along roadways that have historically experienced high levels of deer-vehicle collisions (DVC). CBAQs should be maintained at current levels if harvest remains steady, unless population indices indicate that adjustments are necessary to increase or reduce local deer harvest in a county.

Every year the Indiana DNR deer program, private lands biologists, and conservation officers work collectively to analyze trends in deer population and public opinion indices to determine whether CBAQs should be adjusted. The following population and public opinion indices are gathered through the Deer Management Survey (see Chapter 7), harvest reports, and public comment and are used in CBAQ evaluations: annual deer harvest, hunter success rate, hunter effort, Archer's Index deer observations, DVC rates, public opinion on deer population size, and public desire for changes in populations. Because these data sources are not true measurements but rather indices of the deer population, trends in these data over time are weighed and collectively inform the final decision of Indiana DNR when setting CBAQs for the fall deer season.

County Bonus Antlerless Quotas 2021-2022. After reviewing deer population and public opinion indices, the following changes will be made to CBAQs for the 2021-2022 deer hunting season (Figure 3-12):

- Franklin and Ripley counties: CBAQ dropped to 2
- Steuben and LaGrange counties: CBAQ raised to 2

DMU Summaries. Indiana DNR analyzes deer data on a regional scale based on Deer Management Units (DMUs; Figure 3-13). DMUs are defined groupings of counties based on similar characteristics such as habitat, hunter density, and urban development. Trends in a DMU's indices influence the CBAQs for the counties within it.

While the COVID-19 pandemic likely contributed to an increase in statewide deer harvest and hunter effort during the 2020 deer season, individual trends for each DMU have remained consistent over the last five years. In 2020, the Northwest and Northeast DMUs largely drove the state's increase in harvest and collectively experienced a 14.4% increase in total harvest from the season before. This same upward harvest trend was apparent but less pronounced in the West Central and East Central DMUs. Collectively the Wabash, South, Muscatatuck Plateau, Dearborn Upland, and Southwest DMUs in the southern portion of the state experienced no significant increase in harvest.

The following summaries explain the trends observed in each DMU and how they affect the CBAQs in that region. County-specific data referenced below is available at wildlife.in.gov/wildlife-resources/animals/ white-tailed-deer/deer-harvest-data/.

DMU 1 – *Northwest*

Total deer harvest has been trending downward in the Northwest DMU since 2013, but in 2020 it increased notably. In recent years, DVC rates have remained steady while deer observation rates from the Archer's Index (see Chapter 8) and estimated hunter success rates have steadily trended upward. Hunter opinion of the deer population is trending upward, and indices generally support the maintenance of current CBAQs for counties. In 2020 there were numerous reports of Epizootic Hemorrhagic Disease (EHD) in the Northwest DMU; however, these counties already have low CBAQs, and many of their indices point to increasing deer populations, so adjustment to CBAQs is unnecessary.

DMU 2 – *Northeast*

Total deer harvest and DVCs have been gradually trending upward in the Northeast DMU since 2017. Hunter success is level or rising, and public opinion of the deer population size is trending upward. Because of these upward trends in deer population indices, both LaGrange and Steuben counties will be returned to a CBAQ of two in 2021. While there were numerous reports of EHD in DeKalb county in 2020, this county had been experiencing an upward trend in DVCs and total harvest, so no change to the CBAQ is necessary.

DMU 3 – *West Central*

Since 2017, there has been a steady increase in total harvest in the West Central DMU. This trend has been accompanied by a slow rise in DVC rates in the last three years; however, they remain lower than historical rates. Observation rates from the Archer's Index have fluctuated over the last decade but have leveled off the last three years. Hunter success rates and public opinion of the deer population size are increasing across the DMU. Overall, public approval of Indiana DNR deer management is improving across the DMU, and the CBAQs appear to be set at appropriate levels for each county.

DMU 4 – *East Central*

The 2020 deer season harvest in the East Central DMU reached a 10-year high; however, DMU-wide DVCs, Archer's Index observation rates, and public opinion on population size have remained level. Hunter opinion on deer management has been steadily increasing, and harvest success rates have remained steady, supporting the maintenance of CBAQs at current levels.

DMU 5 – *Wabash Valley*

In recent years, total harvest has remained level in the Wabash Valley DMU; however, there has been a downward trend in doe harvest, accompanied by an upward trend in buck harvest, which may be a result of shifting hunter harvest desires. In fact, buck harvest has been higher than doe harvest nine out of the last 10 years in this DMU. There has also been a decrease in the number of deer that hunters desire to take recorded in the Deer Management Survey. This year CBAQs will remain the same in the Wabash Valley DMU because there are currently no significant trends in population indices at county levels to indicate a necessary change in CBAQs. Harvest trends, Deer Management Survey responses, and hunter success will be closely monitored in this DMU in the future to determine whether any CBAQ changes are necessary.

DMU 6 – *South*

There has been a downward trend in total deer harvest, DVCs, hunter success, and public opinion of the population size over the last few years in the South DMU; however, observation rates from the Archer's Index have remained steady, which suggests that declines in harvest might be driven in part by declining hunter effort. Traditionally, counties within this DMU have had high CBAQs, but these were dropped significantly in 2019 after an outbreak of EHD across the DMU. This year, CBAQs will remain at reduced levels in continued response to the 2019 EHD outbreak.

DMU 7 – *Muscatatuck Plateau*

Total deer harvest has trended downward in the Muscatatuck Plateau DMU in recent years. While DVC rates and deer observation rates from the Archer's Index have remained steady, there has been a notable downward trend in hunter success over the last four years. In response to these trends and a high incidence of EHD in Franklin and Ripley counties in 2020, CBAQs will be temporarily reduced to two in Franklin and Ripley counties.

DMU 8 – *Dearborn Upland*

Total deer harvest has trended downward across the Dearborn Upland DMU for many years now. As a result, CBAQs were reduced each year from 2014 until 2019 when they were placed at two across the DMU in response to the 2019 EHD outbreak. In recent years, deer observations from the Archer's Index and hunter success rates have remained level. There has been a downward trend in the number of deer desired by hunters as CBAQs have been reduced. Both factors contribute to the declining DMU deer harvest. For 2021, CBAQs will remain at two across this DMU in response to the 2019 EHD outbreak.

DMU 9 – *Southwest*

Total deer harvest, hunter success rates, and DVC rates have remained steady across the Southwest DMU in recent years. Many of the CBAQs were reduced over the last eight years, and now all counties have a CBAQ of two. Trends in public opinion of the deer population and deer observation rates from the Archer's Index are steady. Currently all CBAQs appear to be set at an appropriate level and require no change for the 2021 deer season.

Table 3-14. Indiana County Bonus Antlerless Quotas (CBAQ), 2018-2020. In 2019, all quotas were lowered to a two or less in response to an epizootic hemorrhagic disease (EHD) outbreak in southern and south-central Indiana. Numbers in parentheses represent the original quotas for the 2019-2020 season before they were lowered due to EHD. In 2020, all counties, except those with a CBAQ of A, were open to the Special Antlerless Firearms season.

	Bonus Antlerless Quota				Bonus Antlerless Quota		
County	2018	2019	2020	County	2018	2019	2020
Adams	1	1	1	Lawrence	4	2 (4)	3
Allen	2	2	2	Madison	2	2	2
Bartholomew	4	2	2	Marion	3	2	2
Benton	A	A	A	Marshall	2	2	2
Blackford	1	1	1	Martin	4	2 (4)	3
Boone	2	2	2	Miami	2	2	2
Brown	4	2 (4)	3	Monroe	4	2 (4)	3
Carroll	2	2	2	Montgomery	2	2	2
Cass	2	2	2	Morgan	3	2 (3)	3
Clark	8	2 (4)	2	Newton	2	2	2
Clay	3	2 (3)	2	Noble	3	2	2
Clinton	2	2	2	Ohio	3	2	2
Crawford	4	2 (4)	2	Orange	4	2 (4)	3
Daviess	1	1	2	Owen	4	2 (4)	2
Dearborn	4	2 (3)	2	Parke	4	2 (3)	2
Decatur	3	2	2	Perry	4	2 (4)	3
Dekalb	2	2	2	Pike	2	2	2
Delaware	2	2	2	Porter	3	2	2
Dubois	3	2	2	Posey	1	1	2
Elkhart	3	2	2	Pulaski	3	2	2
Fayette	3	2	2	Putnam	4	2 (3)	2
Floyd	8	2 (4)	2	Randolph	1	1	1
Fountain	2	2	2	Ripley	4	2 (4)	3
Franklin	4	2 (4)	3	Rush	1	1	1
Fulton	2	2	2	Saint Joseph	3	2	3
Gibson	2	2	2	Scott	4	2 (4)	2
Grant	2	2	2	Shelby	2	2	2
Greene	4	2 (4)	2	Spencer	3	2	2
Hamilton	2	2	2	Starke	3	2	2
Hancock	1	1	1	Steuben	1	1	1
Harrison	8	2 (4)	2	Sullivan	3	2 (3)	2
Hendricks	3	2	2	Switzerland	3	2	2
Henry	2	2	2	Tippecanoe	2	2	2
Howard	2	2	2	Tipton	A	A	A
Huntington	2	2	2	Union	2	2	2
Jackson	4	2 (4)	3	Vanderburgh	2	2	2
Jasper	3	2	2	Vermillion	4	2 (3)	2
Jay	1	1	1	Vigo	3	2 (3)	2
Jefferson	4	2 (4)	3	Wabash	2	2	2
Jennings	4	2 (4)	3	Warren	2	2	2
Johnson	3	2	2	Warrick	2	2	2
Knox	2	2	2	Washington	4	2 (4)	3
Kosciusko	3	2	2	Wayne	3	2	2
Lagrange	1	1	1	Wells	A	A	1
Lake	3	2	2	White	3	2	2
LaPorte	3	2	2	Whitley	1	1	1

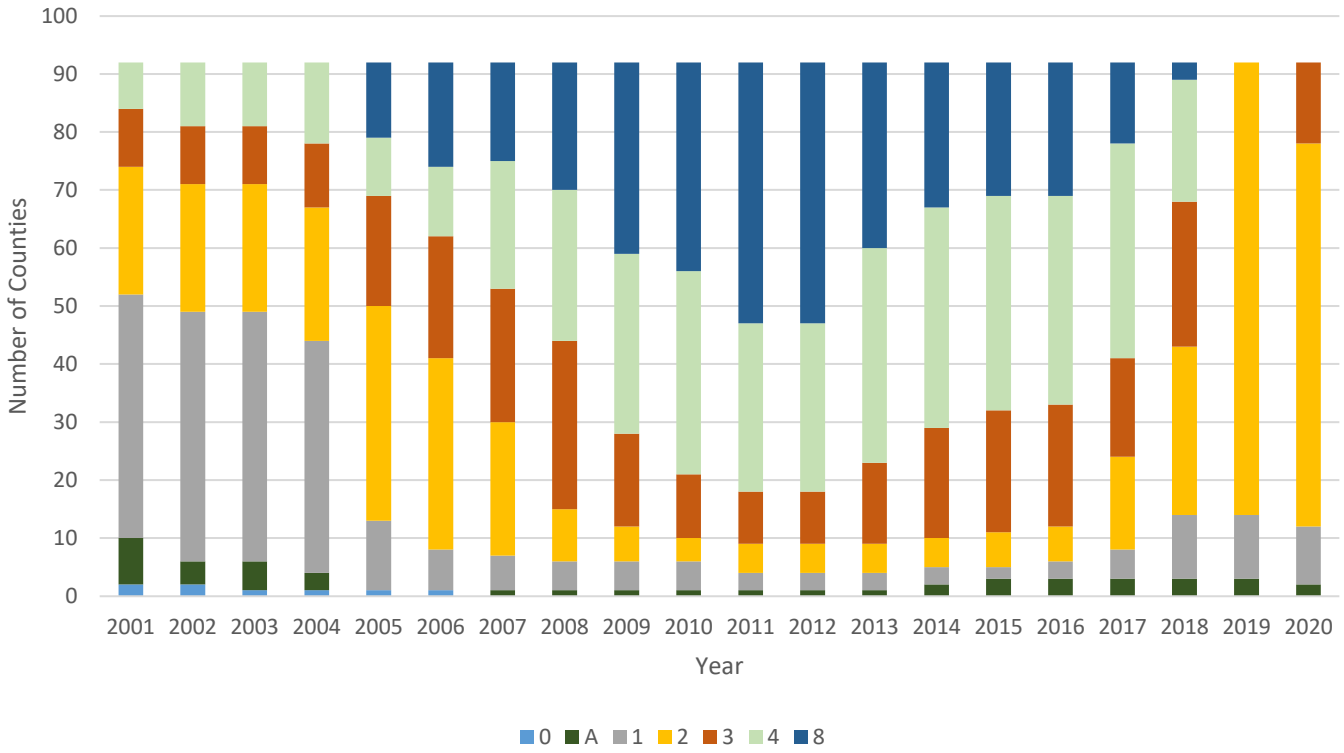

Figure 3-11. Number of counties with the corresponding county bonus antlerless quota during the Indiana deer hunting season from 2001 to 2020.

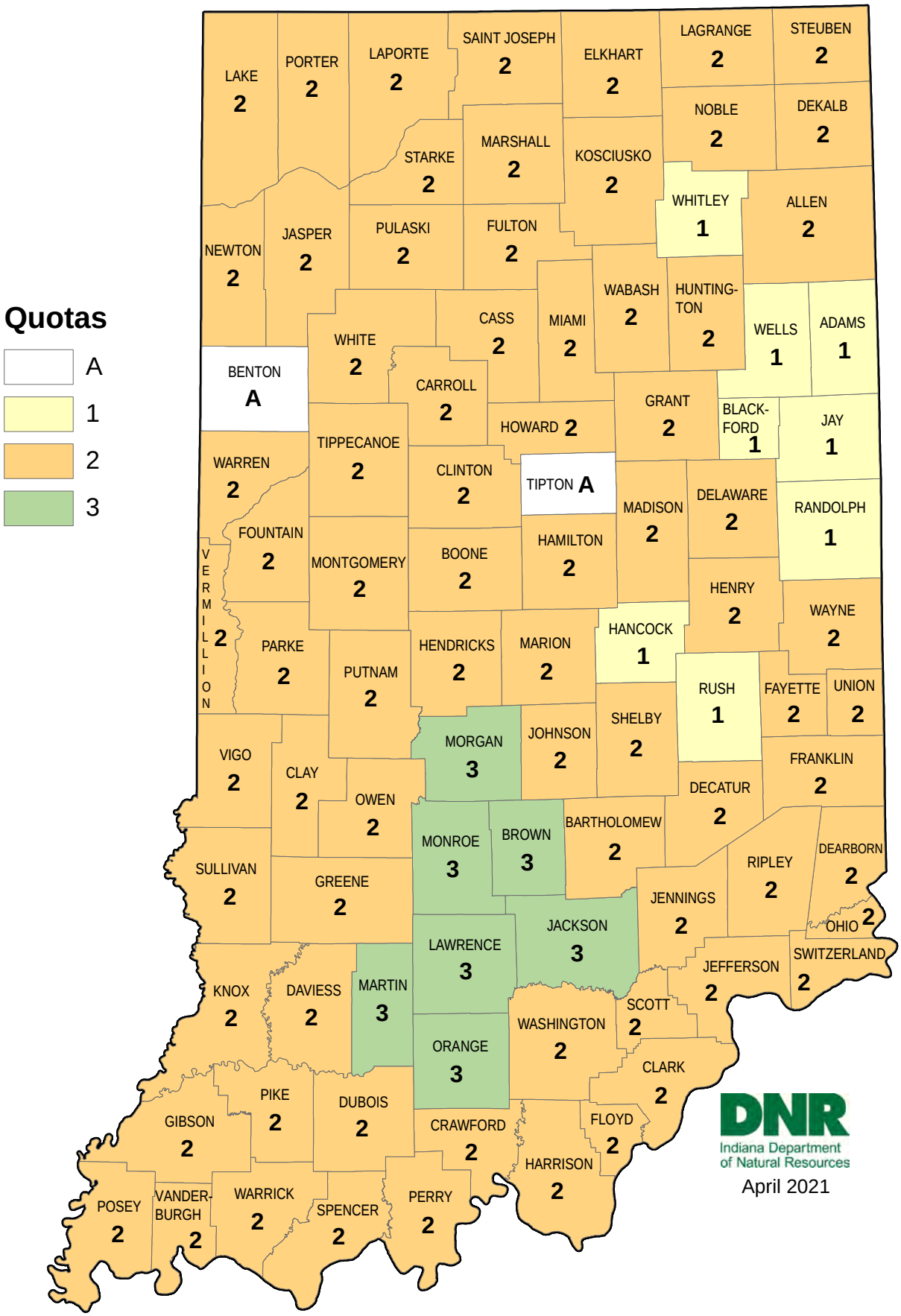

Figure 3-12. The County Bonus Antlerless Quotas for the 2021-2022 Indiana deer hunting season.

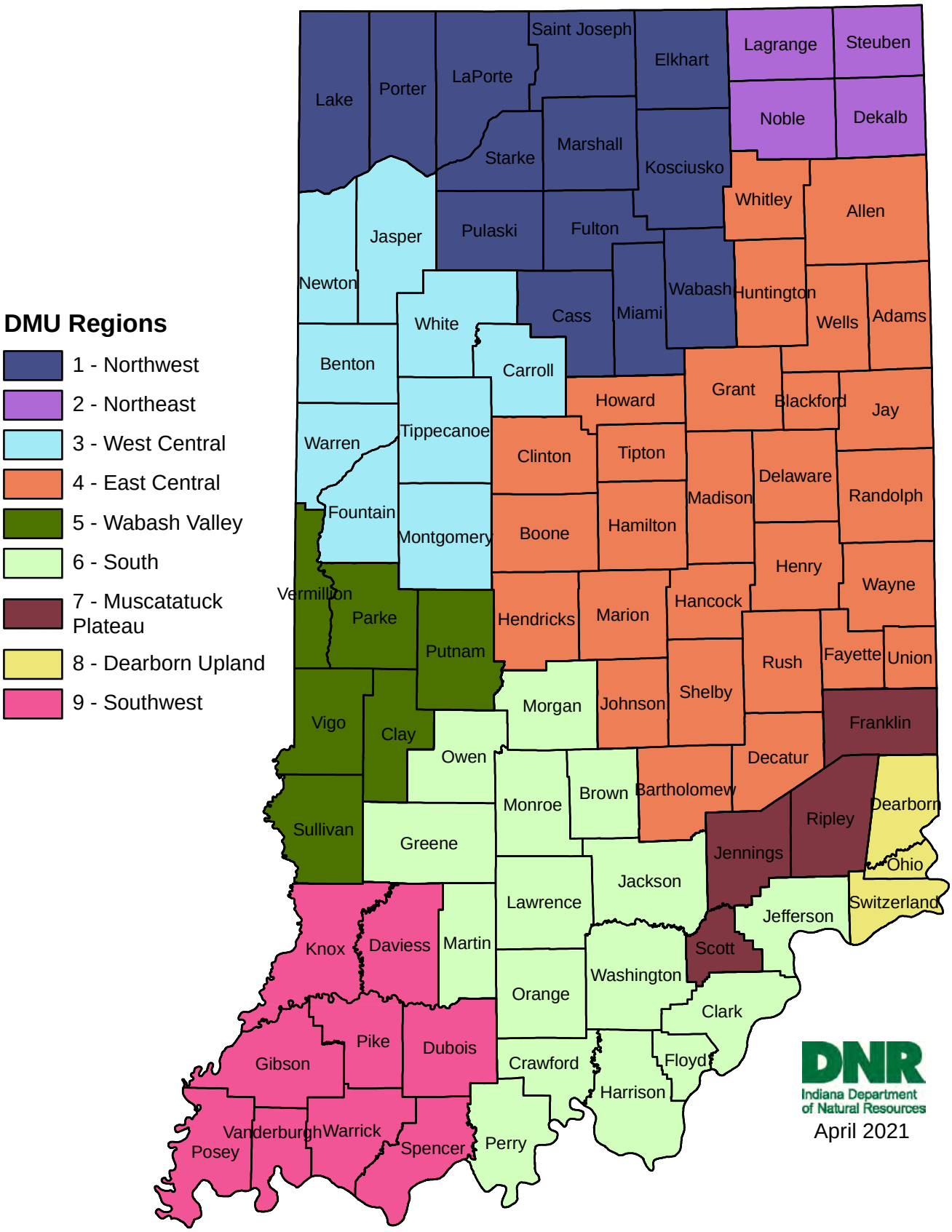

Figure 3-13. Indiana deer management units (DMUs) created by Indiana DNR and Purdue University to better understand survey data trends regionally.

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 license exemptions for landowners and active military members who are not tracked in the license sales data. Lifetime license holders accounted for 17% of the deer harvest in 2020. More than 11% of deer were harvested by landowners or military-exempt hunters in 2020. 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).

Indiana DNR defines a successful hunter as an individual who harvests at least one deer during the hunting season, regardless of how many deer the hunter attempted to harvest. 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). With this method, success rates for lifetime and exempt license holders are assumed to be the same as those for annual licensed hunters. This calculation is not applicable at the county level because deer are not always harvested in the same county where a license was purchased.

Hunter success can also be calculated from hunter survey responses. During multiple years of the annual Deer Management Survey (DMS), hunters were asked to report the number of deer they wanted to harvest, the number of deer they harvested, and the license or exemption used to harvest the deer. This information allows us to calculate hunter success in a similar way as the license sales and harvest data: the number of hunters who attempted to harvest a deer compared to the number of those hunters who harvested a deer. Since the DMS was available for all hunters with a valid email address in the Indiana DNR system, this calculation captures all hunters regardless of license type or exemption, providing an accounting of success rates for lifetime license holders, landowners, and military-exempt hunters.

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 informs the setting of hunting quotas and regulations.

Methods – For the 2020-2021 hunting season, license sales, the Deer Management Survey, and harvest data were used to estimate hunter success. We estimated success rates for all nonyouth resident and nonresident annual license holders in our database for each deer season from 2015 to 2020. It was not possible to calculate youth success rates using the same methodology because youth licenses are not specific to deer. Success was defined as harvesting and checking in at least one deer during the 2020-2021 deer season using the same Customer ID (CID) number that was used to purchase an annual deer license. To calculate success rate, we divided the number of successful hunters in each category by the total number of hunters in that category:

Resident License Success Rate (SRLR) = (The number of nonyouth hunters who purchased a resident annual deer license and checked in a deer using the same CID number) ÷ (The total number of nonyouth hunters who purchased a resident annual deer license)

Nonresident License Success Rate (SRLNR) = (The number of nonyouth hunters who purchased a nonresident annual deer license and checked in a deer using the same CID number) ÷ (The total number of nonyouth hunters who purchased a nonresident annual deer license)

Using the DMS, we estimated success rates for all nonyouth resident and nonresident annual license holders, lifetime license holders, and license exempt hunters who participated in the annual deer management survey for each deer season from 2017 to 2020. Although hunters can hunt using multiple license types per season, we categorized them into a single category to avoid double counting. Any hunter who purchased an annual license was categorized as an annual license holder. Any hunter who hunted using a lifetime license and did not buy an annual license was categorized as a lifetime license holder. Any hunter who hunted using a license exemption and did not purchase an annual license or hunt on a lifetime license was categorized as license-exempt. Like the license success rate, the survey success rate was calculated as the number of successful hunters in each category divided by the total number of hunters in that category:

Resident Survey Success Rate (SRSR) = (The number of nonyouth hunters who reported purchasing a resident annual deer license and checked in a deer under the resident annual license category) ÷ (The total number of nonyouth hunters who reported purchasing a resident annual deer license)

Nonresident Survey Success Rate (SRSN) = (The number of nonyouth hunters who reported purchasing a nonresident annual deer license and checked in a deer under the nonresident annual license category) ÷ (The total number of nonyouth hunters who reported purchasing a nonresident annual deer license)

Lifetime Survey Success Rate (SRSL) = (The number of nonyouth hunters who reported hunting using a lifetime license and checked in a deer under the lifetime license category) ÷ (The total number of nonyouth hunters who reported hunting using a lifetime license)

Exemption Survey Success Rate (SRSE) = (The number of nonyouth hunters who reported hunting using a license exemption and checked in a deer under a license exemption category) ÷ (The total number of nonyouth hunters who reported hunting using a license exemption)

We used harvest data and license success rates to calculate the number of hunters afield for each deer season from 2015 to 2020. For each year we queried the number of unique hunters who checked in a deer under the following categories: resident annual license, nonresident annual license, lifetime license, landowner exemption, and military exemption. As with the DMS success rate calculation, hunters were exclusively assigned to a single category to avoid overestimating the number of hunters afield. To calculate the number of hunters afield, we divided the number of unique hunters in each category by the license success rate and summed the category estimates. We used the license success rates to estimate hunters afield because survey responses appear to be biased toward successful hunters.

$$\text{Hunters Afield} = (HCD_{RAL}/SRL_{R}) + (HCD_{NAL}/SRL_{N}) + (HCD_{LL}/SRL_{R}) + (HCD_{LO}/SR_{LR}) + (HCD_{LO}/SRL_{R}) + (HCD_{ME}/SRL_{R}) + (HCD_{Y}/SRL_{R})$$

Where,
HCD_{RAL} = Adult hunters who checked in a deer and purchased a resident annual deer hunting license
HCD_{NAL} = Adult hunters who checked in a deer and purchased a nonresident annual deer hunting license
HCD_{LL} = Hunters who checked in a deer using a lifetime license

HCD_{LO} = Hunters who checked in a deer using a landowner exemption
HCD_{ME} = Hunters who checked in a deer using a military exemption
HCD_{Y} = Youth hunters who checked in a deer and purchased a youth license

Results – The resident license success rate was similar from 2015 through 2017 at ~0.35 and increased significantly in 2018 and 2019 (Figure 3-14). It increased slightly in 2020 for an annual success rate of 0.40 (CI_{95}=0.003). The nonresident license success rate was similar to the resident license success rate in 2015 and 2017 but was higher in 2016 (Figure 3-14). From 2018 to 2020, the nonresident license success rate followed a pattern similar to the resident license success rate but was consistently lower with an annual success rate of 0.37 (CI_{95}=0.009) in 2020.

Survey success rates have gradually increased over time for resident annual hunters, nonresident annual hunters, and exempt hunters, peaking in 2020 at 0.57 (CI_{95}=0.008), 0.53 (CI_{95}=0.030), 0.50 (CI_{95}=0.024) for each group respectively (Figure 3-15). Lifetime license hunters were the only license category displaying a different trend, with survey success rates peaking at 0.57 (CI_{95}=0.013) in 2018 and falling to 0.52 (CI_{95}=0.016) in 2020. Survey success rates were consistently higher than license success rates with a mean difference of 0.13 (CI_{95}=0.02) for resident annual hunters and 0.13 (CI_{95}=0.03) for nonresident annual hunters, but they displayed similar trends.

Both resident and nonresident license and survey success rates increased over time, and nonresident success rates were lower than resident success rates for the last three deer seasons. Although the number of deer checked in has increased over time (Table 3-15), because of the increasing license success rate, the estimated number of hunters afield has fallen since 2015 for most license categories including resident annual hunters, lifetime license hunters, landowner exempt hunters, military exempt hunters, and youth annual hunters (Figure 3-16). The number of hunters afield rebounded slightly in 2020 for resident annual hunters, landowner exempt hunters, and youth annual hunters (Figure 3-16). Nonresident annual hunters are the only license category to have consistently increased over time (Figure 3-16). The total estimated number of hunters afield was highest in 2015 at 233,736, fell to a low of 201,423 in 2019, and increased slightly in 2020 to 213,327 (Figure 3-17).

Discussion – An increase in hunter success rates was apparent in both the license success rate and the survey success rate. The lifetime license survey success rate was the only estimated success rate to decrease over time but is now comparable to the rate for other license categories. The large mean difference in success rates between the license data and the survey data is likely because of systematic biases in both data sets. The license data calculation is based on the success rate of only nonyouth hunters who purchased a license and assumes that everyone who purchased a license took advantage of the hunting opportunity. Furthermore, a hunter is only counted as successful if they checked in a deer with the same CID number as they used to purchase an annual license. These underlying assumptions likely result in an underestimate of success rate and thus an underestimate in the number of hunters afield; however, we use the license success rate for the hunters afield calculation because we believe it is a more accurate estimate of success than the deer management survey estimates, which are calculated from a nonrandom sample of deer hunters.

Based on the survey success estimates, we know that the success rate of hunters who purchased an annual license may not be the same for other hunters. For example, lifetime license holder success rates were generally higher than those of other groups, and exempt success rates were generally lower. One of the goals of the DMS was to estimate success rates for different groups based on license category to help us more precisely estimate the number of hunters afield (Caudell and Vaught 2018); however, given the survey bias toward successful hunters, this is infeasible without a correction factor to adjust between hunter success based on license sales data and hunter success calculated from the DMS. In the future, a harvest effort survey sent to a random sample of firearms hunters may provide this correction factor.

There are several practical applications for estimating hunter success and hunters afield. Hunter success may act as an index of deer populations (Roseberry and Woolf 1991) and a predictor of hunter satisfaction (Gigliotti 2000). Estimating the number of hunters afield using a standardized method of calculation provides a repeatable index for hunter trends in Indiana. Because the proportion of the population actively participating in hunting has been declining over time (U. S. Fish & Wildlife Service 2018), it is important to have an accurate index of these trends. 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 participating in the hunting season will help evaluate the success of these programs. Ultimately, the most accurate measure of hunter success and hunters afield requires documenting every hunter that attempts to harvest a deer through license sales, registration, or some other record.

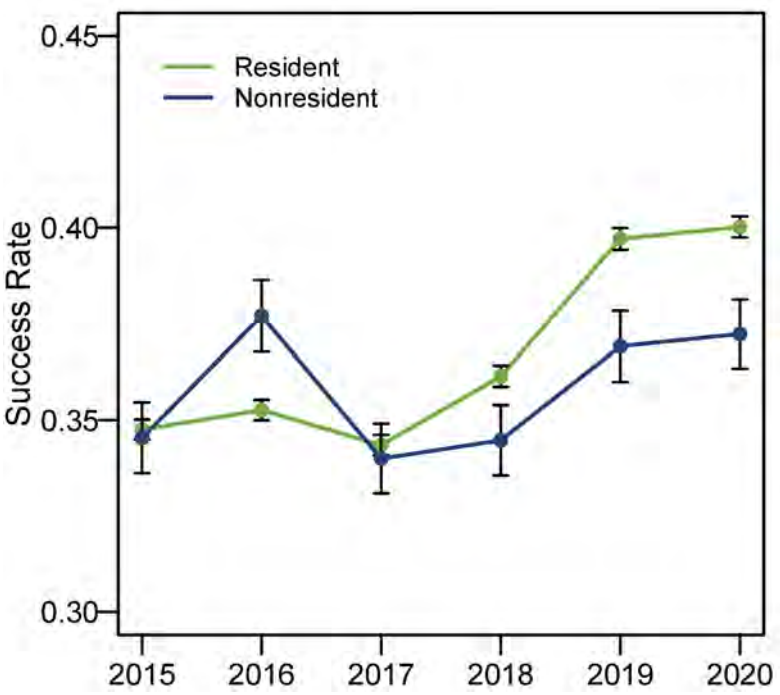

Figure 3-14. Calculated annual success rates of nonyouth licensed resident and nonresident deer hunters who purchased an annual deer license and checked in at least one deer using the same Customer ID number.

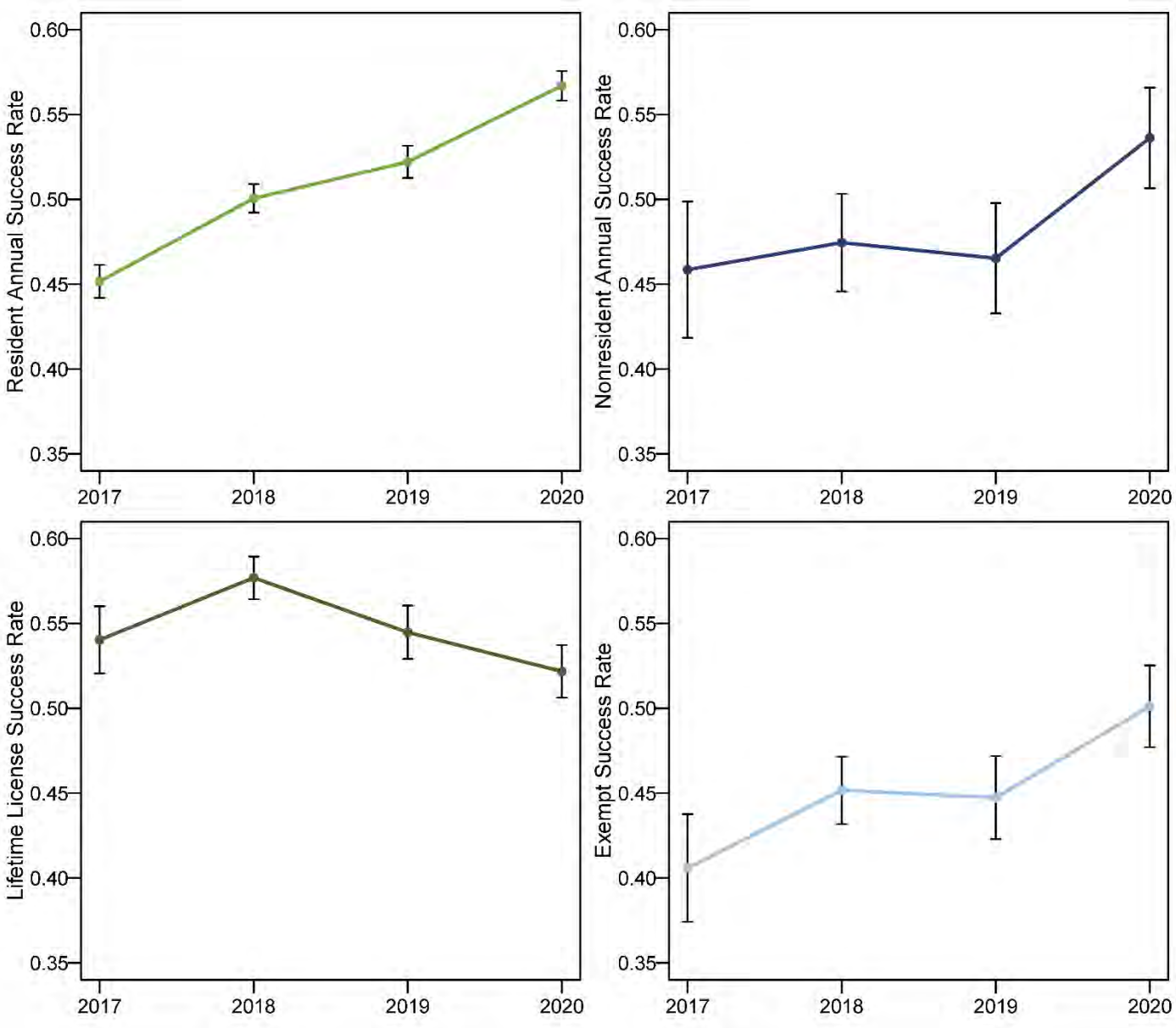

Figure 3-15. Calculated annual success rates of nonyouth deer hunters who hunted using resident and nonresident annual licenses, lifetime licenses, and military and landowner exemptions, and participated in the annual Deer Management Survey.

Table 3-15. Number of deer harvested by hunters who checked in a deer (HCD) and listed one of the following license types: annual license - resident (RAL), annual license - nonresident (NAL), lifetime license (LL), landowner exemption (LO), military exemption (ME), or youth (Y) from 2015-2021 in Indiana.

	Number of successful hunters					
Type of Hunter	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
HCD_{RAL}	43,854	43,742	41,068	41,972	45,113	48,448
HCD_{NAL}	3,516	3,928	3,572	3,562	3,856	4,135
HCD_{LL}	13,932	13,050	13,623	13,169	13,123	13,012
HCD_{LO}	11,065	10,471	9,838	9,670	9,665	10,365
HCD_{ME}	79	71	83	69	67	57
HCD_{Y}	8,766	8,067	7,780	7,820	7,870	9,043

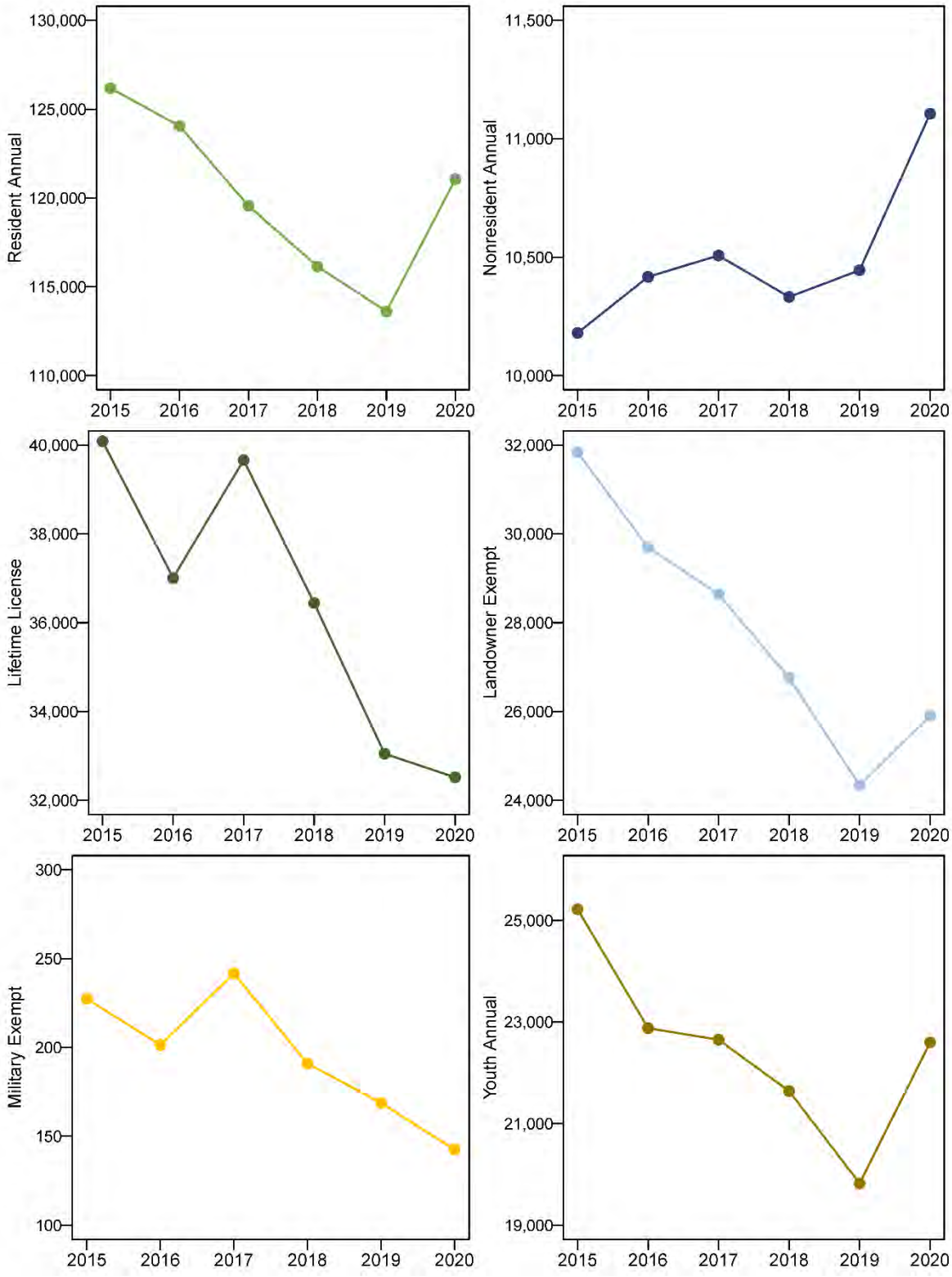

Figure 3-16. Estimated hunters afield in each license category including resident annual license holders, nonresident annual license holders, lifetime license holders, landowner exemptions, military exemptions, and youth annual license holders.

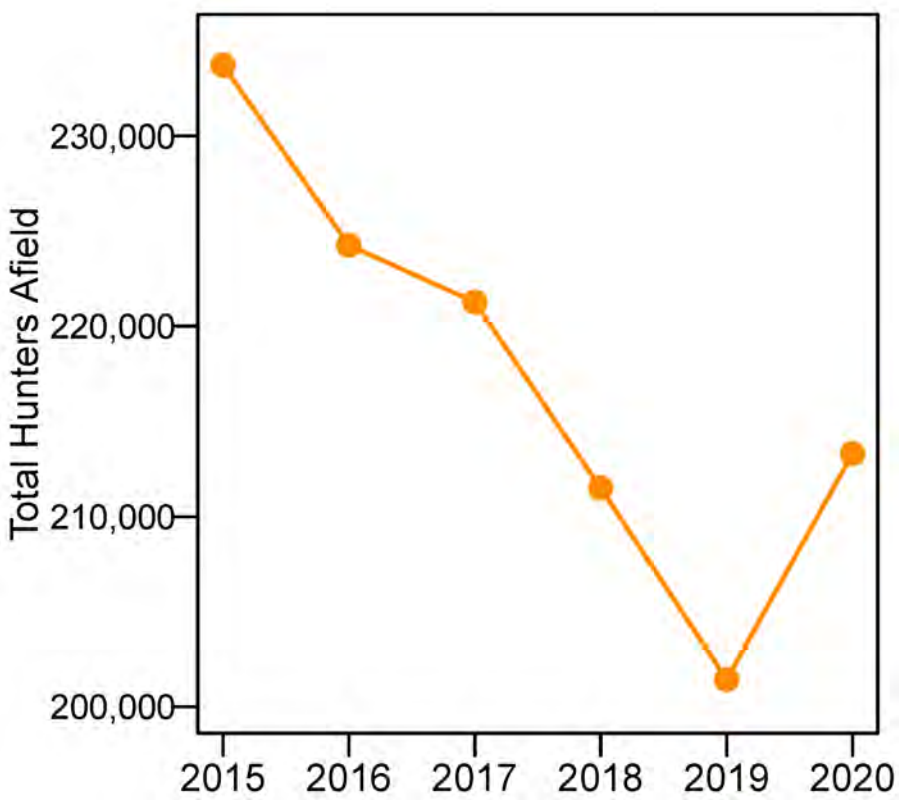

Figure 3-17. Total estimated hunters afield during Indiana deer hunting seasons, 2015-2016 through 2020-2021.

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. 2020. 2019 Indiana White-tailed Deer Report. Indiana Department of Natural Resources, Bloomington, USA.

Frawley, Brian J. 2020. Michigan Deer Harvest Survey Report 2019 Seasons. Michigan Department of Natural Resources. Wildlife Report No. 3691. https://www.michigan.gov/documents/dnr/2019_deer_harvest_survey_report_701035_7.pdf.

CHAPTER 4.
DEER CONTROL PERMITS

Moriah Boggess, Olivia Vaught, and Linnea Petercheff,
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 issued for population control, and the number of deer taken on control permits is lower than the number of deer harvested during the hunting season (Table 4-1). 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 the number of deer taken on the permit, and the sex, the equipment used, and the disposal method for each deer taken to the Indiana DNR. Indiana DNR received reports from 169 of the 231 deer control permits issued statewide. Reports were not received from the remaining 62 permits. An average of 13.0 (n=228; CI_{95}=11.6, 14.3) deer were authorized per permit, and an average of 6.8 (n=169; CI_{95}=5.6, 8.0) deer were taken per permit (Table 4-1). Damages reported at the time of the application ranged from $500 to $97,500. Permit recipients reported an average of 19.9% (n=110; CI_{95}=14.9%, 24.8%) of soybean crops damaged and 18.6% (n=93; CI_{95}=13.2%, 23.9%) of corn crops damaged.

A total of 1,156 deer were reported taken statewide on deer control permits, representing 0.9% of the cumulative deer taken, which is the total number of hunter-harvested deer and deer taken on control permits in 2020. Most of the deer that were taken on control permits were does and button bucks (n=993), which represented 1.4% of the cumulative number of deer taken in 2020. Fewer adult bucks (n=159) were taken on control permits, which represented 0.2% of the cumulative number of deer taken in 2020. The majority of deer (75.4%) 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 2020, 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. The sum of permits per county is greater than the total number of permits issued because some permits were issued for multiple counties and are counted for each county. The number of deer taken per permit was divided among multiple counties on a single permit.

County	Number Permits Issued	Number of Deer Taken	Average Deer Taken / Permit	% of Cumulative Deer	County	Number Permits Issued	Number of Deer Taken	Average Deer Taken / Permit	% of Cumulative Deer
Adams	1	1	1.0	0.1%	Lawrence	2	2	1.0	0.1%
Allen	2	1	0.5	0.0%	Madison	1	4	4.0	0.7%
Bartholomew	4	1	0.3	0.1%	Marion	2	0	0.0	0.0%
Benton	1	1	1.0	0.8%	Marshall	10	43	4.3	1.9%
Blackford	0	0	0.0	0.0%	Martin	0	0	0.0	0.0%
Boone	0	0	0.0	0.0%	Miami	0	0	0.0	0.0%
Brown	8	147	18.4	8.4%	Monroe	6	28	4.7	1.8%
Carroll	1	4	4.0	0.4%	Montgomery	3	0	0.0	0.0%
Cass	0	0	0	0.0%	Morgan	2	1	0.5	0.1%
Clark	5	41	8.2	3.0%	Newton	0	0	0.0	0.0%
Clay	0	0	0	0.0%	Noble	8	20	2.5	0.6%
Clinton	0	0	0	0.0%	Ohio	3	18	6.0	2.7%
Crawford	0	0	0	0.0%	Orange	1	5	5.0	0.3%
Daviess	1	3	3.0	0.2%	Owen	1	0	0.0	0.0%
Dearborn	12	59	4.9	2.3%	Parke	0	0	0.0	0.0%
Decatur	1	3	3.0	0.3%	Perry	5	42	8.4	2.6%
DeKalb	3	16	5.3	0.7%	Pike	1	0	0.0	0.0%
Delaware	2	0	0.0	0.0%	Porter	2	10	5.0	0.6%
Dubois	2	2	1.0	0.1%	Posey	4	47	11.8	3.5%
Elkhart	1	0	0.0	0.0%	Pulaski	2	26	13.0	1.3%
Fayette	2	20	10.0	2.0%	Putnam	0	0	0.0	0.0%
Floyd	3	17	5.7	2.5%	Randolph	0	0	0.0	0.0%
Fountain	0	0	0	0.0%	Ripley	8	40	5.0	2.3%
Franklin	13	36	2.8	1.4%	Rush	0	0	0.0	0.0%
Fulton	2	23	11.5	1.5%	Saint Joseph	4	0	0.0	0.0%
Gibson	2	4	2.0	0.3%	Scott	2	0	0.0	0.0%
Grant	0	0	0	0.0%	Shelby	0	0	0.0	0.0%
Greene	4	1	0.3	0.1%	Spencer	5	33	6.6	2.5%
Hamilton	0	0	0	0.0%	Starke	2	7	3.5	0.4%
Hancock	1	2	2.0	0.7%	Steuben	7	26	3.7	0.8%
Harrison	11	99	9.0	4.0%	Sullivan	7	59	8.4	2.9%
Hendricks	1	0	0.0	0.0%	Switzerland	4	30	7.5	1.6%
Henry	2	0	0.0	0.0%	Tippecanoe	3	4	1.3	0.3%
Howard	0	0	0.0	0.0%	Tipton	0	0	0.0	0.0%
Huntington	0	0	0.0	0.0%	Union	3	6	2.0	0.9%
Jackson	4	6	1.5	0.4%	Vanderburgh	2	5	2.5	0.6%
Jasper	0	0	0.0	0.0%	Vermillion	1	4	4.0	0.3%
Jay	0	0	0.0	0.0%	Vigo	0	0	0.0	0.0%
Jefferson	4	13	3.3	0.8%	Wabash	2	2	1.0	0.1%
Jennings	3	11	3.7	0.7%	Warren	0	0	0.0	0.0%
Johnson	2	4	2.0	0.6%	Warrick	3	30	10.0	2.1%
Knox	0	0	0.0	0.0%	Washington	11	98	8.9	4.6%
Kosciusko	0	0	0.0	0.0%	Wayne	2	0	0.0	0.0%
Lagrange	4	15	3.8	0.6%	Wells	0	0	0.0	0.0%
Lake	1	8	8.0	0.5%	White	1	0	0.0	0.0%
LaPorte	6	19	3.2	0.9%	Whitley	2	9	4.5	0.8%

Table 4-2. Number of damage reports for each crop type or other reason for 2020 deer control permits. Some individuals reported multiple crops or reasons.

Crop or Reason for Permit	Number of Reports
Alfalfa	13
Barley	2
Christmas Trees	3
Clover	2
Corn	114
CRP	1
Grapes	5
Hay	20
Health and Safety	4
Hemp	1
Landscaping	3
Nursery Stock	3
Orchard	8
Popcorn	3
Produce	23
Pumpkins	13
Rye	2
Soybeans	135
Timber Production	8
Wheat	8
Wildflowers	2
Woodland	5

CHAPTER 5.
DEER-VEHICLE COLLISIONS

Moriah Boggess 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 (e.g., county road, state road, interstate, etc.), road conditions, estimated cost of damage, and other data used in road safety analyses. INDOT provides data on deer-vehicle collisions 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 consistent way 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 15,559 in 2019 to 14,325 in 2020 (Figure 5-1; Table 5-1). The number of deer-vehicle collisions per billion miles traveled (DVC/BMT) was 178 DVC/BMT in 2020, a decrease of 8.7% from 2019.

Ohio (1,057 DVC/BMT), Pulaski (858 DVC/BMT), and Brown (826 DVC/BMT) counties had the highest number of DVC/BMT (Figure 5-2). Marion (9 DVC/BMT) and Lake (41 DVC/BMT) counties had fewer than 50 DVC/BMT. Compared to 2019, DVC/BMT decreased in 71 counties and increased in 21 counties. Four counties showed an increase greater than 15% in DVC/BMT compared to 2019, while 28 counties showed a decrease greater than 15%.

Photo by Moriah Boggess

Most deer-vehicle collisions in 2020 occurred on state roads (35.3%) and county roads (28.5%; Table 5-2). From 2015 to 2020, state roads had the highest average number of DVC/BMT by road type per year (450 DVC/BMT). U.S. routes had the highest average number of deer-vehicle collisions (85 DVC) per 100 miles of road from 2015 to 2020 (Table 5-2).

Nearly 50% of deer-vehicle collisions in 2020 occurred between September and December (Figure 5-3). Compared to 2019, the number of collisions during March, April and May 2020 decreased by 22.4%, 33.0%, and 25.1%, respectively. Collisions in April were also 33.5% lower than the average number of collisions during that month over the previous five years (2015-2019). Many factors may contribute to this substantial decrease, including reduced traffic as a result COVID-19. Additionally, deer-vehicle collisions occurred most often during dawn and dusk, which varies by month as day length changes (Figure 5-4).

The estimated economic cost of deer-vehicle collisions from damage to vehicles in 2020 was $64.6 million based on the average estimated cost per collision (Table 5-3). From 2015 to 2020, deer-vehicle collisions cost drivers a total of more than $371 million (Table 5-3).

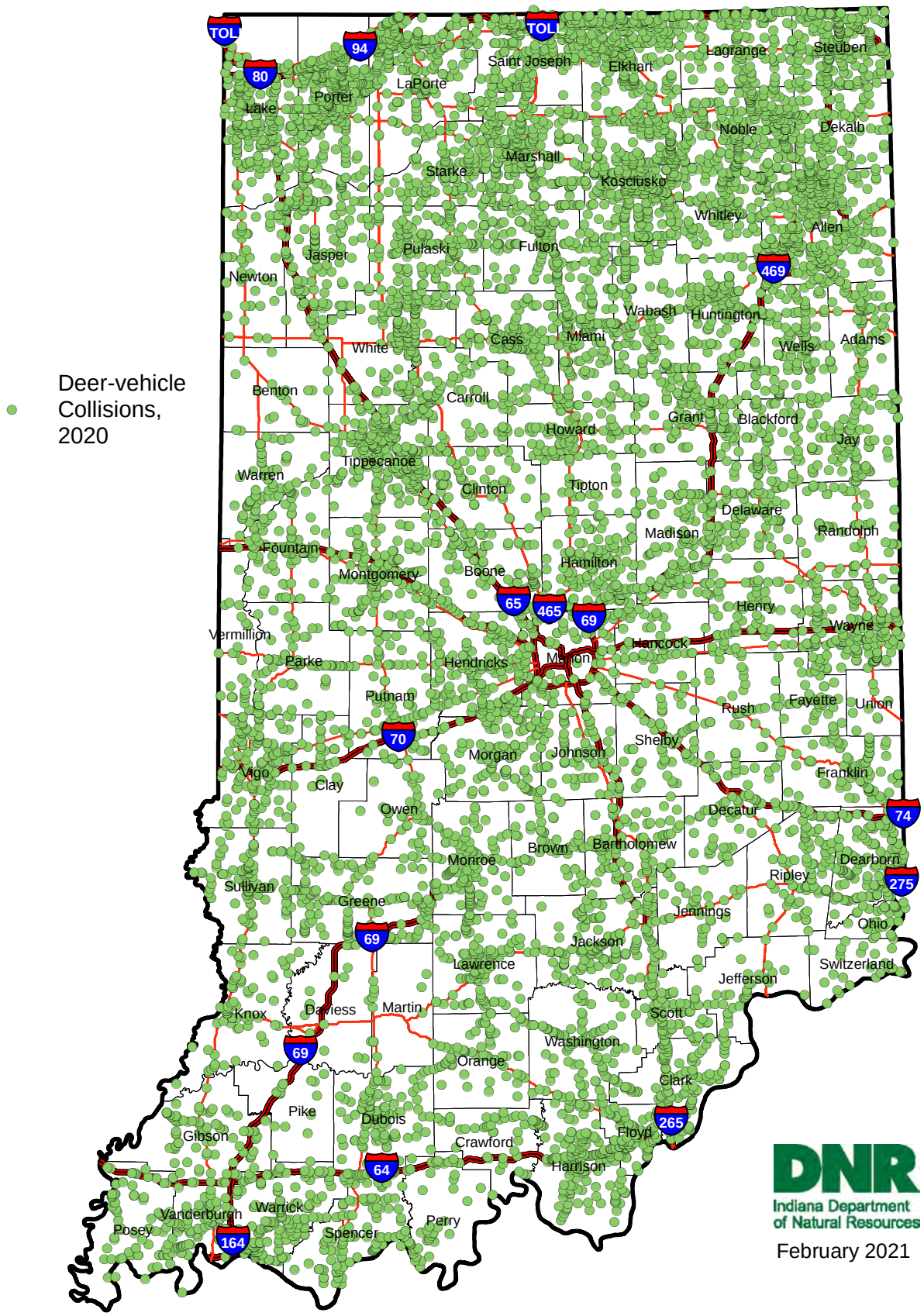

Figure 5-1. Locations of deer-vehicle collisions in Indiana in 2020. Only 12,323 (86.0%) of the 14,325 deer-vehicle collisions reported to INDOT included GPS location data to map.

Table 5-1. Number of deer-vehicle collisions by county in Indiana, 2019 and 2020.

	Deer-vehicle Collisions			Deer-vehicle Collisions	
County	2019	2020	County	2019	2020
Adams	153	104	Lawrence	211	203
Allen	462	442	Madison	162	147
Bartholomew	144	151	Marion	87	101
Benton	26	18	Marshall	309	326
Blackford	57	56	Martin	21	18
Boone	143	153	Miami	201	196
Brown	122	111	Monroe	161	143
Carroll	122	129	Montgomery	164	174
Cass	200	185	Morgan	182	147
Clark	161	170	Newton	87	113
Clay	74	68	Noble	353	317
Clinton	115	93	Ohio	53	49
Crawford	90	83	Orange	124	94
Daviess	31	22	Owen	87	67
Dearborn	310	242	Parke	120	137
Decatur	93	76	Perry	99	77
Dekalb	349	268	Pike	25	16
Delaware	174	165	Porter	375	375
Dubois	233	185	Posey	95	128
Elkhart	368	369	Pulaski	207	168
Fayette	58	65	Putnam	139	134
Floyd	153	100	Randolph	104	103
Fountain	105	97	Ripley	141	122
Franklin	130	117	Rush	54	61
Fulton	178	160	Saint Joseph	350	308
Gibson	137	119	Scott	71	89
Grant	204	171	Shelby	96	83
Greene	271	212	Spencer	189	209
Hamilton	206	202	Starke	156	145
Hancock	109	110	Steuben	470	442
Harrison	241	239	Sullivan	140	135
Hendricks	174	186	Switzerland	36	33
Henry	111	106	Tippecanoe	310	335
Howard	127	122	Tipton	37	36
Huntington	245	191	Union	5	5
Jackson	228	213	Vanderburgh	152	110
Jasper	241	201	Vermillion	100	90
Jay	105	145	Vigo	225	183
Jefferson	66	45	Wabash	195	169
Jennings	53	59	Warren	98	103
Johnson	139	112	Warrick	234	208
Knox	141	117	Washington	195	141
Kosciusko	519	450	Wayne	199	196
Lagrange	246	202	Wells	151	166
Lake	270	251	White	175	164
LaPorte	334	316	Whitley	196	161

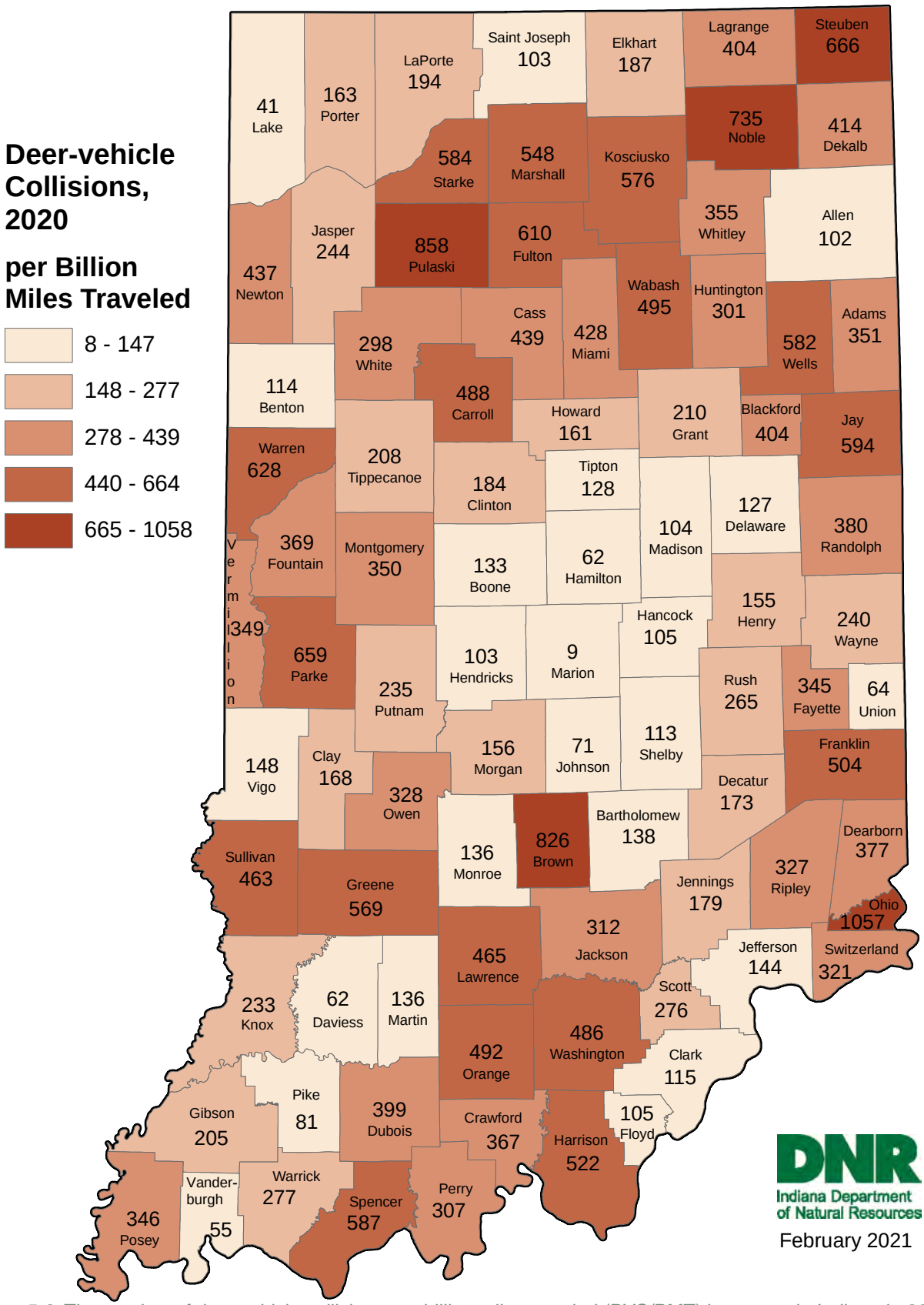

Figure 5-2. The number of deer-vehicle collisions per billion miles traveled (DVC/BMT) by county in Indiana in 2020. DVC/BMT provide a relative rate of deer-vehicle collisions given the number of miles driven in that county per year. Counties with high DVC/BMT have proportionally more deer-vehicle collisions per mile 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 number of miles traveled (e.g., Lake County).

Table 5-2. The number of deer-vehicle collisions (DVC) in 2020, average number of deer-vehicle collisions per year from 2015-2020, miles of road, average deer-vehicle collisions per 100 miles, and average deer-vehicle collisions per billion miles traveled (DVC/BMT) from 2015-2020 by road type. Collision values were averaged from 2015-2020, and miles-traveled values were averaged from 2015-2019. Collisions on unknown road types (0.4%) were proportionally distributed among the other road types.

Road Type	2020	Avg DVCs 2015-2020	Road Length (mi)	Avg DVCs per 100mi of Road	Avg BMT per year	Avg DVC/BMT per year
County Road	4,089 (28.5%)	4,212 (28.2%)	65,218	6.5	19.4	217.3
Interstate	983 (6.7%)	1,154 (7.7%)	1,704	67.7	19.1	60.5
Local/City Road	1,702 (11.9%)	1,654 (11.1%)	19,662	8.4	21.2	77.9
State Road	5,056 (35.3%)	5,492 (36.7%)	7,238	75.9	12.2	449.6
US Route	2,407 (16.8%)	2,445 (16.3%)	2,869	85.2	10.1	241.0

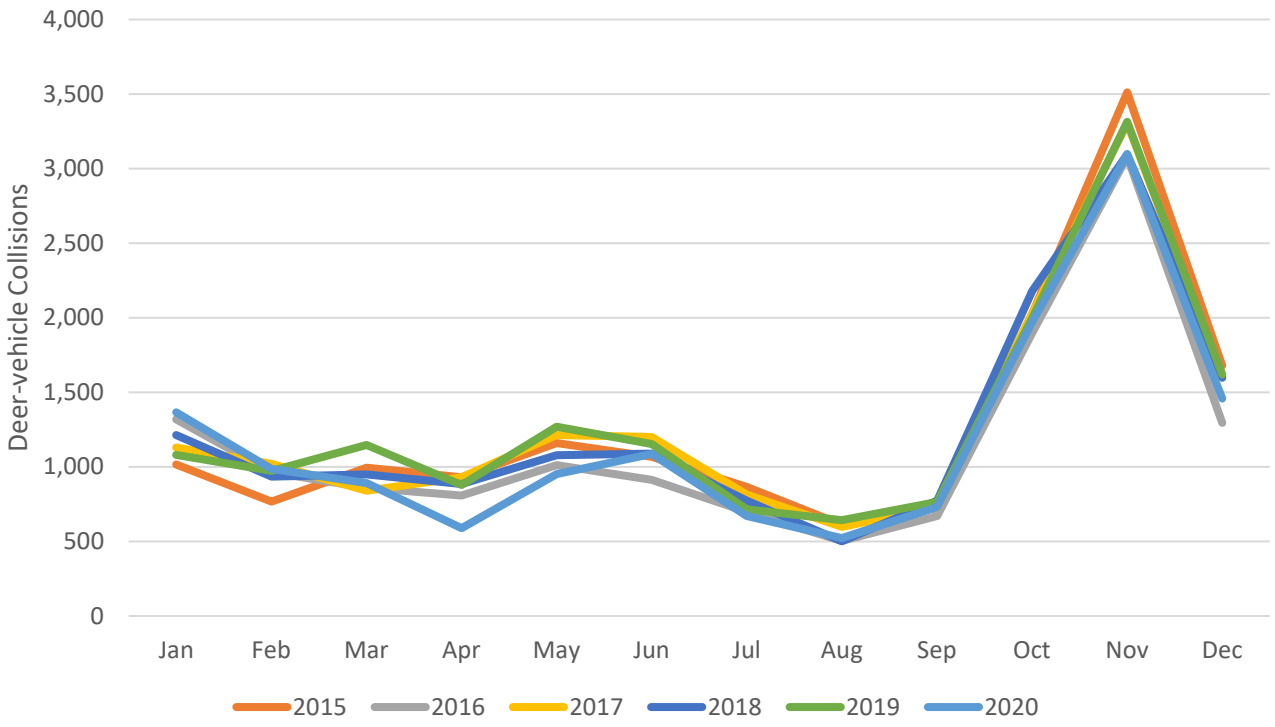

Figure 5-3. Number of deer-vehicle collisions by month in Indiana from 2015-2020. There was a noticeable decrease in collisions during March, April, and May 2020.

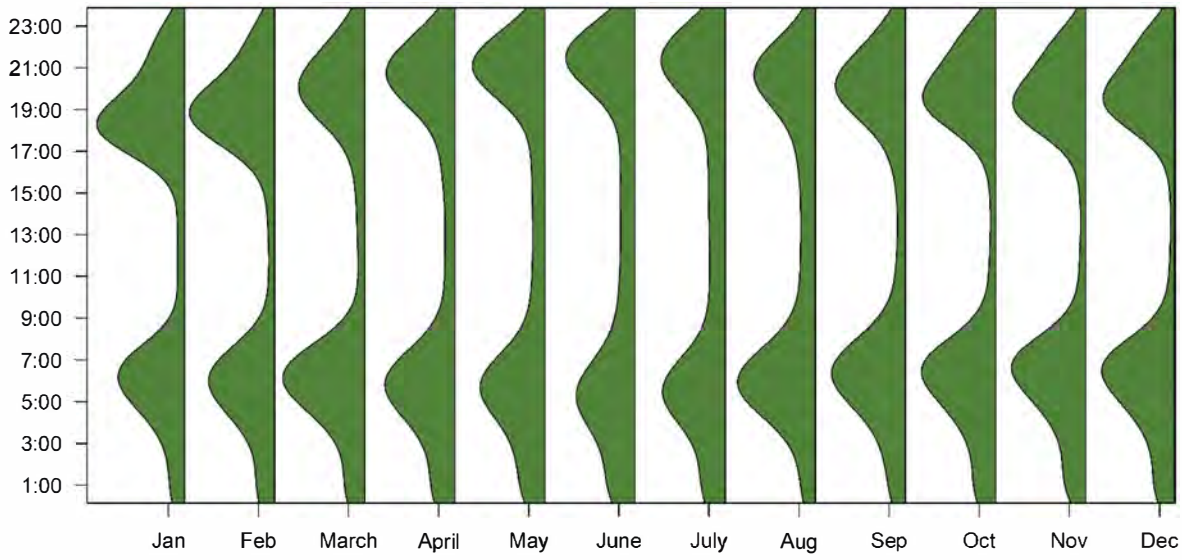

Figure 5-4. The proportion of deer-vehicle collisions by time of day in Indiana from 2016-2020.

Table 5-3. Reported economic loss due to deer-vehicle collisions in Indiana from 2015-2020. Collisions with an unknown estimate or an estimate less than $1,000 were not included. Total Damage Estimate 2015-2020 is calculated by multiplying the total number of collisions for that damage estimate range by the average value of damage.

age Estimate Range	2020 DVCs	2019 DVCs	2018 DVCs	2017 DVCs	2016 DVCs	2015 DVCs	Total DVCs	Total Damage Estimate 2015-2020
$1,001 to $2,500	4,503 (32.6%)	5,234 (35.1%)	5,365 (36.7%)	5,501 (37.3%)	5,157 (38.7%)	6,017 (41.2%)	31,777 (36.9%)	$55,609,750
$2,501 to $5,000	5,615 (40.7%)	6,063 (40.6%)	5,851 (40.0%)	5,917 (40.1%)	5,397 (40.5%)	5,750 (39.4%)	34,593 (40.2%)	$129,723,750
$5,001 to $10,000	3,015 (21.9%)	3,029 (20.3%)	2,826 (19.3%)	2,806 (19.0%)	2,366 (17.7%)	2,456 (16.8%)	16,498 (19.2%)	$123,735,000
$10,001 to $25,000	606 (4.4%)	542 (3.6%)	520 (3.6%)	488 (3.3%)	373 (2.8%)	345 (2.4%)	2,874 (3.3%)	$50,295,000
$25,001 to $50,000	47 (0.3%)	42 (0.3%)	40 (0.3%)	30 (0.2%)	37 (0.3%)	22 (0.2%)	218 (2.5%)	$8,175,000
$50,001 to $100,000	9 (0.1%)	10 (0.1%)	7 (0%)	11 (0.1%)	5 (0%)	4 (0%)	46 (0.1%)	$3,450,000
Over $100,000	0 (0%)	1 (0%)	2 (0%)	4 (0%)	1 (0%)	1 (0%)	9 (0%)	$900,000
Total	13,795	14,921	14,611	14,757	13,336	14,595	86,015	$371,888,500

Hooves characteristic of a deer that survived an EHD infection. The grooves indicate the deer had a high fever. Hunters may see deer with hooves like this during the hunting season. Photo by Moriah Boggess

CHAPTER 6. DEER HEALTH

Moriah Boggess, Olivia Vaught, Mitch Marcus, Emily McCallen, and Julia Buchanan-Schwanke,
Indiana Department of Natural Resources

Epizootic Hemorrhagic Disease

Epizootic hemorrhagic disease (EHD) is a virus spread to white-tailed deer by a biting midge (*Culicoides variipennis).* Often worse in drought years, outbreaks of EHD tend to occur in five- to 10-year cycles. Deer can be reported as sick, dead, or in a group with a sick or dead animal via the Indiana DNR's online Sick or Dead Wildlife Report form (on.IN.gov/sickwildlife) and by calls directly to DNR offices.

In 2020, Indiana DNR received 126 reports of potential EHD cases involving 258 sick or dead deer from 37 counties. Testing for EHD requires fresh samples of the spleen, liver, kidney, or blood, which is not always available. Indiana DNR tests deer to confirm the presence of EHD in a county and not the total number of infected animals. A total of 11 deer from 10 counties were tested, and five (45%) deer from five counties tested positive for EHD. Reports of EHD were clustered in the northwest, northeast, and southeast corners of the state (Figure 6-1).

The spread of EHD in 2020 was less widespread in comparison to the 2019 outbreak that occurred in more than half of the states' counties. Before 2019, the last major outbreak of EHD in Indiana occurred in 2012. A less widespread but significant outbreak occurred in 2013. Maps of deer reported, tested, and confirmed to have EHD are available online (wildlife.IN.gov/8541.htm) and updated daily.

Chronic Wasting Disease

Chronic wasting disease (CWD) is a neurodegenerative disease that affects members of the cervid family, including 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 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 or other material.

Despite considerable ongoing research related to CWD, there is no effective cure or vaccine. CWD is fatal to infected cervids. CWD attacks the animal's brain and causes behavioral changes, excessive saliva production, 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 abnormally thin or weak, 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 December 2020, CWD had been found in wild and captive cervid herds in 26 states, three Canadian provinces, Finland, Norway, South Korea, and Sweden (Richards 2021).

CWD has been detected in white-tailed deer in three states bordering Indiana: in wild and captive deer in Ohio, in wild and captive deer in Michigan, and in wild deer in Illinois (Richards 2021). Ohio confirmed its first case of CWD in a wild white-tailed deer in December 2020. The positive animal was found more than 60 miles from Indiana's eastern border (Ohio Department of Natural Resources 2020). In Michigan, the closest positive white-tailed deer was found approximately 30 miles from the Indiana border (Michigan Department of Natural Resources 2020). Illinois reported 176 new detections of CWD in wild deer during fiscal year 2020 (Dufford and McDonald 2020). The closest CWD cases in Illinois are approximately 25 miles west of the Illinois/Indiana state line.

Each year, Indiana DNR collects tissues 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 for the presence of the disease in Indiana. Sick deer reported by the public are also tested through the statewide CWD surveillance program. Because prions accumulate in the lymph nodes, brain, and spinal cord, CWD is diagnosed by examination of brain or lymphoid tissue from a dead animal.

After the CWD surveillance efforts in northwest and northeast Indiana during the 2019 season (Caudell and Vaught 2020), Indiana DNR returned to those areas during three weekends in November 2020 to conduct targeted CWD surveillance. Biologists were stationed at eight northwest locations throughout Newton, Jasper, Lake, LaPorte, Porter, Pulaski, St. Joseph, and Starke counties, and at five northeast locations throughout Steuben, LaGrange, Noble, and DeKalb counties. Submission of samples for CWD testing was voluntary, and hunters received a metal tag reminiscent of historic confirmation tags for participating.

In addition to the targeted surveillance, hunters interested in having their deer tested for CWD were able to drop off deer heads at any participating Fish & Wildlife Area (FWA), State Fish Hatchery (SFH), or National Wildlife Refuge (NWR) property throughout the season. The heads were later sampled by Indiana DNR. Wildlife biologists and property managers collected routine samples from road-killed and hunter-harvested deer, and biologists responded to calls and online reports about sick deer that were consistent with clinical signs of CWD. People were able to report sick deer online through the Sick or Dead Wildlife Report form. For a fee, hunters could also submit the heads or lymph nodes from their harvested deer to the Animal Disease Diagnostic Lab (ADDL) at Purdue University to be tested.

Samples collected by staff were submitted to approved laboratories and tested using immunohistochemical (IHC) staining procedures. Results were posted online for hunters to access using the confirmation number for that hunter-harvested deer. Any positive deer would have resulted in a phone call to the hunter before the results were posted online.

Totals of 855 hunter-harvested deer, 13 road-killed deer, and 15 targeted deer from Indiana were tested statewide in 2020 (Table 6-1). To date, no wild deer from Indiana have tested positive for CWD. The CWD detectability rates were calculated for each of the 11 targeted surveillance counties and non-target counties (Figure 6-2) based on sampling intensity. The detectability provides us with a calculated prevalence of CWD in free-ranging deer for which there is a 95% probability that the true prevalence falls below. It represents the percent for which CWD must be present in the free-ranging deer population in order for that season's surveillance efforts to have the ability to detect the disease. For example, if CWD is present in the deer population in Steuben County, there is a 95% chance that it occurs in less than 1.42% of the population (Jennelle, et al. 2018) based on our sampling efforts. The ability to detect the disease ranged from 1.27% to 9.30% in the northwest targeted area and from 1.42% to 4.71% in the northeast targeted area (Table 6-2).

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 2021, a total of 4,144 wild hunter-harvested white-tailed deer were sampled in the bTB surveillance zones, and none of those deer tested positive for the disease (Caudell and Vaught 2017, Caudell and Vaught 2018, Caudell and Vaught 2019).

In addition to testing hunter-harvested deer, small mammals and deer have been sampled for bTB on the affected 2016 cattle farm or from lands within a 1.5-mile radius of that farm since 2017. In 2020, U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (USDA-APHIS-WS) collected 117 raccoons, 13 opossums, three groundhogs and one skunk from that area as targeted clean-up. As of early 2021, the total number of non-hunter-harvested deer and small mammals sampled in that area is 111 deer, 180 raccoons, 33 opossums, three ground hogs, and one skunk. One wild raccoon tested positive for bTB in 2017. Another wild raccoon tested positive for bTB in 2020 (Caudell and Vaught 2018, Caudell and Vaught 2019, Caudell and Vaught 2020).

To date, all wild deer sampled through hunter-harvest surveillance, disease permits, and USDA-APHIS-WS targeted clean-up have tested negative for bTB. Additionally, all sampled wild deer exhibiting signs of potential bTB infection have tested negative for bTB. These results suggest that the prevalence of bTB in wild deer in the Franklin County surveillance zone is at a level difficult to detect and is likely very low to non-existent. As a result, Indiana DNR did not conduct intensive bTB surveillance in Fayette and Franklin counties during the 2020-2021 deer hunting season.

Automated Deer Disease Report Form

Anyone can report sick or dead deer directly to Indiana DNR through the online Sick or Dead Wildlife Report form (on.IN.gov/sickwildlife) This form is useful for tracking reports of sick deer with clinical signs consistent with diseases of interest, such as EHD and CWD. The person who reports a deer showing clinical signs of EHD, CWD, or other diseases of potential concern receives a phone call from a wildlife biologist or technician to verify the clinical signs and lack of obvious injury, assess if the animal's location is still known, and determine whether to collect a sample or submit the animal for testing if necessary.

Literature Cited

Caudell, J. N., and O. D. L. Vaught. 2017. 2016 Indiana White-tailed Deer Report. Indiana Department of Natural Resources, Bloomington, USA.

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. 2019. 2018 Indiana White-tailed Deer Report. Indiana Department of Natural Resources, Bloomington, USA.

Caudell, J. N., and O. D. L. Vaught. 2020. 2019 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.

Dufford, D. and P. McDonald. 2020. Illinois Chronic Wasting Disease (CWD): 2019-2020 Surveillance and Management Report. Illinois Department of Natural Resources, Wildlife Disease Program, Springfield, 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 surveillance approach to detect chronic wasting disease in deer. Journal of Applied Ecology 55:2944-2953.

Michigan Department of Natural Resources. 2021. 2020 CWD Testing Results as of January 29, 2021. Michigan Department of Natural Resources, Lansing, USA. https://www.michigan.gov/dnr/0,4570,7-350-79136_79608_90516_90536-538324--,00.html.

Ohio Department of Natural Resources. 2020. Tissue Sample Confirmed Positive for Chronic Wasting Disease in One Wild Ohio Deer. 14 December 2020. https://ohiodnr.gov/wps/portal/gov/odnr/discover-and-learn/safety-conservation/about-odnr/news/confirmed-positive-cwd-in-one-ohio-wild-deer.

Richards, B. 2021. Distribution of chronic wasting disease in North America, 2021 update. https://www.usgs.gov/centers/nwhc/science/expanding-distribution-chronic-wasting-disease?qt-science_center_objects=0#qt-science_center_objects.

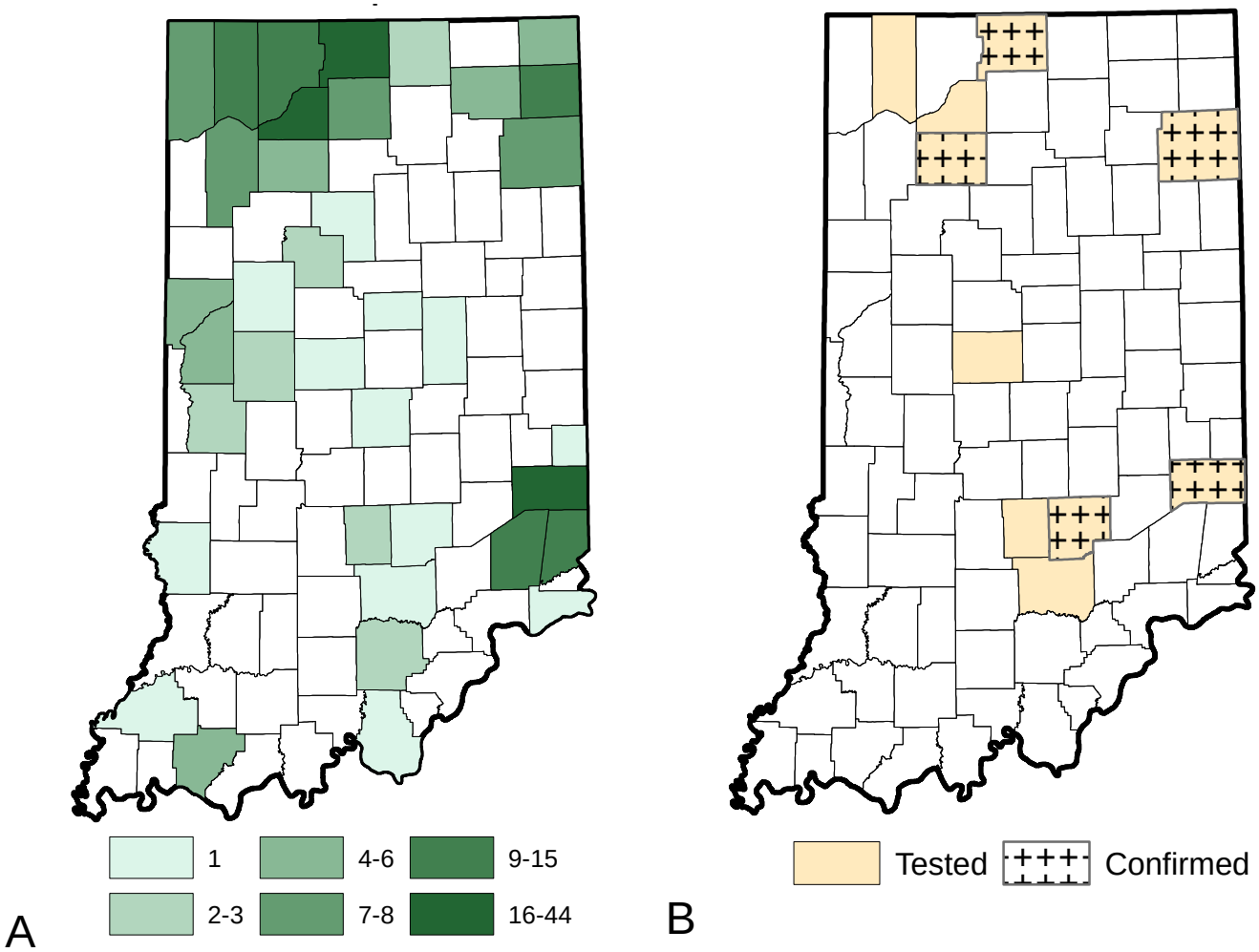

Figure 6-1. A) Number of deer reported as suspect of EHD in each county in 2020. B) Counties in which deer were tested for EHD, and counties in which EHD was confirmed in 2020.

Table 6-1. Results of CWD surveillance by county during Indiana's 2020-2021 deer hunting season.

County	Hunter-Harvested Samples	Road Killed Samples	Targeted Deer	Opportunistic Samples	Total Samples	County	Hunter-Harvested Samples	Road Killed Samples	Targeted Deer	Opportunistic Samples	Total Samples
Adams	0	0	0	0	0	Lawrence	1	2	2	5	10
Allen	3	0	2	0	5	Madison	0	0	1	0	1
Bartholomew	2	0	1	0	3	Marion	0	0	0	0	0
Benton	0	0	0	0	0	Marshall	12	0	0	0	12
Blackford	0	0	0	0	0	Martin	0	0	0	1	1
Boone	0	0	1	0	1	Miami	0	0	0	0	0
Brown	0	0	0	0	0	Monroe	5	1	0	0	6
Carroll	1	0	0	0	1	Montgomery	0	0	0	0	0
Cass	1	0	0	0	1	Morgan	0	0	0	0	0
Clark	0	0	0	0	0	Newton	19	0	1	1	21
Clay	0	0	0	0	0	Noble	58	0	2	0	60
Clinton	0	0	0	0	0	Ohio	0	0	0	0	0
Crawford	0	0	0	0	0	Orange	0	0	0	0	0
Daviess	1	1	0	0	2	Owen	0	0	0	0	0
Dearborn	0	0	0	0	0	Parke	2	0	0	0	2
Decatur	0	0	0	0	0	Perry	0	0	0	0	0
Dekalb	89	2	0	0	91	Pike	5	3	0	0	8
Delaware	0	0	0	0	0	Porter	67	0	0	1	68
Dubois	2	0	0	0	2	Posey	6	0	0	0	6
Elkhart	13	0	0	0	13	Pulaski	62	1	0	2	65
Fayette	0	0	0	0	0	Putnam	4	0	0	0	4
Floyd	0	0	0	0	0	Randolph	0	0	0	0	0
Fountain	2	0	0	0	2	Ripley	19	0	0	0	19
Franklin	0	0	1	0	1	Rush	1	0	0	0	1
Fulton	10	0	0	0	10	Saint Joseph	52	0	0	0	52
Gibson	1	0	0	0	1	Scott	0	0	0	0	0
Grant	0	0	0	0	0	Shelby	0	0	0	0	0
Greene	2	0	1	0	3	Spencer	1	0	0	0	1
Hamilton	1	0	0	0	1	Starke	44	1	0	1	46
Hancock	0	0	0	0	0	Steuben	124	0	0	1	125
Harrison	0	0	0	0	0	Sullivan	3	0	0	0	3
Hendricks	0	0	0	0	0	Switzerland	0	0	0	0	0
Henry	1	0	0	0	1	Tippecanoe	0	0	0	0	0
Howard	0	0	0	0	0	Tipton	0	0	0	0	0
Huntington	1	0	0	0	1	Union	0	0	0	0	0
Jackson	1	0	1	0	2	Vanderburgh	0	0	0	0	0
Jasper	32	0	1	0	33	Vermillion	0	0	0	0	0
Jay	0	0	0	0	0	Vigo	1	0	0	0	1
Jefferson	10	0	0	0	10	Wabash	0	0	0	0	0
Jennings	9	0	0	0	9	Warren	0	0	0	0	0
Johnson	0	0	1	0	1	Warrick	2	1	1	0	4
Knox	0	0	0	0	0	Washington	0	0	0	0	0
Kosciusko	4	0	0	0	4	Wayne	1	0	0	0	1
Lagrange	37	0	0	0	37	Wells	3	0	0	0	3
Lake	15	1	0	0	16	White	1	0	0	0	1
LaPorte	117	0	0	1	118	Whitley	3	0	0	0	3

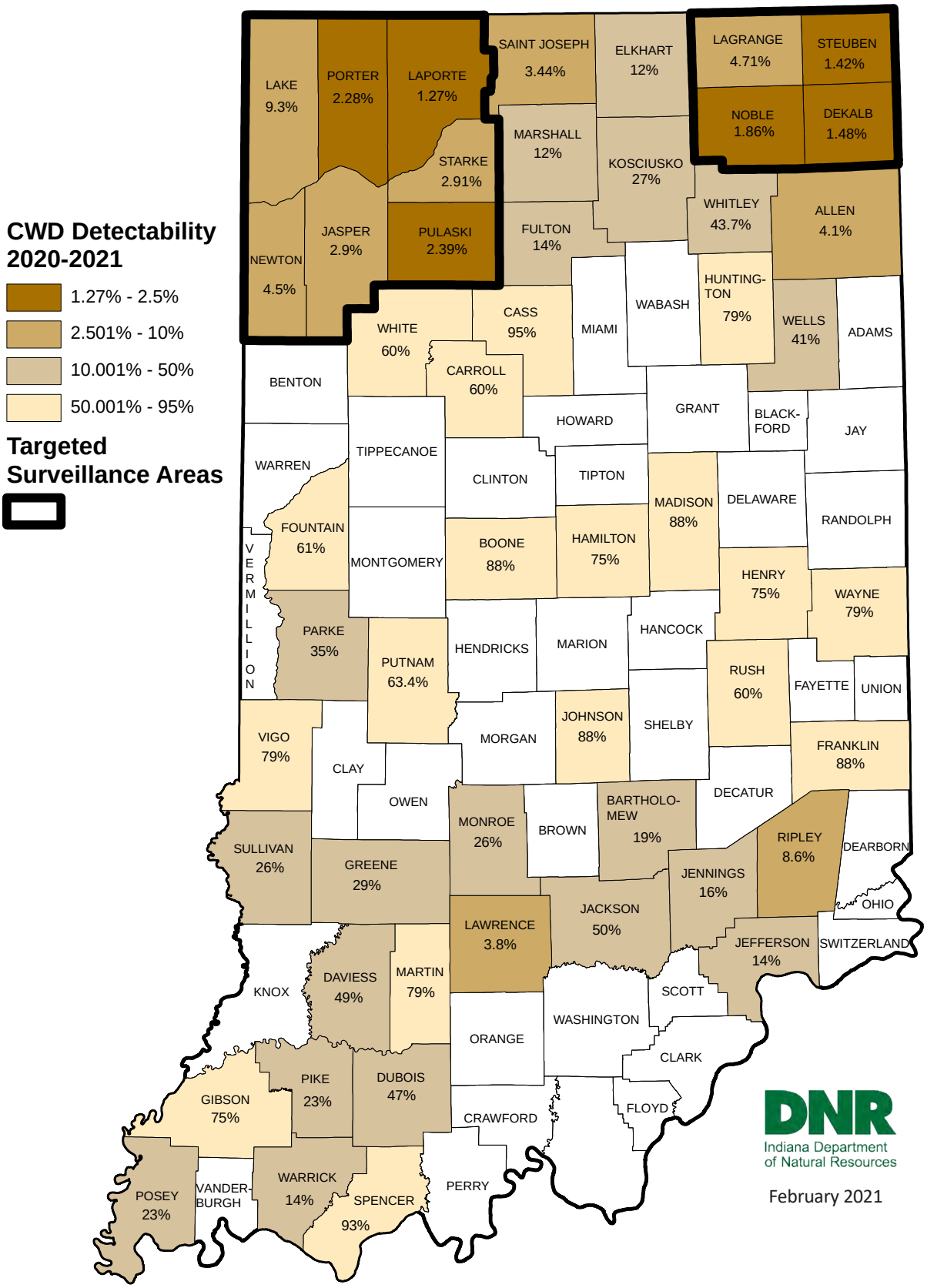

Figure 6-2. Statewide CWD detectability rates for the 2020-2021 deer hunting season. Based on sampling intensity, detectability provides the rate for which there is a 95% probability the true prevalence falls below. For example, if CWD is present in the deer population in Steuben County, there is a 95% chance that the disease occurs in less than 1.42% of the population (Jennelle et al. 2018) based on our sampling efforts. CWD samples were not collected from counties with no detectability rate during 2020. Thick black outlines indicate the 2020 CWD targeted surveillance areas.

Table 6-2. CWD detectability rates for the 2020-2021 CWD surveillance areas in northwest and northeast Indiana compared to the 2018-2019 and 2019-2020 seasons. Percentages are the level for which CWD must be present in the population in order for that season's surveillance efforts to have the ability to detect the disease. Each CWD surveillance season varied in effort and samples collected.

	CWD Detectability		
County	2018-2019	2019-2020	2020-2021
Northwest Indiana			
JASPER	2.29%	5.10%	2.90%
LAKE	3.19%	2.59%	9.30%
LAPORTE	3.26%	1.53%	1.27%
NEWTON	1.94%	4.52%	4.50%
PORTER	1.63%	2.66%	2.28%
PULASKI	1.88%	1.72%	2.39%
STARKE	2.45%	4.70%	2.91%
Northeast Indiana			
DEKALB	18.00%	1.50%	1.48%
LAGRANGE	2.90%	1.70%	4.71%
NOBLE	5.10%	2.06%	1.86%
STEUBEN	1.31%	1.64%	1.42%

CHAPTER 7.
DEER MANAGEMENT SURVEY

Moriah Boggess, Olivia Vaught, and Emily McCallen,
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 DNR. These data are used to set harvest regulations and to examine the potential effect of proposed regulatory changes. Since 2018, Indiana DNR has administered the Deer Management Survey to provide a convenient method for any interested hunter or non-hunter to share their opinions.

The Deer Management Survey consists of a core set of questions that remain the same every year to collect longitudinal data, with additional sets of unique questions that change each year to address emerging issues in state deer management. In the 2021 Deer Management Survey, the Indiana DNR asked several questions designed to assess opinions and/or gather data about hunter willingness to provide Indiana DNR with data on their harvested deer, landowner interest in technical assistance to manage their land for deer, hunting property use, the Special Antlerless Firearms season, furbearer hunting, and firearm muzzle energy. 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 is 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).

Here we report the results of the 2021 Deer Management Survey on these topics. 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 online Deer Management Survey Dashboard available at wildlife.in.gov/wildlife-resources/animals/white-tailed-deer/deer-management-survey-results/. The Special Antlerless Firearms season questions are reported in Chapter 9, and questions regarding furbearer hunting will be reported in a furbearer harvest summary report that will be available online at wildlife.IN.gov/wildlife-resources/wildlife-and-fisheries-reports/.

Methods

The 2021 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 residents and non-residents who had purchased any type of hunting, trapping, or fishing license in the last five years; anyone who checked in a deer in the last five years; and anyone who created an electronic account with Indiana DNR for other reasons (such as obtaining the survey). Because lifetime license holders and landowner hunters 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 underrepresented in the survey. Survey invitations were distributed by GovDelivery, a mailing subscription service, in February and March 2021. Descriptive statistics were generated using Program R.

Results and Discussion

General Demographics of Respondents

The 2021 Deer Management Survey was sent to 346,048 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 within the past five years, all of which were dependent upon the individual providing a valid email. Out of the surveys successfully sent, 26,012 surveys were started for a response rate of 7.5% (Table 7-1). 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.

When residents of Indiana were asked ***Do you***

consider yourself a deer hunter even if you did not hunt during the 2020-2021 deer hunting season, 20,775 residents indicated they were deer hunters while 2,335 residents indicated they were not deer hunters. Of the Indiana hunters, 18,340 hunted during the 2020-2021 deer season (i.e., were active resident hunters). An additional 2,252 did not hunt in the past season but still wanted to provide input on deer around where they live in Indiana (i.e., were inactive resident hunters). Of the non-hunting Indiana residents, 1,983 wanted to provide input on deer management where they live (i.e., were resident non-hunters; Table 7-2). Of the non-residents who responded to the survey, 1,348 self-identified as being a hunter, and 1,210 reported they hunted during the 2020-2021 deer hunting season (i.e., were active non-resident hunters; Table 7-2).

Indiana hunters were asked about where they lived and hunted. Of the 17,911 hunters who responded, the most common responses were: *I hunt mostly in the county that I live in, but I also occasionally hunt in other counties* (30.2%) *and I hunt only in the county that I live in* (30.0%). These were followed by *I never hunt in the county that I live in*; *I only hunt deer in a different county* (22.8%). The remaining 17.0% *occasionally hunt in the county that I live in*, *but mostly hunt in other counties*.

We 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***. A total of 19,155 hunters reported the number of total years they had been a deer hunter. Most (64.4%) reported they had been a hunter for more than 20 years total, followed by 18.1% who reported 10-20 years deer hunting experience, 8.2% who reported 6-10 years hunting, 7.0% who reported 2-5 years hunting, and just 2.6% who reported that this was their first year hunting deer. A total of 19,133 hunters reported the number of years they had hunted in Indiana. Most (55.1%) reported they had hunted deer in Indiana for more than 20 years, followed by 19.7% who reported 10-20 years of deer hunting in Indiana, 10.3% who reported 6-10 years hunting deer in Indiana, 10.5% who reported 2-5 years hunting in Indiana, and 4.5% who reported that this was their first year hunting deer in Indiana.

Respondents were asked to report all types of equipment they used during the 2020-2021 deer season. A total of 19,487 hunters reported which type of equipment they used to hunt deer. The most common responses were high-powered rifles (52.3% of hunters), crossbows (39.9%), compound bows (38.5%), modern in-line muzzleloaders (36.6%), and shotguns (29.0%). Few respondents indicated that they used pistol-caliber rifles or other low-powered rifles (13.5%). Hunters used traditional muzzleloaders (7.8%), handguns (4.6%), traditional bows (2.1%), or modern recurve bows (0.9%) less often.

We asked hunters to select which license(s) they used in the 2020-2021 deer hunting season. A total of 19,364 hunters reported which license they used to hunt deer. The most commonly reported answer was the license bundle (49.1% of hunters) followed by the lifetime license (21.4%), firearms license (13.1%), and landowner exemption (12.6%). Few hunters used archery (7.6%), bonus antlerless (6.6%), crossbow (4.1%), deer reduction zone (3.9%), muzzleloader (2.9%), youth (1.1%), or military exemption (0.3%) licenses.

We asked hunters to report how many deer they wanted to harvest in the 2020-2021 deer hunting season by selecting from harvest combinations that included both bucks and does. A total of 19,285 hunters responded to this question. Most respondents (76.3%) wanted to harvest a buck. The most common combination was one buck and one doe (29.8%), followed by one buck and two does (22.0%) and just a single buck (18.6%). Very few individuals wanted to harvest one buck and three does (3.9%) or one buck and more than three does (2.1%). In total, just under a quarter of hunters wanted to hunt a number of deer regardless of its sex (one deer 6.5%, two deer 8.4%, three deer 4.8%, four deer 1.1%, and more than four deer 1.2%). Only 1.7% reported wanting to harvest only a single doe.

Perceptions about Deer Populations and Management

Both hunters and non-hunters responded to a series of questions about deer population sizes and how harvest should change. Hunters were asked ***How would you like to see the County Bonus Antlerless Quota change next year in [County] for the 2020-2021 deer hunting season?*** To avoid using terminology they may be unfamiliar with, non-hunters were asked ***How***

would you like to see the number of does that can be harvested by hunters change in the next year in [County]? (Figure 7-1). Hunters were asked ***Please describe the size of the deer population in [County] during the 2020-2021 deer hunting season*** (Figure 7-2), ***How does the number of deer you saw in [County] during the 2020-2021 deer hunting season compare to the number you saw five years ago?*** (Figure 7-3), and ***How would you like to see the number of deer change in the next five years in [County]?*** (Figure 7-4). County-specific results for hunters are presented online in the Indiana DNR Deer Management Survey Dashboard (wildlife.in.gov/wildlife-resources/animals/white-tailed-deer/deer-management-survey-results/).

In the 2021 survey, asked about how quotas should change, most hunters and non-hunters thought quotas should be maintained (54.5% and 53.6%, respectively; Figure 7-1). Hunters' perceptions about the deer population were skewed toward the low side, with 38.0% responding that it was low, and 18.1% believing that it was too low (Figure 7-2). Responses from non-hunters were normally distributed, with most indicating their perception of the population is about right (48.3%). Both hunter and non-hunter perceptions have remained largely stable since 2018.

Asked about how the deer population *had changed* over the last five years, most hunters thought it was substantially, moderately, or slightly decreasing (28.0%, 17.2%, and 17.8%, respectively) or being maintained (17.7%). Most non-hunters thought it was being maintained (26.9%) or increasing slightly (16.8%) (Figure 7-3). Both hunter and non-hunter perceptions have remained largely stable since 2018. Asked about how deer populations *should change* over the next five years, most hunters thought populations should increase to some degree (78.7%). Another 16.3% thought populations should be maintained. Responses from non-hunters were normally distributed, with most indicating the perception that the population should be maintained (36.0%; Figure 7-4).

Hunters were asked a few attitudinal questions to rate their hunting satisfaction and experience. Hunters were asked, ***How do you think the total deer harvested in this hunting county has changed compared to five years ago?*** (Figure 7-5). Most hunters reported that they thought total deer harvest had decreased (56.7%). An additional 22.9% reported they thought there was no change. Hunters were asked, ***How does the number of deer you harvested in this hunting county in the most recent season compare to five years ago?*** (Figure 7-6). Most hunters thought there was some degree of decrease (56.2%). Over a third of respondents (35.2%) thought there was no change. Hunters were also asked to ***describe the QUALITY of the bucks in this hunting county during the most recent deer hunting season*** (Figure 7-7). Most (51.5%) hunters thought the bucks were of average quality, followed by low quality (27.4%).

Respondents were also asked about attitudes toward management, including ***On a scale of 0 (terrible) to 100 (excellent), how would you rate the job the Indiana DNR is doing managing deer STATEWIDE?*** (Figure 7-8). Non-hunters rated the DNR 77.9 on average while hunters rated it 69.9 on average out of 100. Both non-hunters and hunters were asked the same question about how well Indiana DNR is doing managing deer in their county (Figure 7-9). On average, non-hunters rated the DNR at 78.2, while hunters rated the DNR at 68.5 out of 100. Over the past four years, hunters have indicated significant improvement in how well they think DNR is managing deer in their county, while non-hunters have remained consistent.

Finally, hunters were asked, ***On a scale of 0 (no enjoyment) - 100 (great enjoyment), how would you rate your overall enjoyment of your hunting experience during the 2020-2021 deer hunting season?*** (Figure 7-10). On average, this rating has remained largely steady over the past few years. Hunters rated their enjoyment, on average, at 81.1 out of 100.

Deer Data Collection for DNR

Indiana DNR is interested in collecting information from hunter-harvested deer to help improve our understanding of the deer population in Indiana. Hunters were asked how likely they were to provide DNR with the live weight of deer, the field-dressed weight of deer, the lactation status of does, or antler measurements of bucks they harvest (Figure 7-11). Most hunters (82.6%) were likely to provide antler measurements of bucks followed by recording the field-dressed weight of deer (76.4%) and providing the lactation status of does (65.1%).

The DNR may offer incentives for collecting up to five different types of data from harvested deer. Hunters were asked, ***What incentive is most preferable if you complete all five of the above activities for a deer?*** (Figure 7-12). Over 40% of hunters said no incentive was needed to complete all the activities, while 34.0% preferred a deer program hat. A metal band (14.7%), deer program patch (5.1%), and deer program magnet (4.6%) were the least preferred.

Private Property for Hunting

Hunters were asked to describe the private property where they primarily hunt deer to assess its size and use. A majority of hunters (62.5%) have been given permission to hunt for free on the property where they hunt deer (Figure 7-13). Another 21.4% indicated they are the sole owner of the property. Fewer hunters responded that they own the property jointly with others (8.1%), the property is leased and they share hunting privileges with other listed lessees (6.4%), or the property is leased and they are the only person named on the lease for hunting (1.7%).

Hunters were asked about the total acreage of the primary and secondary private properties where they hunt deer (Figure 7-14). Most property sizes fell within 20 to 49 acres (21.9%) and 50 to 99 acres (21.4%). Fewer properties were 5 to 19 acres (17.6%) or 100 to 199 acres (17.8%). The remaining responses were split among 200 to 319 acres (8.1%), 320 to 640 acres (4.9%), less than 5 acres (3.8%), and more than 640 acres (3.1%). Hunters were then asked, ***How many acres have permanent cover (e.g., forest, shrubland, woody or shrubbed wetland, CRP, etc.)?*** (Figure 7-15). Permanent cover ranged from 5 to 19 acres (28.8%), 20 to 49 acres (27.1%), and 50 to 99 acres (22.0%) on most properties. Over 12% of properties had less than 5 acres of permanent cover while 5.3% had 200 to 319 acres, 1.3% had 320 to 640 acres, and 0.6% had more than 640 acres.

Hunters were asked, ***Approximately how many deer were harvested on this property during this last deer season? (Figure 7-16) and Approximately how many individuals (including yourself) have permission to hunt the private property on which you primarily hunt deer?*** (Figure 7-17). On most properties, hunters harvest 1 to 5 deer (69.5%). Only 1.2% harvested more than 11 deer on the property. A majority of hunters reported that 2 (25.3%) or 3 (22.9%) hunters have permission to hunt on the private property they primarily hunt. Several hunters (15.0%) indicated they were they only person hunting the property, and nearly 20% said more than 5 people have permission to hunt the property.

Hunters were asked about additional uses of the properties where they hunt deer (Figure 7-18). Hunters were able to choose multiple answers from a list. Nearly 49% of hunters said the properties they hunt were private residences, followed by 46.7% used for row crop agriculture, 42.3% used for turkey hunting, and 40.3% used for small game hunting. Other outdoor recreation (26.5%), tree farm or timber harvesting (14.8%), and cattle/other livestock (12.9%) were also popular uses.

The final set of questions related to hunted properties was about management decisions on the property. Hunters were asked, ***Which of the following describes how decisions are made about land use for this property?*** (Figure 7-19). In 40% of surveys, hunters reported another person is the sole decision maker for the property. Fewer (17.7%) reported another person(s) considers my input, but they have the final say, and 15.2% said I am the sole decision maker. Other answers included, Another person(s) and I have about equal say (12.7%) and I consider input from other people, but I make the final decision myself (8.2%).

A follow-up question asked, ***Which of the following describes how decisions are made about deer management for this property?*** (Figure 7-20). Compared to the previous question, fewer hunters (22.7%) responded that another person(s) is the sole decision maker. Over 21% of hunters said they are the sole decision maker while 18.5% said another person(s) and I have about equal say, 17.2% said another person(s) considers my input, but they have the final say, and 11.9% said I consider the input from other people, but I make the final decision myself.

The final question about properties used for deer hunting asked, ***How important do you consider each of the following goals when making decisions about deer management on this property?*** (Figure 7-21). Improving habitat quality for deer, increasing the number of deer sightings, and improving the quality of bucks each were considered to be moderately

or extremely important goals by 80% of hunters. Fewer hunters (57.0%) felt maximizing year-to-year harvest was a moderately or extremely important goal, and almost 30% reported reducing tree or crop damage was not an important goal at all.

Technical Assistance

The Indiana DNR is interested in collecting deer harvest information from hunters and/or land managers in exchange for technical assistance. Hunters were asked how likely they were to enroll in a program that required elements in exchange for different forms of technical assistance to help them meet their deer management goals (Figure 7-22). Of the eight elements, most hunters were willing to some degree to record deer/wildlife observations while hunting on their hunting property, with 53% being moderately or extremely likely. Similarly, hunters were just as willing to record antler measurements of all bucks harvested on the property they hunt. Slightly fewer hunters were willing to record field-dressed weights of all deer harvested, conduct trail camera surveys on the property, or record the lactation status of all does harvested. A total of 57.9% of hunters said they were not at all likely to pay a nominal fee for exclusive program benefits or consultation.

Indiana DNR may provide different types of technical assistance to hunters and/or land managers in exchange for data from deer harvested on a property. Hunters were asked how likely they were to enroll in a program that offered various benefits in exchange for data submission of harvested deer (Figure 7-23). Hunters were most likely to some degree to enroll in a program if the benefit was age estimates of harvested deer (somewhat likely – 34.8%, moderately likely – 24.1%, extremely likely – 12.8%). The next two most likely benefits were annual deer harvest report for the property (somewhat likely – 30.1%, moderately likely – 19.4%, and extremely likely – 14.1%) and additional antlerless tags to meet management objectives (somewhat likely – 27.5%, moderately likely – 18.5%, and extremely likely – 12.0%). Six of the eight possible benefits each received responses of not at all likely from over 40% of hunters.

Deer Management Cooperatives

Deer hunters and/or land managers with similar goals for deer management on their properties often develop deer management cooperatives with their neighbors. Joining or developing a local deer management cooperative improves deer management on the local landscape as all cooperators work together toward common goals. Indiana DNR gauged hunters' experience with deer management cooperatives (Figure 7-24). Nearly equal proportions of hunters said they knew about deer management cooperatives but had never been involved in one (45.9%) or they had never heard of a deer management cooperative before this (45.8%). Very few hunters were actively involved in a deer management cooperative (3.2%) or had been involved in one in the past (2.3%).

License for License-exempt Hunters

The Indiana DNR receives federal funds for each hunting license sold. License-exempt hunters were asked, ***How willing would you be to purchase a $5 license that results in the Indiana DNR receiving an additional $15 from the federal government that can only be used for bird and mammal management in the state?*** (Figure 7-25). Most hunters (29.9%) were somewhat willing while 23.0% were neither willing nor unwilling and 20.9% were extremely willing. About 15% of hunters were extremely unwilling to purchase a license.

Firearm Muzzle Energy, Caliber, and Gauge

Indiana DNR was interested in hunter opinions about the minimum acceptable muzzle energy for rifles, pistols, muzzleloaders, and shotguns required to shoot a deer in the chest (heart and lung shot) that is 100 yards away (Figure 7-26). On average, hunters reported the minimum acceptable muzzle energy was 1,442 ft-lb for rifles, 922 ft-lb for pistols, 1,261 ft-lb for muzzleloaders, and 1,305 ft-lb for shotguns. Hunters were also asked about the minimum acceptable caliber for a rifle to shoot a deer in the chest that is 100 yards away (Figure 7-27). The average response for rifles was 0.26 inches and 0.38 inches for pistols. Finally, hunters were asked about the minimum acceptable gauge for a shotgun to shoot a deer in the chest that is 100 yards away (Figure 7-28). Most hunters (57.4%) chose the 20 gauge as the minimum acceptable gauge while 30.0% reported the .410 bore, and 12.5% reported the 12 gauge. Only numeric responses within reasonable bounds were included in this analysis. These estimates may be biased toward the equipment hunters use themselves or the current minimum hunting regulations.

Table 7-1. Number of surveys sent, surveys started, and the response rate for the Indiana Deer Management Survey from 2018 to 2021.

	2018	2019	2020	2021
Surveys Sent	269,389	370,986	469,044	346,048
Surveys Started	23,283	33,987	30,078	26,012
Response Rate	8.60%	9.20%	6.40%	7.50%

Table 7-2. Respondent classification types and number of individuals by type who responded to the Deer Management Survey from 2018 to 2021.

Type	Description	Question Type	2018	2019	2020	2021
Active Nonresident Hunters	Nonresident Indiana deer hunters who hunted during the most recent deer season	County where they hunt	676	1,318	1,066	1,210
Active Resident Hunters	Resident Indiana deer hunters who hunted during the most recent deer season	County where they hunt and county where they live (when they differ)	14,839	22,604	16,894	18,340
Inactive Resident Hunters	Resident Indiana deer hunters who did not hunt during the most recent deer season	County where they live	2,757	3,859	3,528	2,252
Resident Nonhunters	Indiana residents who are not deer hunters	County where they live	2,341	2,573	3,707	1,983
Invalid Responses	Participants who were not qualified to take the survey (nonresident nonhunters) and participants who did not answer enough questions to be categorized	None	2,675	3,633	4,883	2,227
Total Reported	Total sample included for data analysis	All	20,613	30,354	25,195	23,785

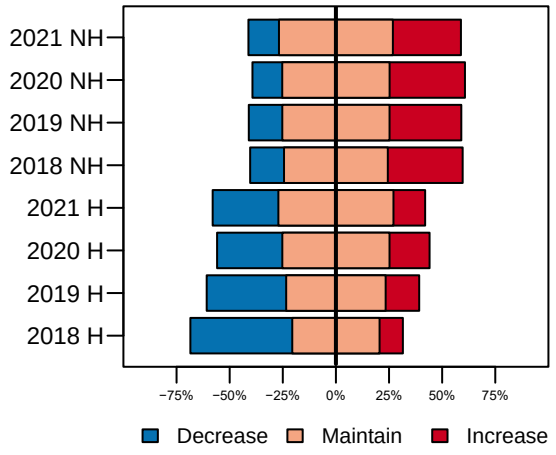

Figure 7-1. Opinion on how the County Bonus Antlerless Quota should change from hunters (H) and non-hunters (NH).

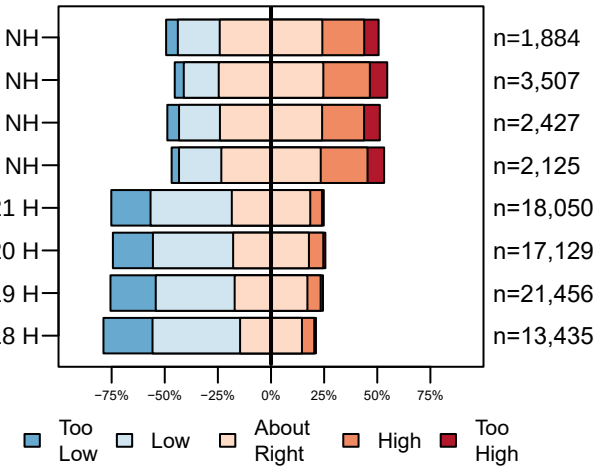

Figure 7-2. The current size of the deer population described by hunters (H) and non-hunters (NH).

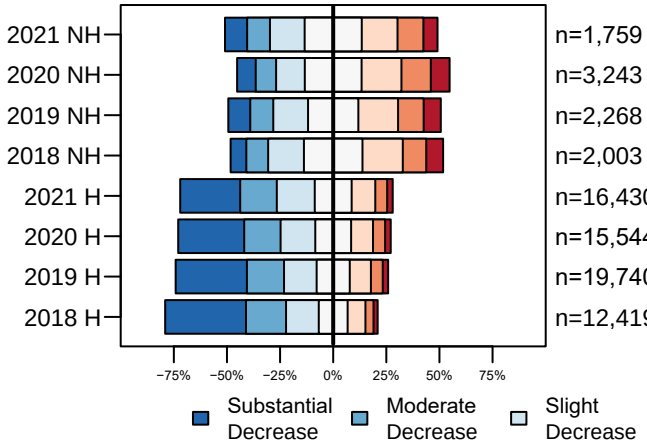

Figure 7-3. The number of deer seen compared to five years ago described by hunters (H) and non-hunters (NH).

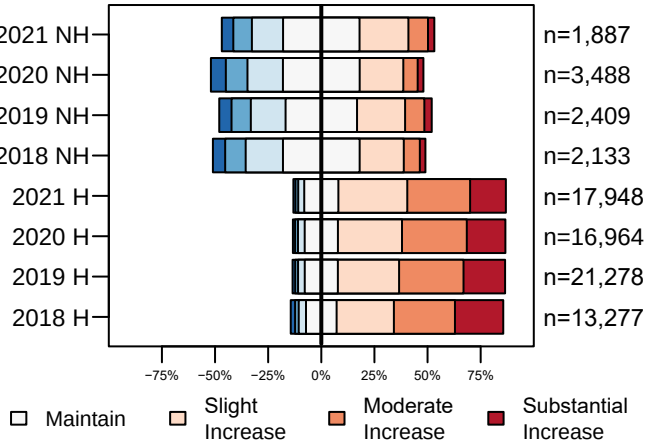

Figure 7-4. The desired change in the size of the deer population described by hunters (H) and non-hunters (NH).

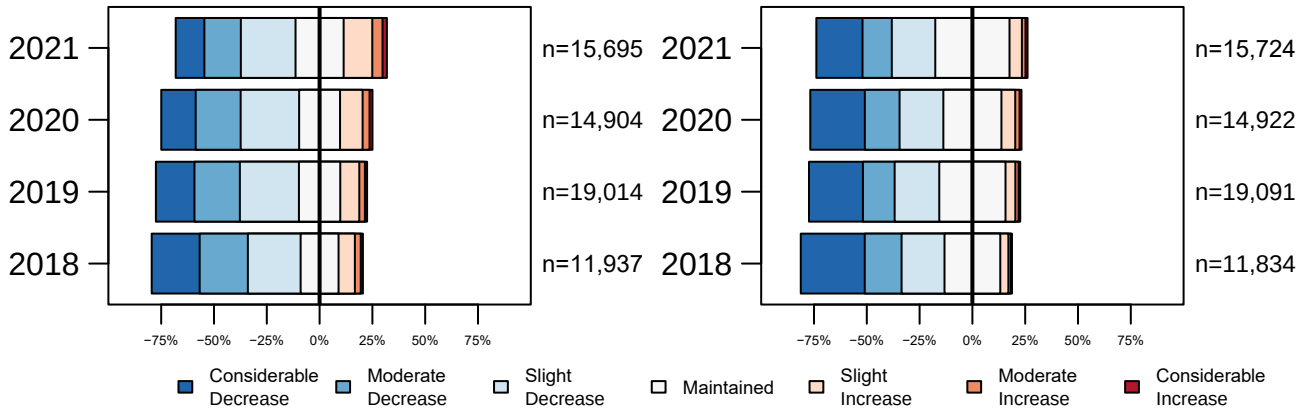

Figure 7-5. Opinion of hunters on how the total number of harvested deer has changed over the last five years.

Figure 7-6. Opinion of hunters on how their personal number of harvested deer has changed over the last five years.

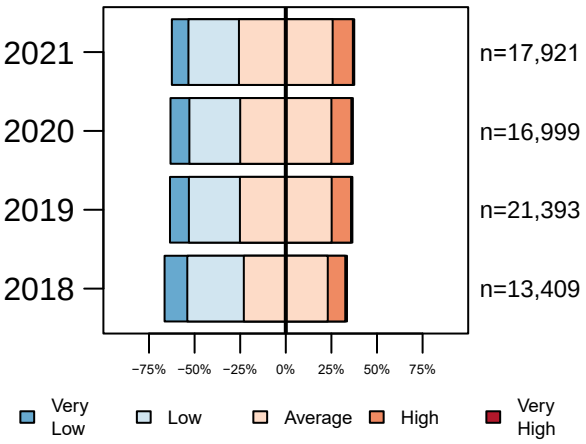

Figure 7-7. Hunters describe the quality of bucks in the county where they hunt.

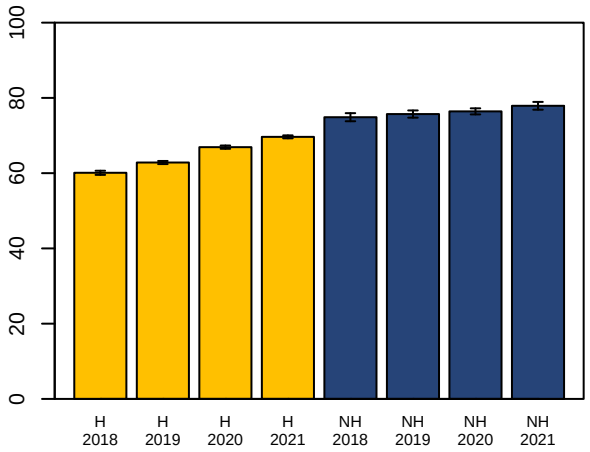

Figure 7-8. Hunters (H) and non-hunters (NH) were asked to score Indiana DNR's statewide deer management on a scale of 0 (poor) to 100 (excellent).

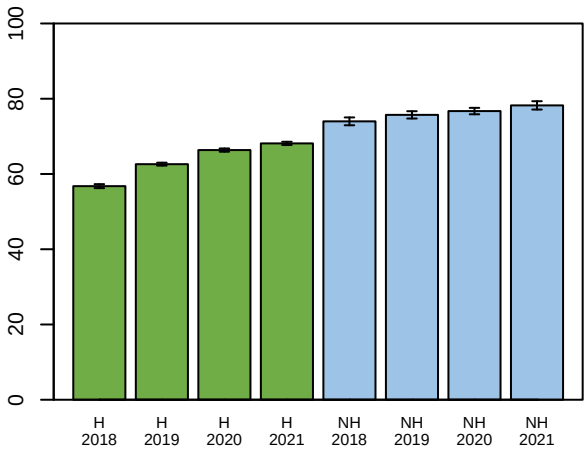

Figure 7-9. Hunters (H) and non-hunters (NH) were asked to score Indiana DNR's county deer management on a scale of 0 (poor) to 100 (excellent).

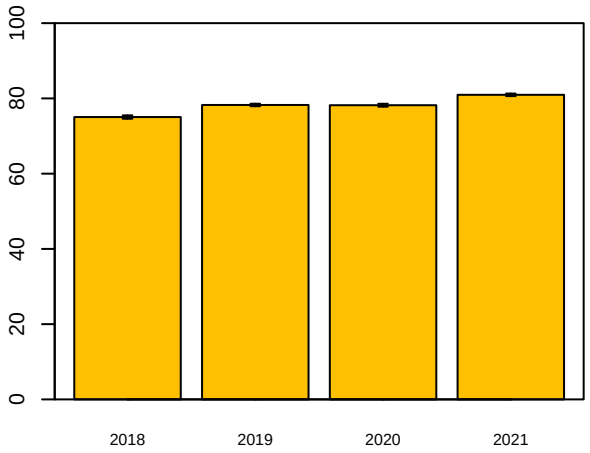

Figure 7-10. Hunters were asked to score their hunting experience on a scale of 0 (no enjoyment) to 100 (great enjoyment).

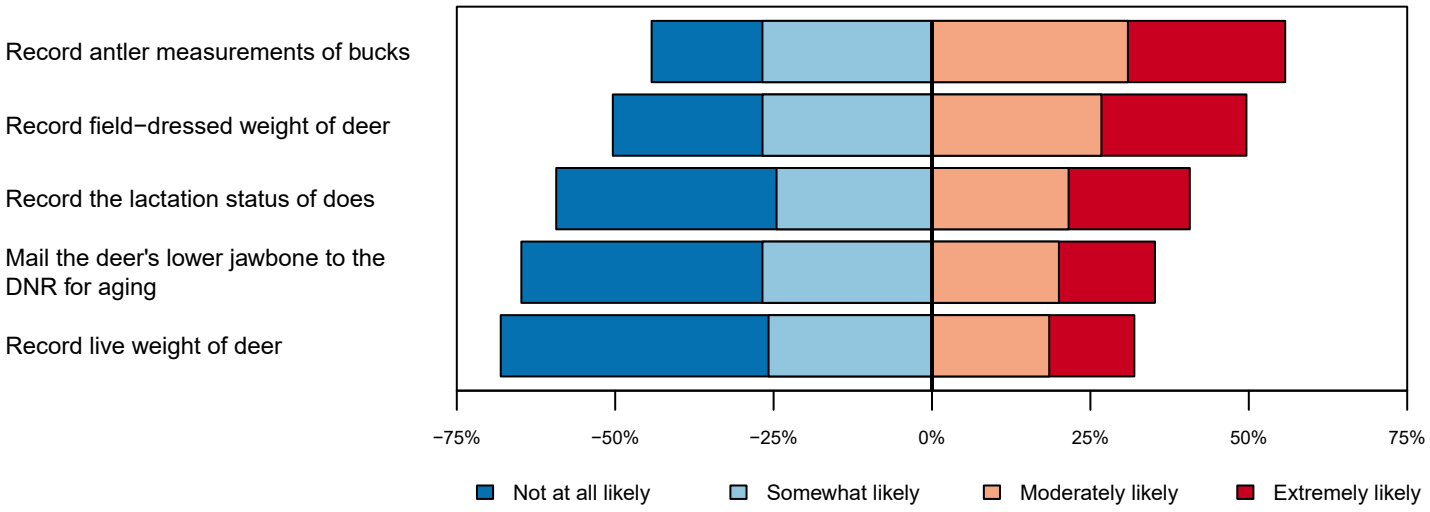

Figure 7-11. Hunters in Indiana were asked how likely they are to provide the DNR with different types of information to help us improve our understanding of the deer population (n=16,769).

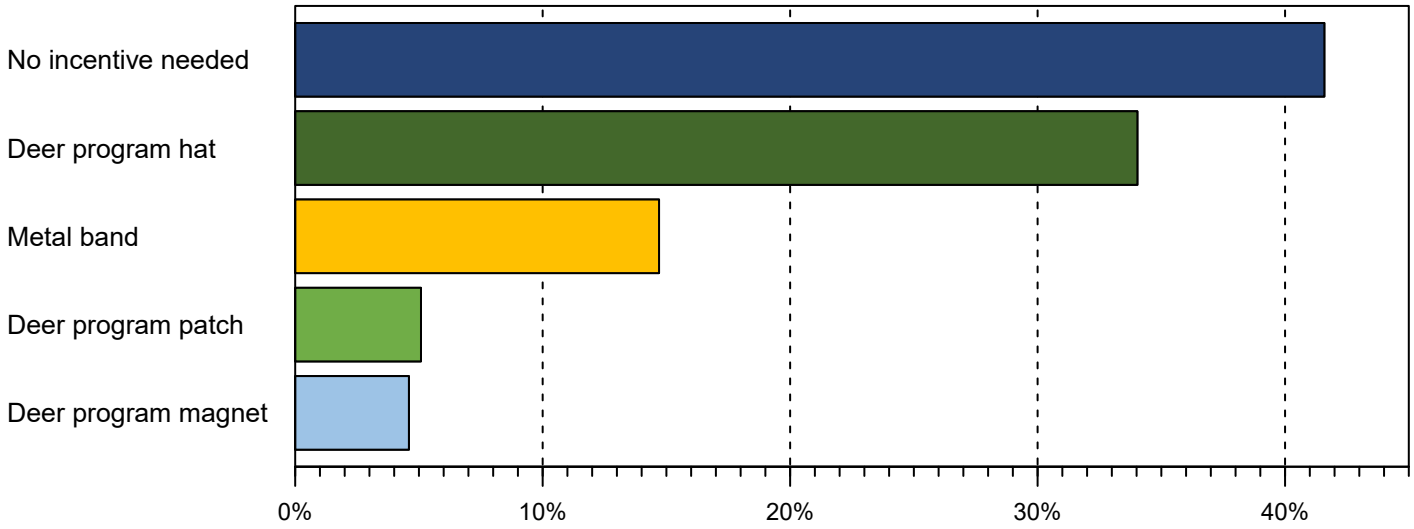

Figure 7-12. Hunters in Indiana were asked which incentive was preferable for completing all five data collection activities (n=15,779).

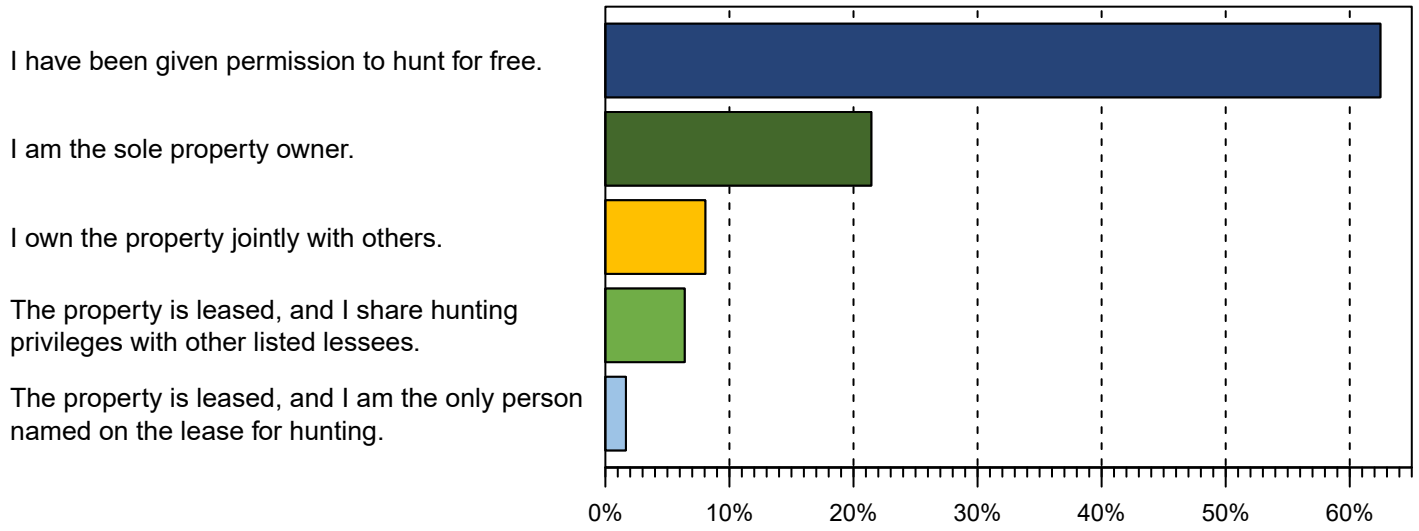

Figure 7–13. Hunters in Indiana were asked to describe the ownership status of the private property where they primarily hunt deer (n=15,246).

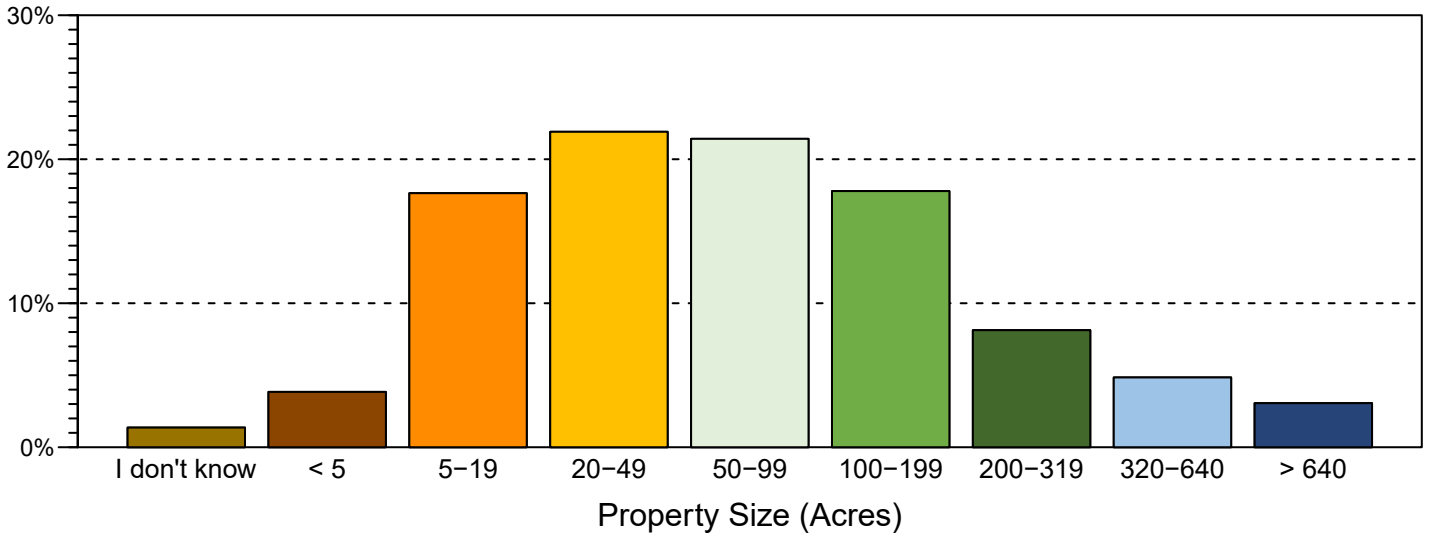

Figure 7–14. Hunters in Indiana were asked about the size of the primary (n=15,274) and secondary (n=1,872) private property where they hunt deer.

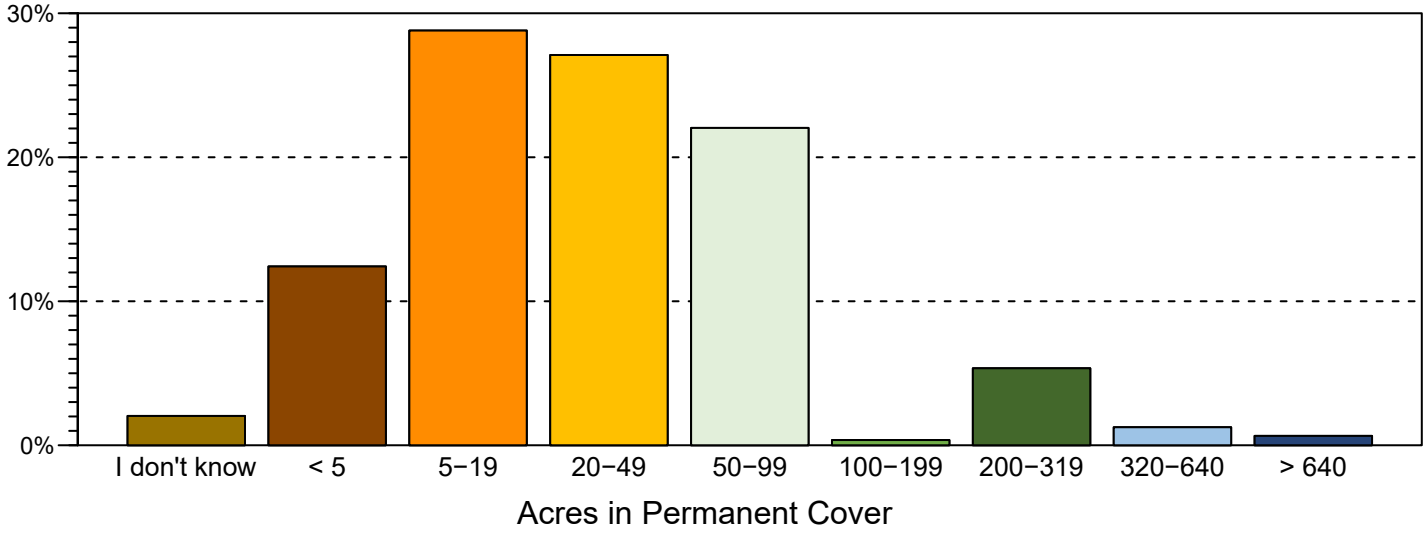

Figure 7–15. Hunters in Indiana were asked about the amount of permanent cover at the primary (n=15,249) and secondary (n=1,849) private property where they hunt deer.

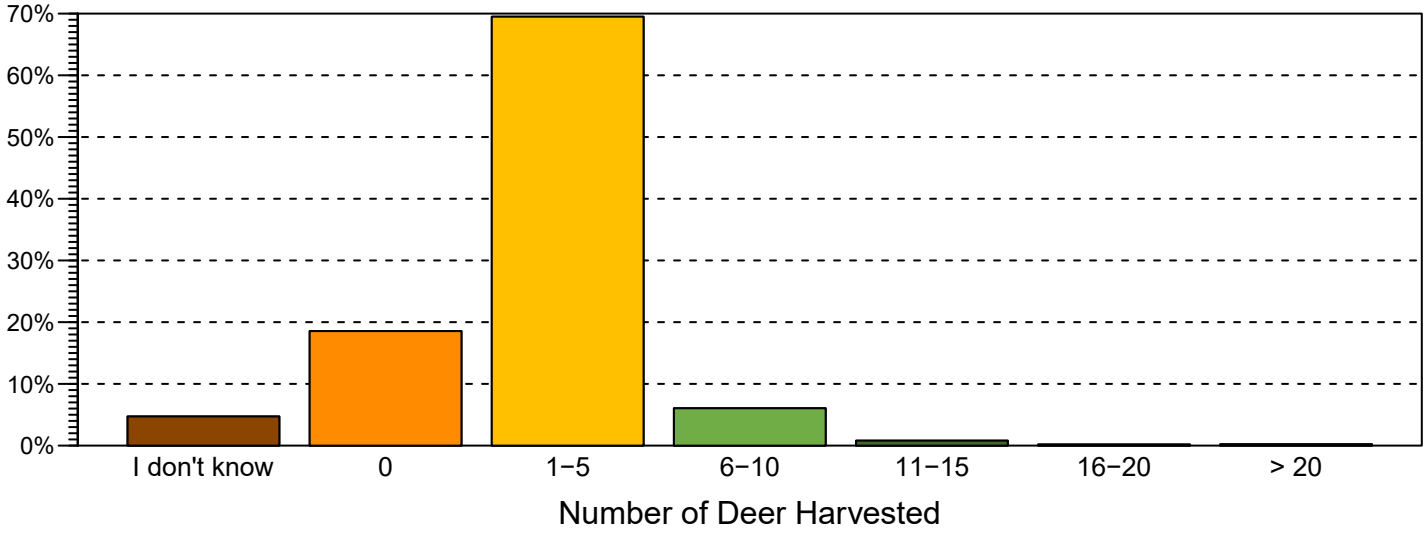

Figure 7–16. Hunters in Indiana were asked about the number of deer harvested at the primary (n=15,261) private property where they hunt deer.

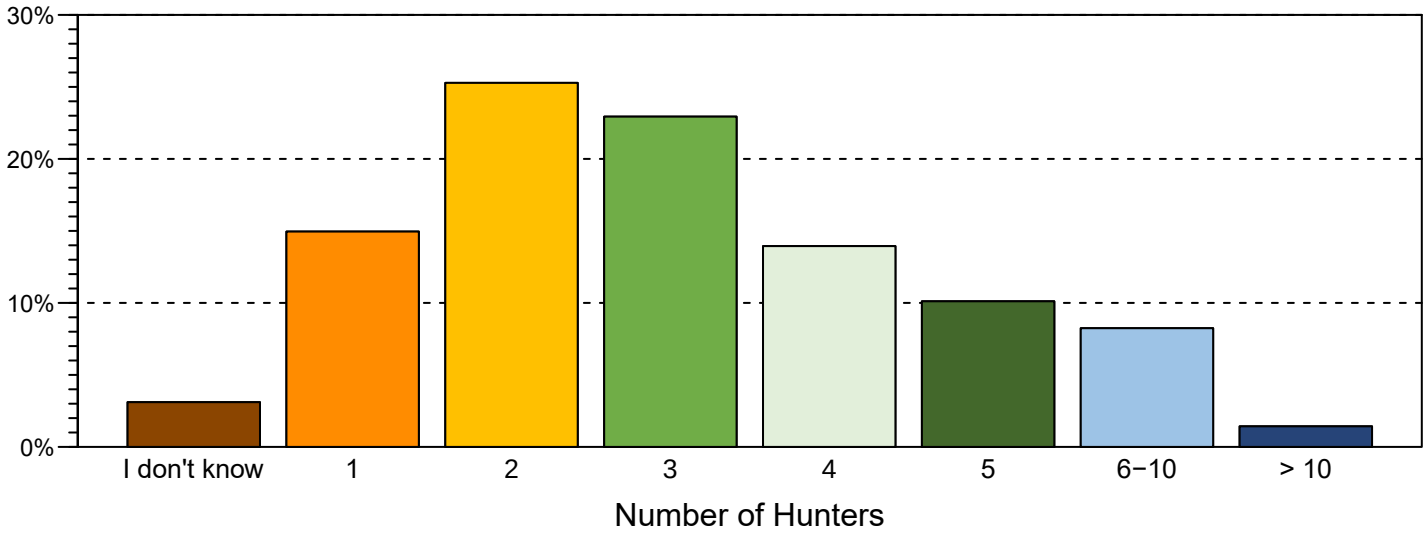

Figure 7–17. Hunters in Indiana were asked how many individuals have permission to hunt at the primary (n=15,261) private property where they hunt deer.

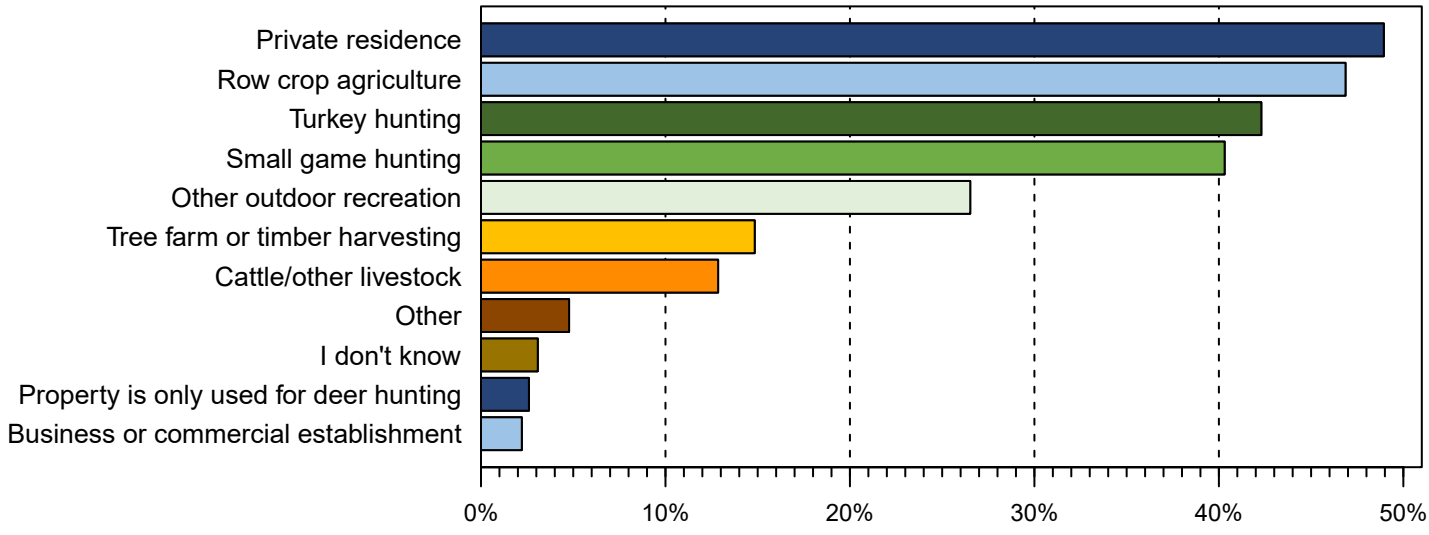

Figure 7–18. Hunters in Indiana were asked about additional uses at the primary (n=15,246) and secondary (n=1,846) private property where they hunt deer.

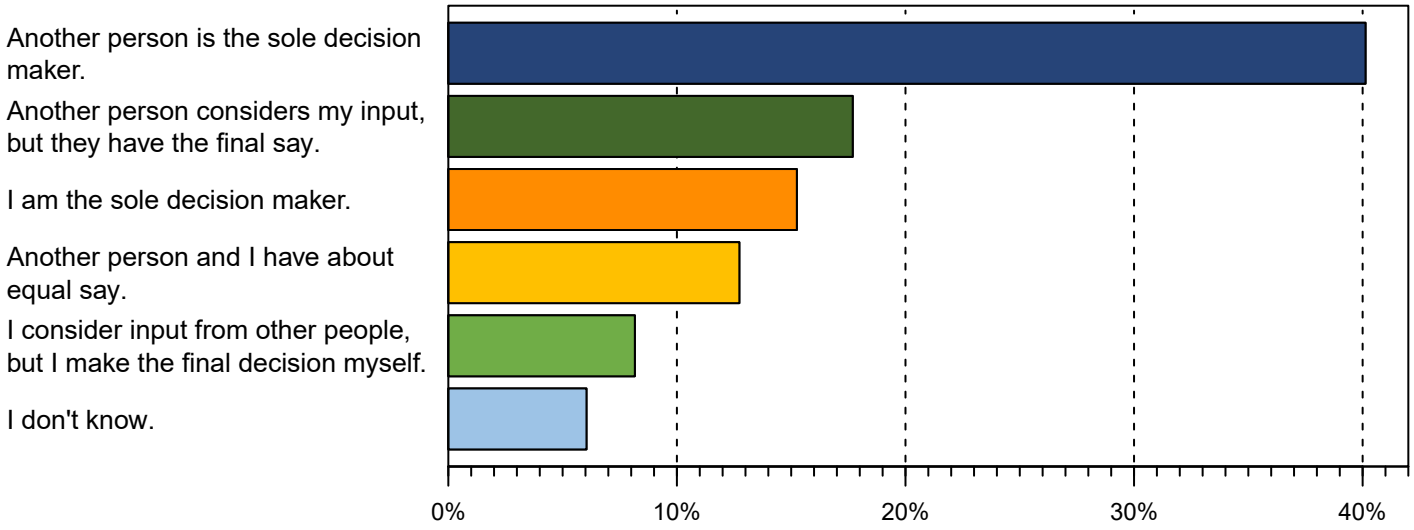

Figure 7–19. Hunters in Indiana were asked how decisions about land use are made for the primary (n=15,222) private property where they hunt deer.

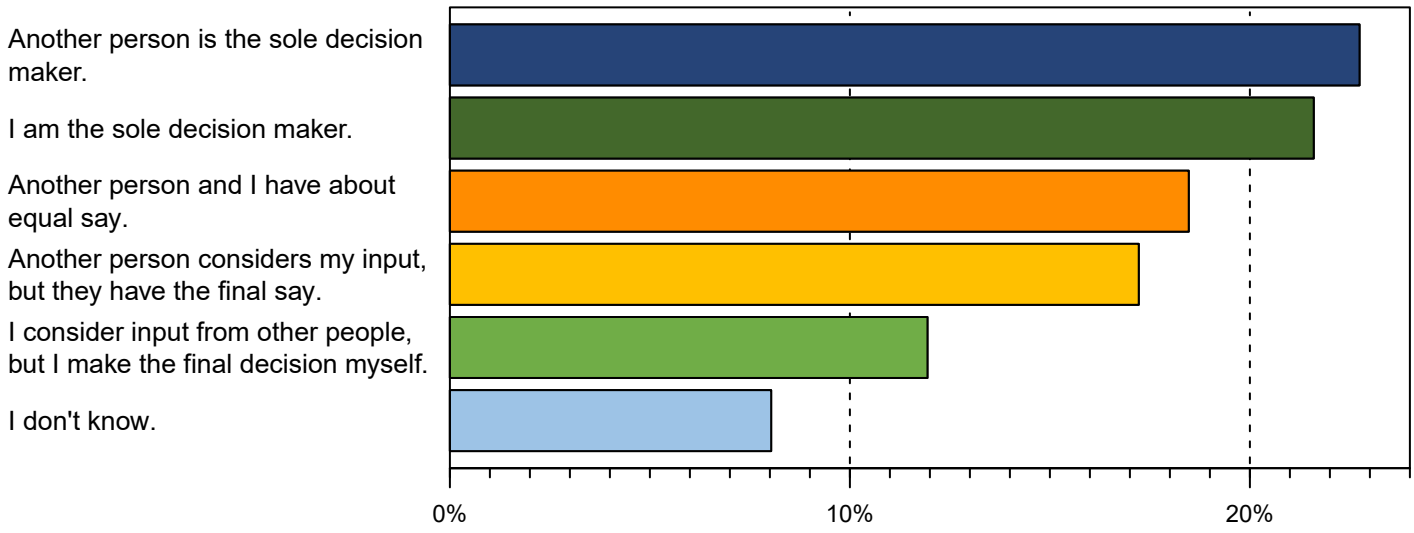

Figure 7–20. Hunters in Indiana were asked how decisions about deer management are made for the primary (n=15,202) private property where they hunt deer.

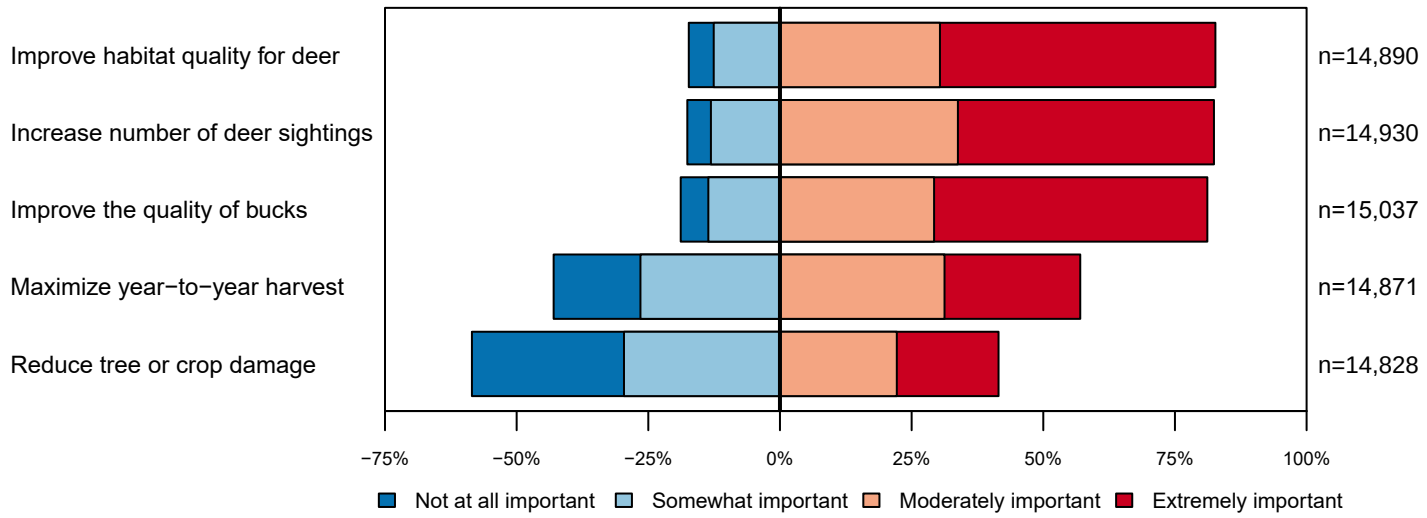

Figure 7–21. Hunters in Indiana were asked how important they consider different goals when making decisions about deer management for the primary private property where they hunt deer.

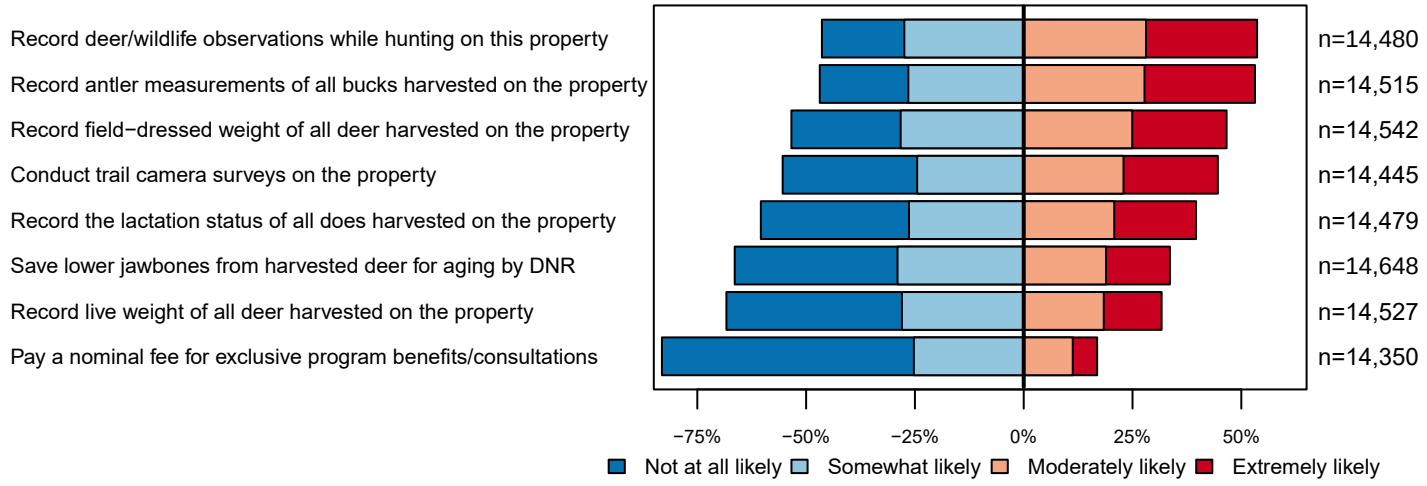

Figure 7–22. Hunters in Indiana were asked how likely they are to provide the DNR with different types of information in exchange for different forms of technical assistance to help meet deer management goals.

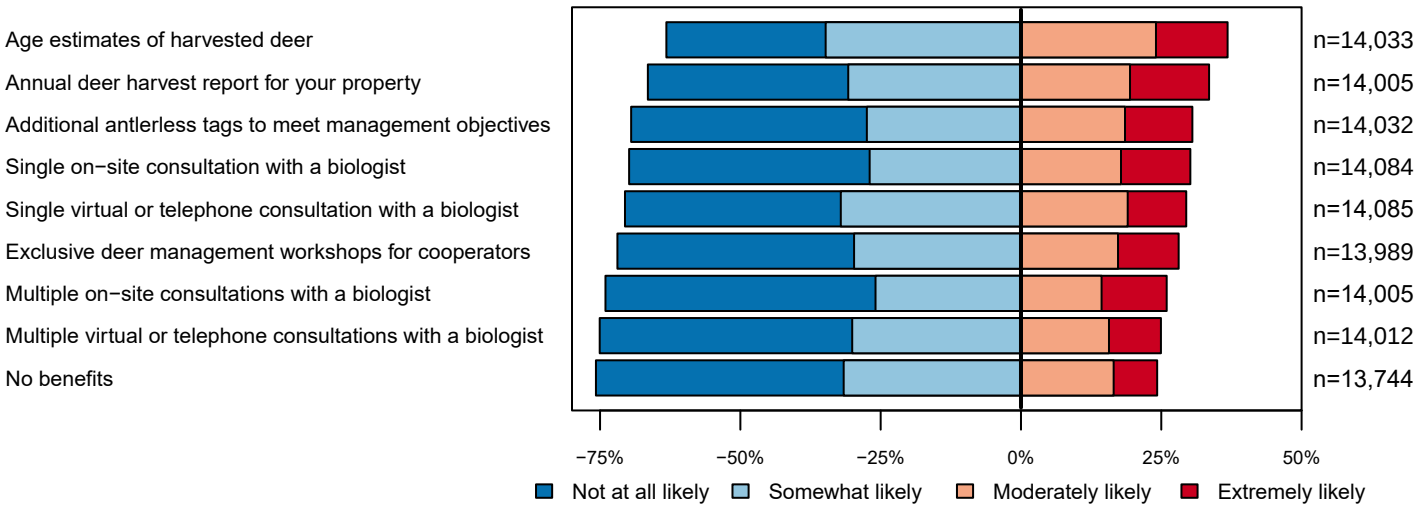

Figure 7–23. Hunters in Indiana were asked how likely they are to enroll in a program that offers different benefits in exchange for data submission of harvested deer.

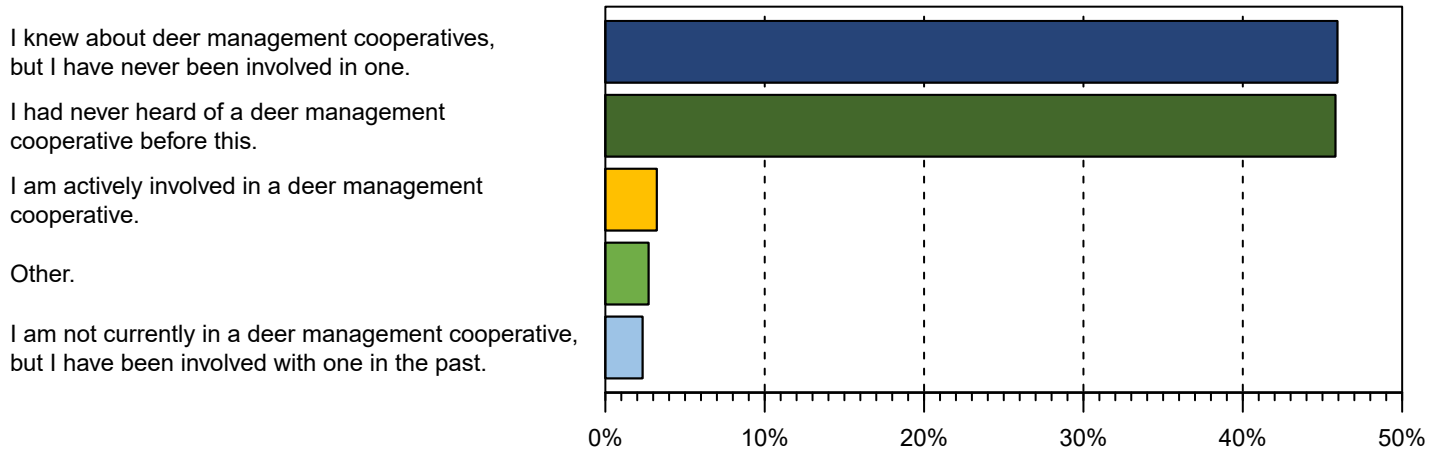

Figure 7–24. Hunters in Indiana were asked to describe their experience with deer management cooperatives.

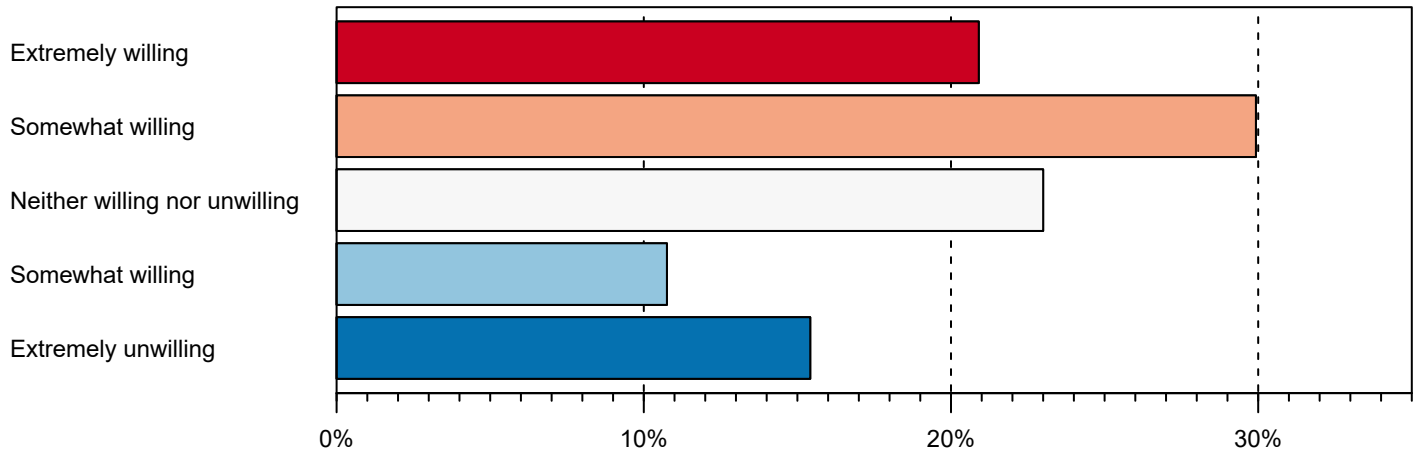

Figure 7–25. License–exempt deer hunters in Indiana (n=5,487) were asked about their willingness to pay $5 for a license to hunt deer on private land.

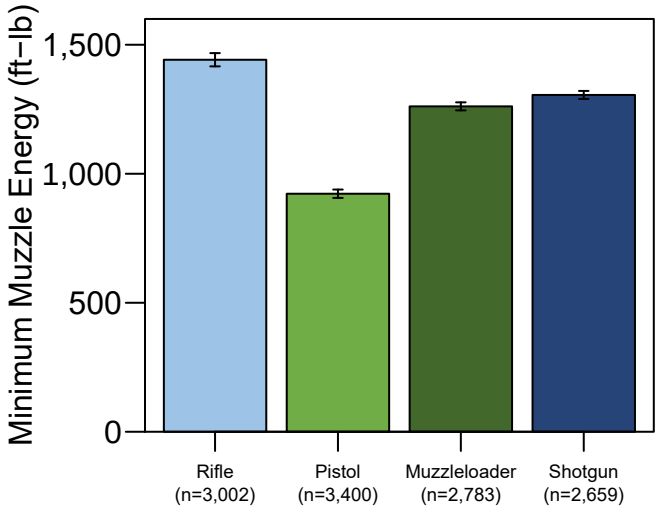

Figure 7–26. Hunters in Indiana were asked about the minimum acceptable muzzle energy for different firearms to shoot a deer in the chest from 100 yards.

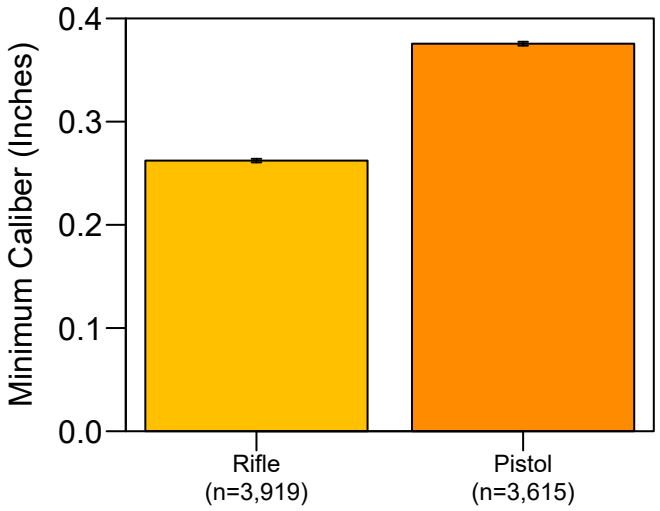

Figure 7–27. Hunters in Indiana were asked about the minimum acceptable caliber for different firearms to shoot a deer in the chest from 100 yards.

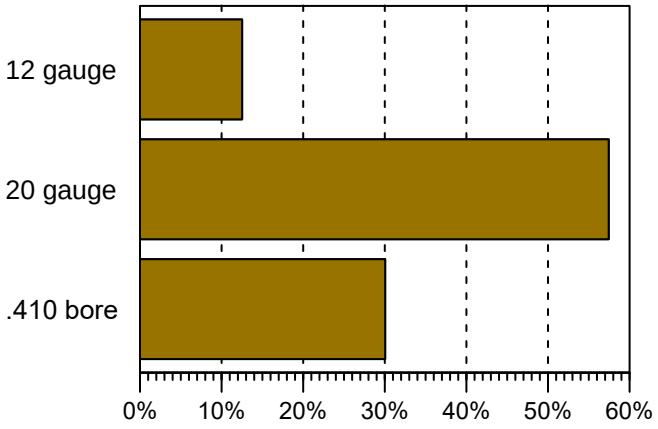

Figure 7–28. Hunters in Indiana (n=3,771) were asked about the minimum acceptable shotgun gauge to shoot a deer in the chest from 100 yards.

CHAPTER 8. VOLUNTEER MONITORING

Volunteer monitoring is public participation in data collection and analysis of natural resources. The Indiana DNR seeks assistance from volunteers as an alternative way to collect data traditionally obtained by biologists. Volunteer monitoring provides people 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 volunteers for three projects: Snapshot Indiana, the Archer's Index, and the After Hunt Survey.

SNAPSHOT INDIANA

Moriah Boggess, Olivia Vaught, Cathleen Steinbeiser, and Geriann Albers, *Indiana Department of Natural Resources*

Snapshot Indiana is a volunteer monitoring project that uses trail cameras to collect data on a variety of wildlife species in Indiana. Remote-trigger cameras (trail cameras) can be useful tools for DNR wildlife managers because they allow data to be collected with minimal 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 before 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.

Snapshot IN Photo

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.

Data collected in 2019 included a total of 121,301 photos taken on 119 cameras during 4,003 camera trap nights. White-tailed deer were the most detected species. At least one buck (14,771 photos), doe (22,406 photos), or fawn (7,948 photos) was detected in more than 45,000 photos. Some deer appeared in multiple photos, and some photos were of more than one deer. Based on observations, the statewide doe:buck ratio was 1.67:1, and the statewide fawn:doe ratio was 0.36:1. The 2020 Snapshot Indiana season yielded nearly 187,000 photos. This is the last year of the program. Analysis of these photos is ongoing, and results will be published in the 2021 Indiana White-tailed Deer Report.

ARCHER'S INDEX

Moriah Boggess, Olivia Vaught, Emily McCallen, and Geriann 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 Indiana DNR to monitor trends in statewide wildlife populations. The partnership between archery hunters and Indiana 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 its 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 several furbearer species. 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. Regulation changes were implemented in 2012 that extended the archery season to one continuous season that ends 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 Indiana 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 10 deer management units (DMU) the Deer Research Program created in partnership with Purdue University to seek to better understand deer trends across regions (see Figure 3-13). Statewide results are reported in this section, and regional results are reported in the DMU Data Sheets section. Bootstrapped confidence intervals (CI_{95}) were calculated for observations per hour each year.

Results and Discussion

In 2020, a total of 321 hunters in 88 counties reported deer observations in the Archer's Index. Hunters observed a total of 13,636 deer in 16,091 hours during 5,019 observational periods ranging from 0.5 to 11 hours. Hunters observed an average of 0.87 deer per hour (CI_{95}=0.84 – 0.90; Figure 8-1). A total of 3,602 bucks, 5,701 does, 3,277 fawns, and 1,056 deer of an undetermined age and sex were observed. From the Archer's Index, the statewide fawn:doe ratio was 0.57:1 (CI_{95}=0.54 – 0.59), and the doe:buck ratio was 1.56:1 (CI_{95}=1.50 – 1.63). Comparatively, the harvest doe:buck ratio was 0.85:1 (CI_{95}=0.84 – 0.86; Figure 8-2).

The Archer's Index provides several trends or indices of the size, composition, and recruitment of the deer population and may be useful for monitoring how these populations change over time. 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 deer population trends and not the actual size. One potential bias proposed by critics of volunteer monitoring indices is that fawn observations may be underrepresented. Older fawns can look like 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 firearms 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 our

doe:buck ratios range between 1.3:1 and 2:1 in most areas, which is typical of hunted deer populations.

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. 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 ± 0.54 fawns. In 2019, Illinois' reported statewide recruitment, based on its fawn:doe ratio, was 1.18:1 (QDMA 2021). Even though a large proportion of deer were bred, resulting in a high birth rate, fawns experienced a high rate of death. Fawn recruitment values can be used for several different purposes, including modeling allowable buck and/or doe harvest and as an indicator of potential problems with a deer herd, such as slow population growth potential.

Indiana has similar fawn:doe ratios compared to those of nearby states, according to recruitment data reported to QDMA (2021): Ohio (0.60:1), Michigan (0.47:1), Kansas (0.47:1), or the Midwest average (0.79). Although these reported ratios are similar, caution should be taken when directly comparing fawn:doe ratios across states, because the respective methodologies used to calculate the fawn:doe ratios differ. 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 its 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 research program, the long-term trend (i.e., index) is more important than a comparison with neighboring states. Readers should investigate how the data are collected in other states before comparing to Indiana's fawn:doe ratios.

Currently, Indiana has an approximately balanced pre-hunt sex ratio (1.56:1). 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 the harvest of does. Observations per hour have leveled off since 2013 (Figure 8-1), 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. 2019. QDMA's Whitetail Report 2019: An Annual Report on the Status of White-tailed deer. Quality Deer Management Association, Bogart, Georgia, USA.

QDMA. 2021. QDMA's Whitetail Report 2021: An Annual Report on the Status of White-tailed deer. Quality Deer Management Association, Bogart, Georgia, USA.

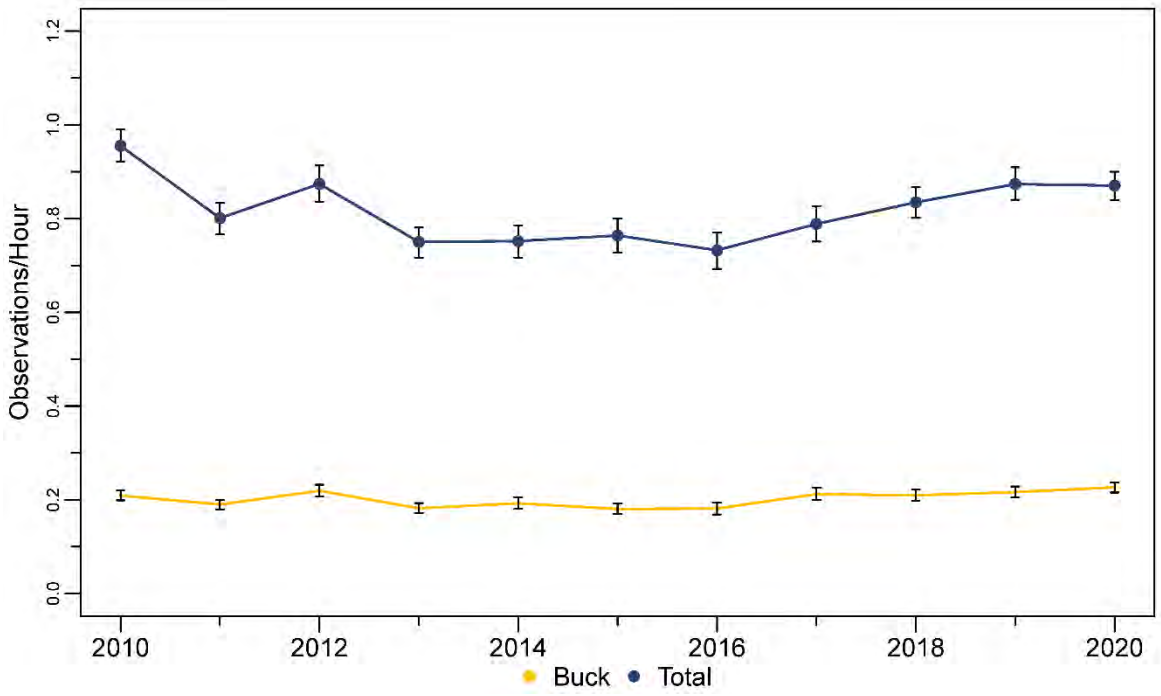

Figure 8-1. Annual average observations per hour of bucks and total deer reported in the Archer's Index.

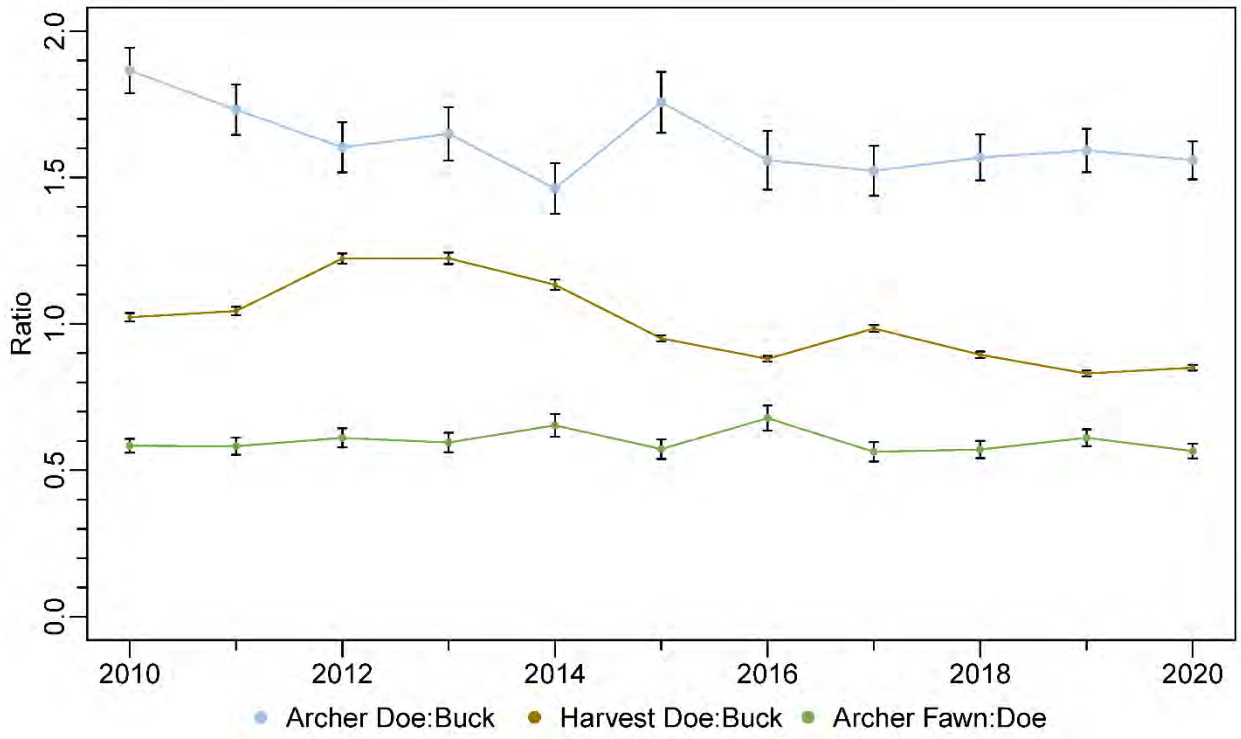

Figure 8-2. Statewide observation of doe:buck and fawn:doe ratios reported in the Archer's Index and the reported doe:buck harvest ratio from CheckIN Game data.

AFTER HUNT SURVEY

Moriah Boggess, Olivia Vaught, and Emily McCallen,
Indiana Department of Natural Resources

For many years, Indiana DNR biologists examined deer at check stations to which hunters brought their deer to record their harvest. Biologists recorded age, sex, and other biological information that was useful for managing the deer herd. In 2015, Indiana moved to an online system, CheckIN Game, to make the process more convenient for hunters. The After Hunt Survey was created in 2017 to allow hunters the opportunity to continue providing biological information about their harvested deer. The goal of the After Hunt Survey is for hunters to self-report on enough deer so that both hunters and managers can examine deer population biology, ecology, and demographics at the county level. The 2020-2021 deer season was the fourth year the After Hunt Survey was available. Because the sample size for most counties was insufficient to report results to the county level, results are reported at regional and statewide levels.

Methods

The After Hunt Survey was administered using Qualtrics, an electronic survey system. Hunters were asked to participate in the survey after they had checked in their deer. They could also access the survey later by visiting deer.dnr.IN.gov and clicking on the After Hunt Survey link under Deer Management. Questions included: 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

Sample Size. A total of 2,518 hunters responded to the survey, a 23% increase from the 2019-2020 survey. At least one response was received from each county. The highest number of responses was 72 from Noble County. Of all responses, 85.3% were completed entirely, while 14.6% were partially completed. To be able to assess data at the county level, 80-120 responses are needed from each county, depending on the number of categories for each question. If these numbers aren't obtained, data can be analyzed at a regional level based on nine of Indiana's 10 Deer Management Units (DMUs; see Figure 3-13). Number of responses per DMU ranged from 88 (Dearborn Upland Unit) to 552 (South Unit; Table 8-1). No responses were attributed to the Urban Deer Management Unit.

Deer Ages. Hunters were asked to age their deer using tooth wear and replacement patterns. Excluding incomplete responses, hunters did not report the ages of 426 does and 560 bucks, including 91 bucks that were going to be mounted. In total, hunters reported the age of 528 does and 634 bucks.

Statewide, most deer were reported as 2.5 years old (Figure 8-3). There was an insufficient number of aged deer reported to summarize the age structure at the county level. Regional age structures were similar to the statewide distribution with a few exceptions. Most of the aged does in the Northwest (39.4%), West Central (40.8%), East Central (38.1%), Wabash Valley (34.4%), and Muscatatuck Plateau (36.4%) DMUs were 1.5 years old. In the Southwest DMU, most of the aged bucks (25.7%) were 4.5 years old (Figure 8-4). Although the Muscatatuck Plateau (29.7%) and East Central (34.5%) DMUs had a greater percentage of 1.5-year-old bucks, the distribution of age classes was similar to that observed for other DMUs.

To assess the accuracy and determine error rates for hunter-aged deer, hunters were asked to submit a photo of the deer's jaw. Only 32 usable photos were submitted, of which 23 included an age estimate. Eleven were aged correctly. The others were aged incorrectly by two years or more. Since the first After Hunt Survey in 2017-2018, hunters have submitted 83 photos of deer jaws, of which 59 included an age estimate. Forty (67.7%) were aged correctly. As more photos that include age estimates are submitted, Indiana DNR will be able to develop error rates for hunter-aged deer to better understand the age structure of the statewide deer herd.

Lactation Rates. Lactation rates provide an estimate of fawn recruitment, which is especially useful in setting harvest quotas. Low fawn recruitment may warrant a change to quotas because it indicates fewer deer are surviving and entering next year's population.

During the 2020-2021 season, 1,065 hunters who harvested a female deer reported that 221 (20.8%)

were lactating and 586 (55.0%) were not; the remaining 230 hunters (21.5%) did not report the lactation status. From Oct. 1, 2020 to Jan. 6, 2021, 37% of adult does aged 2.5 years or older were reported to be lactating. Lactation rates for does aged 2.5 years or older (n=1,195) obtained from all four After Hunt Surveys depict a gradual decline as the season progresses (Figure 8-5). To report lactation rates at the county or regional level, especially for one season, the number of responses must increase substantially. The variation that results from the small sample size obtained does not allow for a reliable estimation of recruitment.

Hunter Experience. The After Hunt Survey asks several questions related to a particular hunting experience. On a scale of 0 (poor) to 100 (excellent), hunters were asked to rate their overall enjoyment of the hunt, the number of does and bucks they saw on the hunt, the quality of those bucks they observed, and how they felt Indiana DNR is managing deer in the county in which they hunt. Responses from quality of bucks (n=2,262), quantity of bucks (n=2,300), and quantity of does (n=2,328) were bimodal (Figure 8-6), meaning most responses were either at the low end or the high end of the scale. Responses about how Indiana DNR was managing deer in the county where they hunted (n=2,259) and how much they enjoyed their hunt (n=2,444) both indicated higher levels of satisfaction (Figure 8-7).

Antler Characteristics. Hunters reported 90% of the bucks harvested had a typical rack; the remaining 10% were non-typical. The total number of points on 1,169 harvested bucks averaged 7.8 (SD=2.6, CI_{95}+0.1) with a median, or midpoint in the range of responses, of eight points. The average inside spread of 957 bucks was 13.3 inches (SD=4.8, CI_{95}+0.2) with a median measurement of 14.3 inches. The total inches of antler, defined as the length of the main beam plus the length of each of the tines as measured from the center of the main beam along the longest portion of the tine, from 386 bucks, averaged 48.6 inches (SD=56.5, CI_{95}+5.6).

Body Weights. Body weights can provide valuable information about the quality of deer and the relationship of recruitment to nutrition if data are frequently reported on small scales (i.e., county or 16-mile2 grid level). Hunters (n=716) reported the field-dressed weight of their deer only if it had been weighed on a scale. Live weights (Figure 8-8) were calculated by multiplying the field-dressed weight by 1.26 as reported in Smart et al. (1973). The number of responses was insufficient to summarize body weights by age class at either the county or regional level. Self-reporting of body weights by hunters needs to be significantly higher for this factor to be used to inform management.

Hunter Effort. The number of hours it takes to harvest a deer can be used to calculate harvest per unit effort, which can serve as an index for deer population size. Because this index may have an inherent selective bias, it should be viewed with caution. For example, hunters may spend more time to harvest a particular buck than they would to harvest a doe.

Hunters (n=1,371) reported they hunted an average of 27.4 hours (SD=35.4, CI_{95}+1.9) and a median of 14 hours before harvesting their buck (Figure 8-9). During this time, hunters (n=1,373) saw an average of 3.1 bucks (SD=4.8, CI_{95}+0.3), with a median of two bucks; they (n=1,362) saw an average of 6.5 does (SD=12.5, CI_{95}+0.7), with a median of three does.

Hunters (n=1,044) reported they hunted an average of 19.9 hours (SD=41.2, CI_{95}+2.5) and a median of nine hours before harvesting their doe (Figure 8-9). During this time, they saw an average of 1.1 bucks (SD=2.2, CI_{95}+0.1), with a median of zero bucks and an average of 4.7 does (SD=6.0, CI_{95}+0.4), with a median of three does. A significantly greater level of reporting is needed for hunter effort to inform management strategies at the county or regional level.

Hunter Preference. Hunters (n=1,115) who saw more than one buck when hunting were asked why they waited for the buck they harvested. They could choose more than one reason, which produced 803 total responses. A total of 288 hunters (35.9%) were waiting for an older buck, 267 (33.3%) were waiting for a buck with larger antlers, 218 (27.1%) felt that the other bucks were out of the range for their equipment, 108 (13.4%) were waiting for a specific buck, and 89 (11.1%) felt it would not have been a safe shot. A total of 106 hunters (13.2%) reported their reason was not listed.

Hunters (n=936) who saw more than one doe while hunting were asked why they waited for the doe they harvested. Hunters were again allowed to choose more than one reason, which produced 805 total responses.

A total of 355 hunters (44.1%) were waiting for a larger, older doe; 269 (33.4%) felt that the other does were out of range; 145 (18.0%) felt it would not have been a safe shot; 117 (14.5%) passed on does because they had fawns with them; 65 (8.1%) did not want to disturb the buck that was with the doe; and 24 (2.9%) were looking for a smaller, younger doe. A total of 136 hunters (16.9%) reported their reason was not listed.

The After Hunt Survey has potential to provide valuable biological information from harvested deer, including age, sex, and reproductive status. It may also be used to develop an index of harvest per unit effort. Additional research is needed to evaluate the utility of harvest per unit effort as an accurate estimator of population size. Reporting must increase significantly before information collected in the After Hunt Survey can be reliably applied at the regional, county, or sub-county level. Increasing promotion of the survey in the annual Hunting/Trapping Guide, media outlets, and on social media will help to ensure a sufficient number of responses are obtained so this information can 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 34:553-555.

Table 8-1. Number of After Hunt Survey responses by Deer Management Unit, 2020-2021.

Deer Management Unit	Number of Counties in Unit	Number of Responses	% of Total Responses
1-Northwest	13	456	18.1%
2-Northeast	4	209	8.3%
3-West Central	9	195	7.7%
4-East Central	28	462	18.4%
5-Wabash Valley	6	172	6.8%
6-South	16	552	21.9%
7-Muscatatuck Plateau	4	131	5.2%
8-Dearborn Upland	3	88	3.5%
9-Southwest	9	253	10.1%
Total		2,518	

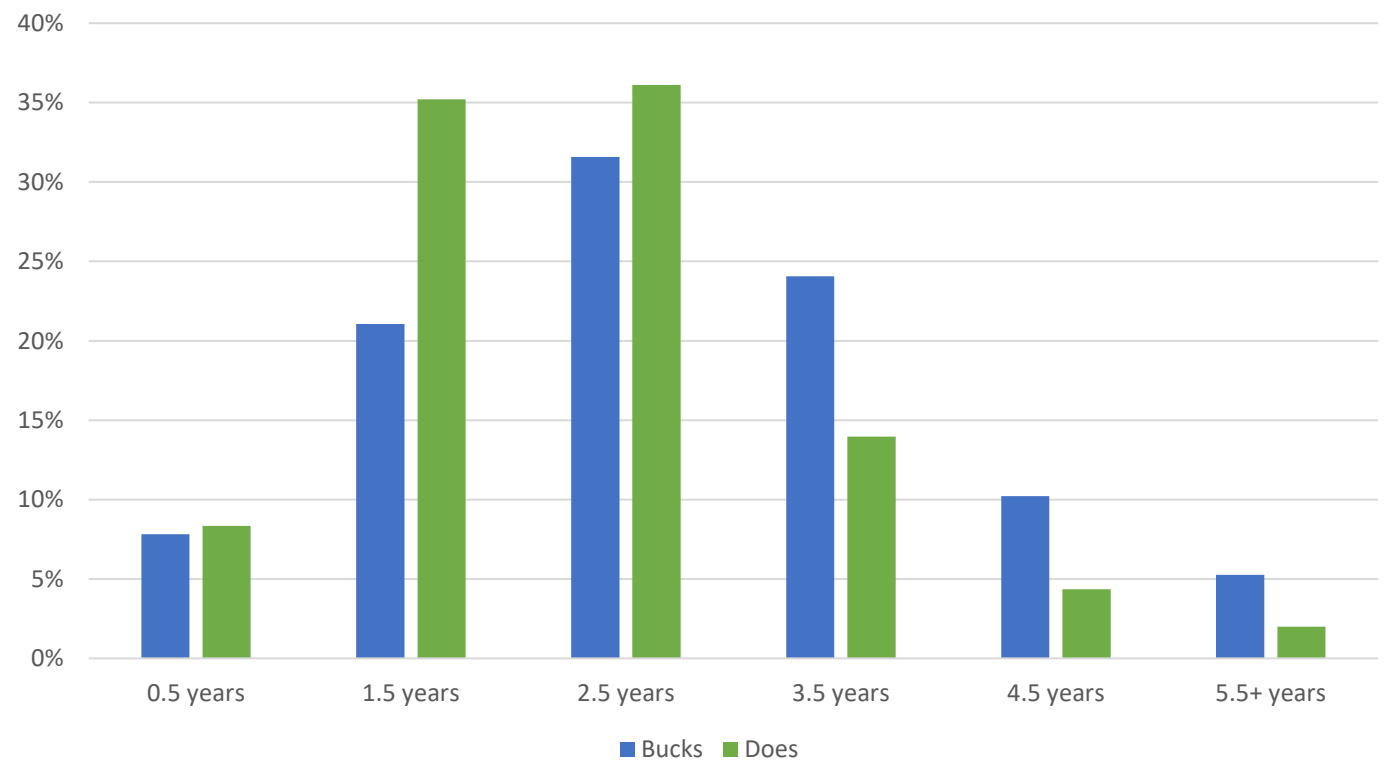

Figure 8-3. Age distribution of the statewide deer harvest reported in the 2020-2021 After Hunt Survey.

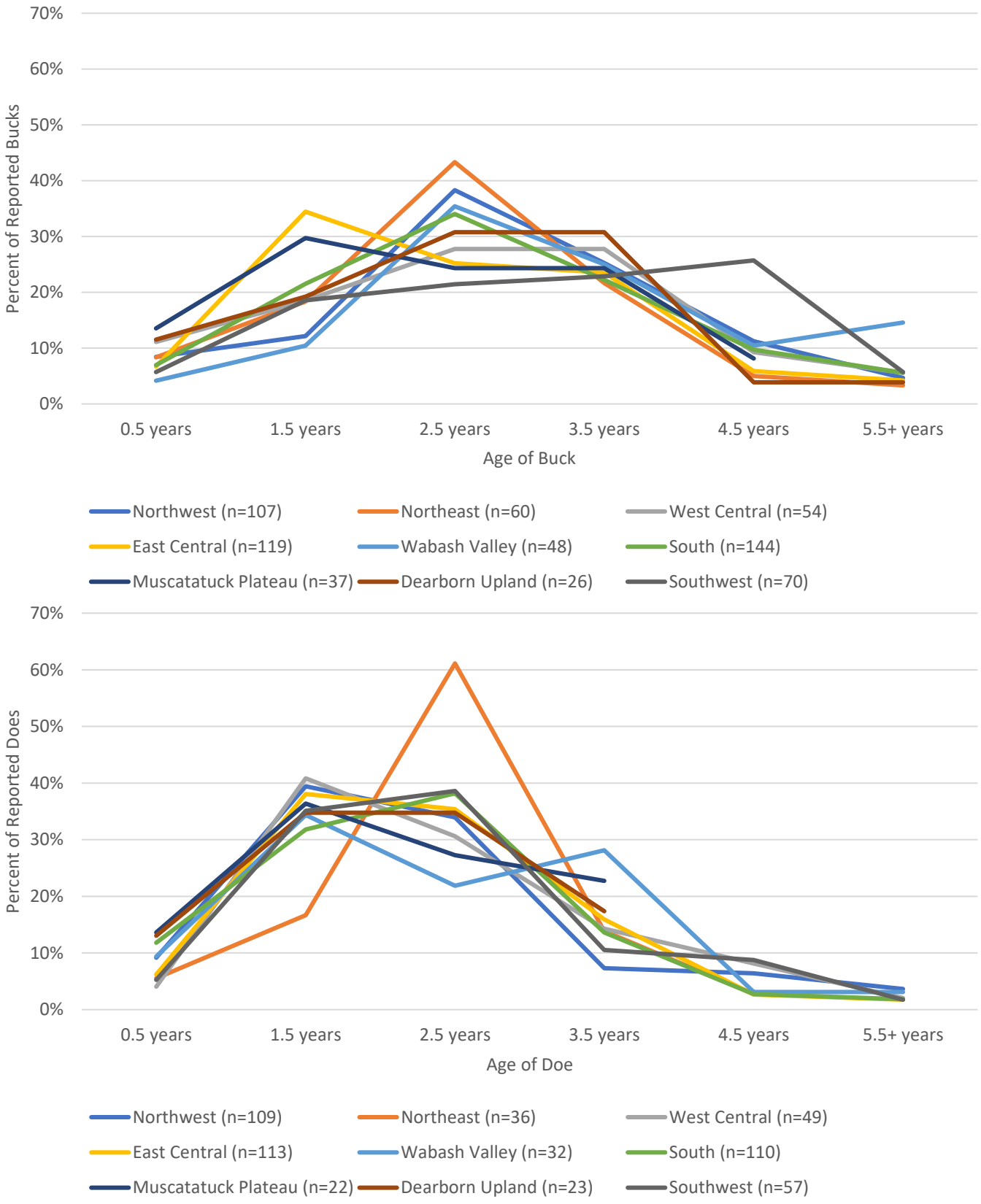

Figure 8-4. Age distribution of harvested bucks (upper graph) and does (lower graph) by Deer Management Unit reported in the 2020-2021 After Hunt Survey. The number of responses in each DMU is next to its name.

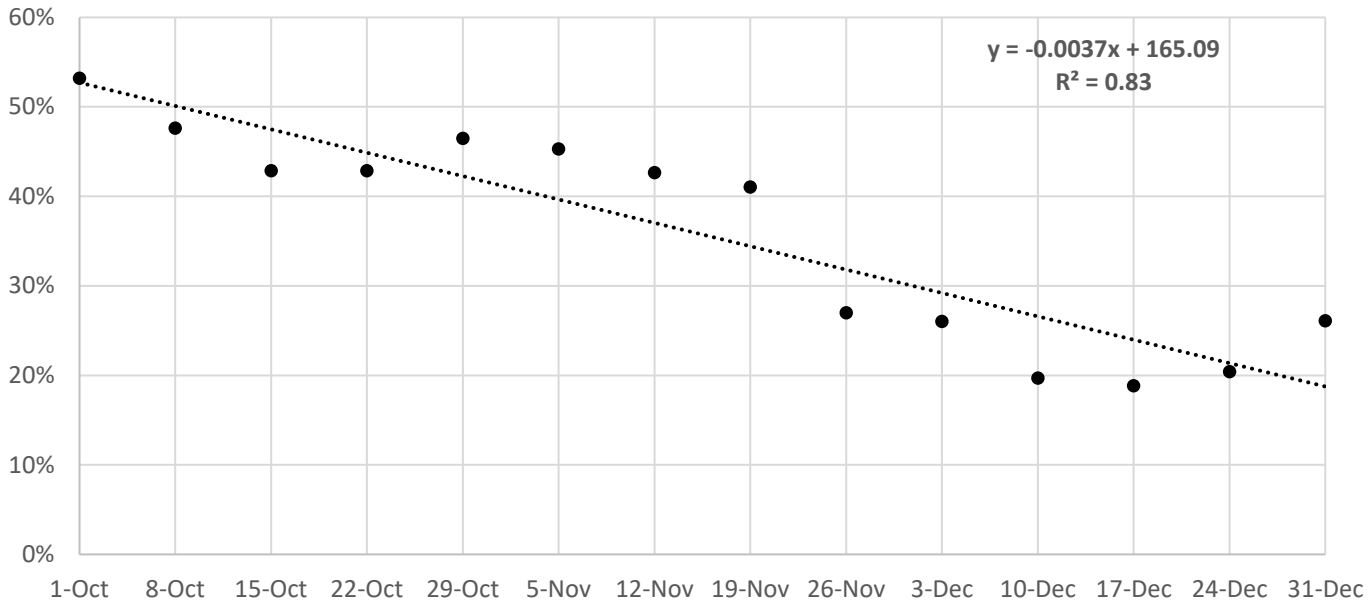

Figure 8-5. Cumulative weekly lactation rates of does at least 2.5 years old reported in the After Hunt Surveys from 2017-2018 to 2020-2021. The trend line indicates a gradual decline in lactation rates as the season ends.

season ends.

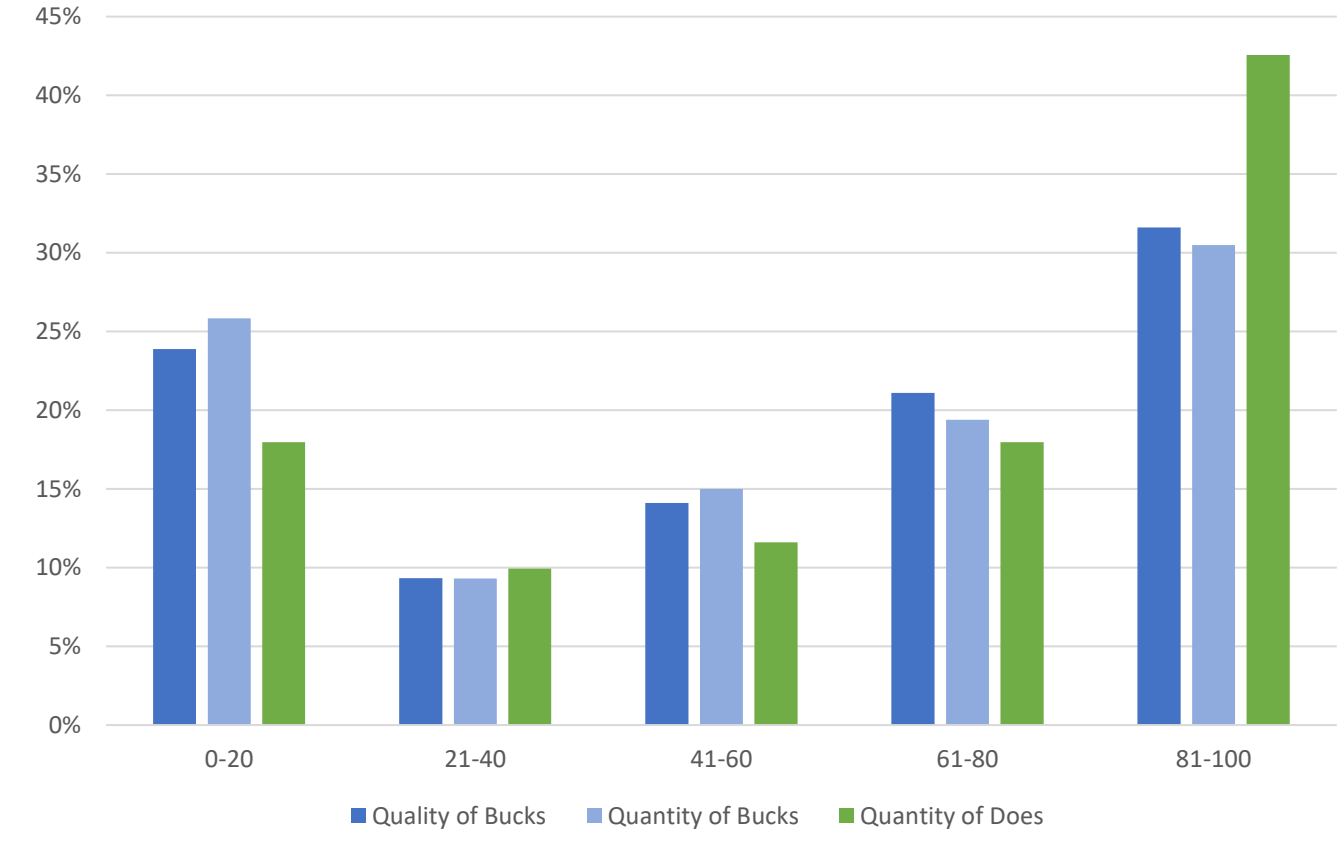

Figure 8-6. Hunter opinion about the quality and quantity of bucks and the quantity of does observed while hunting during the 2020-2021 deer hunting season. Scores range from 0 (poor) to 100 (excellent).

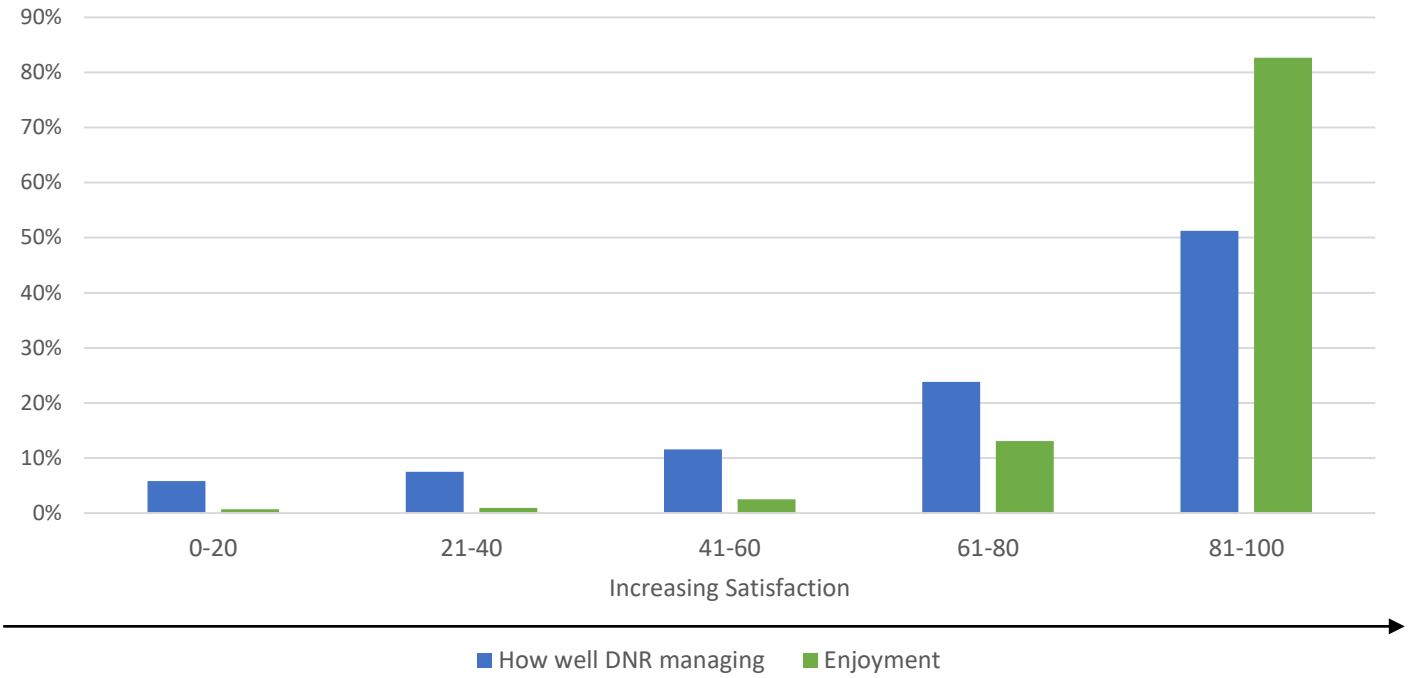

Figure 8-7. Hunter opinion about how the Indiana DNR is managing the deer in the county where they hunted and their enjoyment of the hunt during the 2020-2021 deer hunting season. Scores range from 0 (poor) to 100 (excellent).

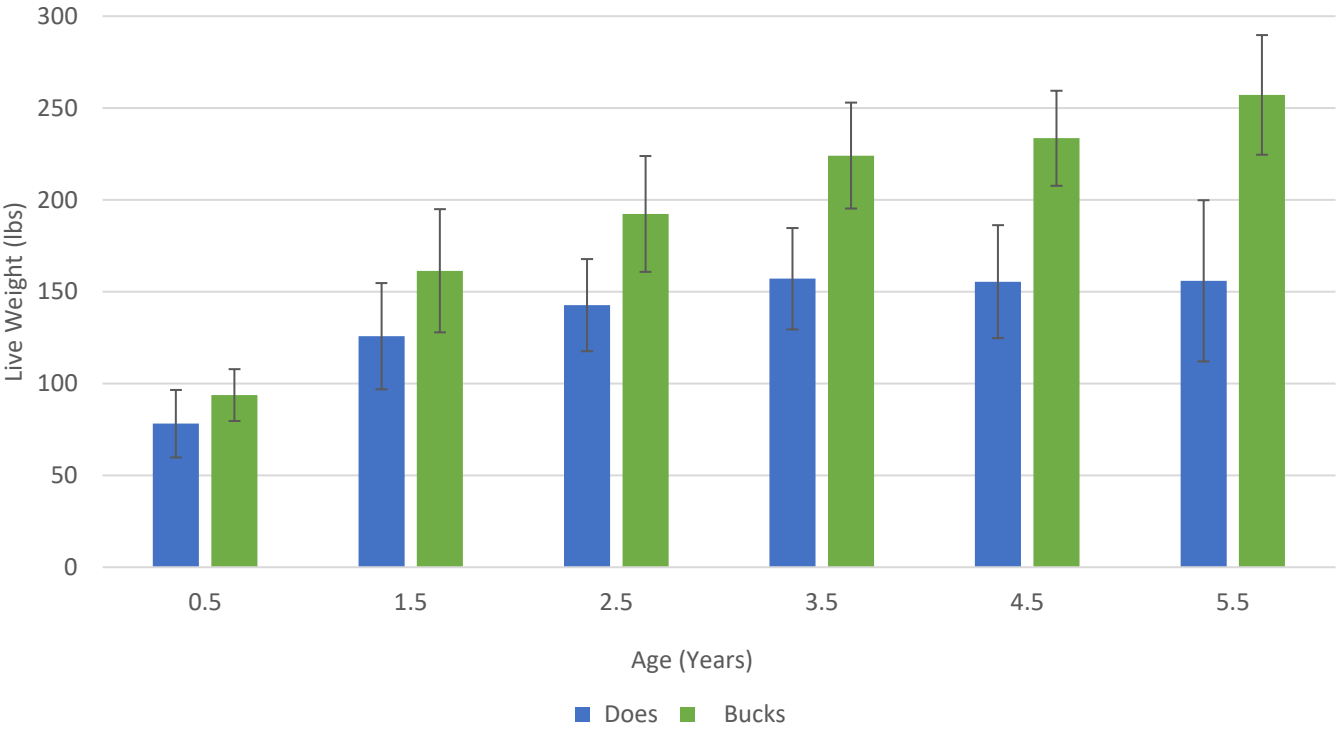

Figure 8-8. Live weights of deer by age class reported in the 2020-2021 After Hunt Survey. Of the 716 hunters who reported a weight, only 432 (60%) also reported the age of the deer.

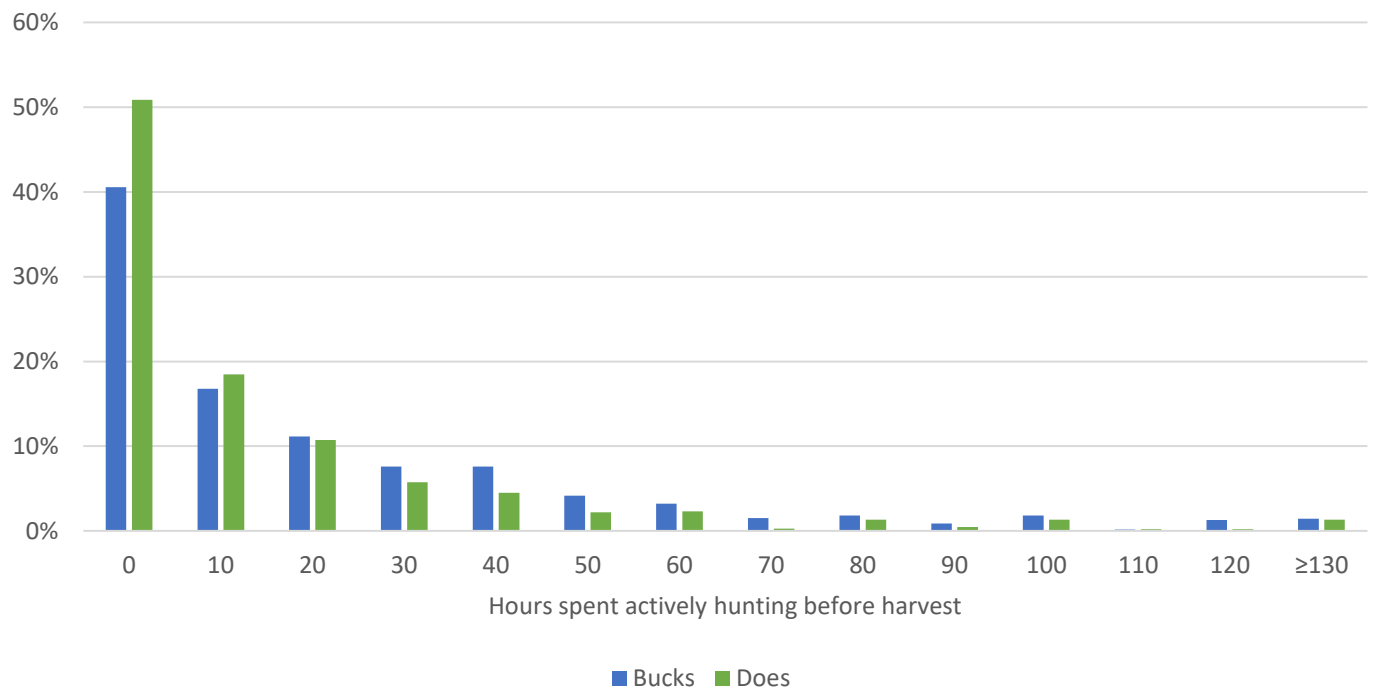

Figure 8-9. Number of hours hunters spent actively hunting before harvesting a buck or a doe during the 2020-2021 deer hunting season, as reported in the 2020-2021 After Hunt Survey.

CHAPTER 9. DNR DEER RESEARCH

PUBLIC OPINION AND HARVEST EFFECTS OF THE SPECIAL ANTLERLESS FIREARMS SEASON

Moriah Boggess, Olivia Vaught, and Emily McCallen,
Indiana Department of Natural Resources

The Special Antlerless Firearms season was first opened during the 2012-2013 Indiana deer hunting season to provide additional antlerless deer hunting opportunities in counties with county bonus antlerless quotas (CBAQ) of four or higher. The goal of the new season was to increase hunting opportunities for antlerless deer, encourage their harvest, and reduce deer populations in counties with high CBAQs.

In 2017, Indiana DNR adopted a new deer management strategy: to focus deer herd management in a strategically targeted manner to more adequately balance ecological, recreational, and economic needs of the citizens of Indiana. This meant a shift away from county-wide deer herd reduction to an approach that maintains or increases populations of deer in some areas to provide wildlife viewing and hunting opportunities while identifying deer conflict in other areas and strategically increasing harvest there.

This shift in deer management meant that CBAQs across the state were reduced, and Deer Reduction Zones (DRZ) were implemented along roadways with high deer-vehicle collision rates. In 2019, Indiana DNR responded to a large outbreak of epizootic hemorrhagic disease (EHD) across southern Indiana in late summer by reducing all counties with a CBAQ of three or higher to two bonus antlerless deer. As a result, 19 southern counties that had CBAQs of four before this change were now ineligible for the Special Antlerless Firearms season. For the fall 2019 season, Indiana DNR implemented an emergency rule to retain the Special Antlerless Firearms season in these 19 counties, providing hunters the opportunity to hunt antlerless deer with a firearm until the CBAQ of two was reached.

DNR File Photo

For the 2020 deer hunting season, no counties had CBAQs of four or greater, so again no counties were eligible for the Special Antlerless Firearms season per the original language of the rule. In the 2019 Indiana White-tailed Deer Report, Indiana DNR evaluated whether the Special Antlerless Firearms season increased harvest of antlerless deer as it was originally intended to do (Caudell and Vaught 2020). The analysis found that the Special Antlerless Firearms season was expected to have a negligible effect on antlerless harvest. In 2020, DNR decided to temporarily open this special season again in all counties except those with a CBAQ of “A”, which excluded two counties.

Opening the Special Antlerless Firearms season across the state in 2020 provided an opportunity to again estimate the effects of this season on antlerless harvest and survey hunters about their approval and participation in the season. In late summer of 2020, the Special Antlerless Firearms Preseason Survey was made available on the DNR website so hunters and non-hunters could provide their opinions on the season before its opening across the state in December. A special block of questions on the Special Antlerless Firearms season was also included in the 2021 Deer Management Survey to assess the people’s opinion and participation in the special season.

Special Antlerless Firearms Pre-Season Survey

The Special Antlerless Firearms Preseason Survey was published and accessible via a link on the Special Antlerless Firearms season web page from Oct. 19, 2020 to April 15, 2021. The survey was available to anyone, and awareness for it was raised through the Special Antlerless Firearms season news release, social media posts, and other related communications.

Only 255 surveys were started and 183 were finished, for a completion rate of approximately 71.7%. Respondents were asked what county they lived in for the majority of 2020. Respondents from 66 of the 92 counties and four non-resident hunters finished the survey. When asked, 179 respondents indicated that they deer hunted during the 2019-2020 hunting seasons, and 133 of those reported successfully harvesting a deer that season. Respondents were also asked if they hunted any other species during the 2019-2020 season, and 101 reported hunting small game, 29 hunted upland birds, 25 hunted waterfowl, and 68 hunted none of the above. Most recipients planned to deer hunt during the 2020-2021 hunting season, with 82.4% responding that they were extremely likely or somewhat likely. Only 0.5% felt they were neither unlikely nor likely and 16.8% felt they were extremely or somewhat unlikely to hunt in 2020-2021.

When resident respondents were asked to describe where they live and hunt, most reported that they either mostly hunt the county they live in and occasionally hunt other counties (43.5%), or they occasionally hunt in the county where they live but mostly hunt in other counties (20.1%). Fewer individuals reported never hunting in the county where they live and hunting in other counties (19.5%) or only hunting the county where they live (16.7%). When asked, 153 respondents indicated that they planned to hunt another county outside of their home county during the 2020-2021 deer hunting season.

Respondents were asked to report all types of equipment they used during the 2019-2020 deer season. The most common responses were modern inline muzzleloaders (62.8%), compound bows (52.4%), high-powered rifles (47.5%), crossbows (44.2%), and shotguns (31.1%). Fewer respondents indicated using pistol-caliber rifles or low-powered rifles (19.1%), traditional muzzleloaders (11.4%), handguns (6.0%), traditional bows (3.8%), or modern recurve bows (1.6%).

Opinion of the Special Antlerless Firearms Season. Respondents were asked to answer a series of questions related to their support or opposition for the Special Antlerless Firearms season. Individuals were asked how confident they were in the statement indicating that our analysis showed that the Special Antlerless Firearms season does NOT significantly increase the harvest of antlerless deer. Most answered that they were not at all confident (37.1%); however, the remaining 62.9% indicated some level of confidence in our analysis: very confident (19.6%), moderately confident (15.8%), somewhat confident (14.7%), and extremely confident (12.5%). Respondents were then asked about their level of agreement or disagreement concerning our analysis and the season's effect on harvest in their county. Slightly more respondents strongly or somewhat disagreed with the analysis (38% and 8%, respectively) than strongly or somewhat agreed (33% and 10%, respectively).

Respondents were asked whether they supported or opposed the Special Antlerless Firearms season. Most respondents either strongly or somewhat opposed the season (45.3% and 9.2%, respectively) and fewer strongly or somewhat supported it (33.8% and 7.1%, respectively). Those who supported the season were asked, ***what reasons do you support having the Special Antlerless Firearm season in [County]?*** Most (61%) selected *it would provide an opportunity to hunt using firearms with my family after Christmas* as their reason. This was followed by the opportunity to hunt deer with a firearm during cooler weather (51%), being able to concentrate on hunting a buck during the regular firearms season (32%), and other reasons (27%) for supporting the season. Respondents who said they opposed the season were asked, ***what reasons do you oppose having the Special Antlerless Firearms season?*** The most selected answer *was too many does are being harvested already, and this would increase the number of does harvested* by 71% of those opposed. This was followed by *this will reduce the deer population by allowing hunters to harvest late-season does that have already been bred* at 55%; *this season would interfere with other hunting opportunities, such as squirrel and rabbit hunting* at 14%, and other reasons not listed at 21%.

Participation in the Special Antlerless Firearms season. Respondents were also asked a series of questions concerning their participation in the special season and what motivated them to participate or not. Asked about recent Special Antlerless Firearms seasons, 48% of respondents reported hunting one in the last five years. Of these hunters, 49% traveled to a county to hunt during the special season. Respondents were then asked to rate their agreement to the statement, ***A Special Antlerless Firearms season will reduce the amount of time I spend on other types of hunting (e.g., waterfowl, upland birds, small game).*** More respondents strongly disagreed or disagreed (42% and 28%, respectively) than strongly agreed or agreed (22% and 5%, respectively).

All respondents were then asked how likely they were to participate in the Special Antlerless Firearms season if it were open in the county in which they live or hunt. More respondents indicated this was extremely or somewhat unlikely (44% and 7%, respectively) than indicated it was extremely or somewhat likely (36% and 6%, respectively). Those who said they were unlikely to hunt the special season were asked to select the reason(s) for their choice. *Too many does are harvested during the regular firearms season* was the most common choice (84%), and *In my county, the number of antlerless deer is so low that I usually reach the limit early in the season*, was the second most common (17%). Fewer selected, *I hunt other species during that time* (8%), *I only harvest bucks* (7%), *My time to hunt is limited, so having another season would not alter when I hunt* (5%), and *I do not use firearms to hunt deer* (3%). Other non-listed reasons were cited by 20% of respondents. Next, those who said they were likely to hunt the special season were asked to select the reason(s) for their choice. *I hunt as much as I can, and this would provide me another opportunity to do so* was selected by 71%. *I have time off from work or school between Christmas and New Year's Day, so I would have more time to hunt during this deer season* was selected by 37%. *I prefer to hang my deer during cool weather. The late season makes it more likely that I can do that* was selected by 32%. *I try but cannot harvest a doe during the regular firearms season. This season would provide additional opportunities to harvest a doe* was selected by 23%, and 17% indicated there was another non-listed reason.

Deer Management Survey: Special Antlerless Firearms Season Questions

A block of questions related to the Special Antlerless Firearms season was included on the 2021 Deer Management Survey (see Chapter 7). A total of 14,576 survey respondents answered questions related to this season.

Participation in the Special Antlerless Firearms Season. Respondents were asked about their participation in the Special Antlerless Firearms season, 24% hunted the 2020-2021 special season, and 38% reported hunting the special season in the last five years. Of those who hunted the 2020-2021 Special Antlerless Firearms season, 36% traveled to a different county from the one they live or normally hunt in to participate in the season. Special Antlerless Firearms season hunters were asked how many days they hunted during the 2020-2021 special season: 16% hunted one day, 28% hunted two, 21% hunted three, 15% hunted four, 14% hunted five, and 7% hunted six to eight days. Asked about their harvest success during the 2020-2021 special season: 78% harvested no deer, 17% harvested one, 4% harvested two, and 1% harvested three or more deer. Respondents were then asked about the reason(s) they did or did not participate in the Special Antlerless Firearms season (Figure 9-1 and 9-2).

Opinion of the Special Antlerless Firearms Season. Next, respondents were asked a series of questions related to their opinion of the Special Antlerless Firearms season. Asked in general what their level of opposition or support for the season was, most indicated they were strongly or somewhat supportive (24% and 19%, respectively) and fewer indicated they were strongly or somewhat opposed (14% and 13%, respectively). Respondents were asked how much confidence they had in our analysis that found the special season does NOT significantly increase the harvest of white-tailed deer. To this statement most were moderately or somewhat confident (31% and 25%, respectively), fewer were either very or extremely confident (18% and 5%, respectively), and still fewer were not at all confident (20%). Respondents were then asked how much they agreed or disagreed with having the Special Antlerless Firearms season in their county, since our analysis found the season does NOT significantly increase antlerless

harvest. To this question slightly more respondents agreed or strongly agreed (21% and 14%, respectively) than disagreed or strongly disagreed (13% and 15%, respectively). Respondents were asked to rate how much they agreed or disagreed with the following statement, ***A Special Antlerless Firearms season will reduce the amount of time I spend on other types of hunting (e.g., waterfowl, upland birds, small game).*** Most respondents disagreed or strongly disagreed (29% and 26%, respectively) and fewer agreed or strongly agreed (6% and 2%, respectively). Finally, respondents were asked to rate the importance of several reasons that they may support or oppose the season (Figure 9-3).

Effects on Deer Harvest

In 2020, there was a statewide increase of 7.8% in the number of firearms hunters who successfully harvested a deer. DNR's preseason analysis estimated an antlerless harvest increase of 6.3% in counties when a Special Antlerless Firearm season was opened; however, participation rates for all hunting activities increased in 2020 because of the COVID-19 pandemic. This change in participation was unequally distributed across the state. Deer Management Units (DMUs) where there was no Special Antlerless Firearms season during 2019 (Northwest, Northeast, West Central, East Central, Wabash Valley, Dearborn Upland, and Southwest) experienced an increase in firearms hunters during 2020. In DMUs that had the season in 2019 (Muscatatuck Plateau and South), the number of firearms hunters stayed flat or decreased in 2020.

Statewide there was a 1.6% increase in the percentage of firearms hunters who harvested does; however, the preseason analysis predicted a 2.0% increase in counties where the Special Antlerless Firearms season was open. In DMUs previously without this late-season hunting opportunity, the percentage of firearms hunters harvesting does increased approximately 2 to 4%. In the DMUs that previously had this late-season hunting opportunity, the number of hunters who harvested does stayed flat or decreased up to 6%.

The number of antlerless deer harvested per successful antlerless deer hunter increased 1.2% statewide. The preseason analysis predicted an increase of 4.3% in counties where the Special Antlerless Firearms season was established. The actual change was slightly lower in DMUs, with a newly established season ranging from -0.5 ± 0.9% to 3.3 ± 0.6% (Figure 9-4). This may be because there was no corresponding increase in county bonus antlerless quota (CBAQ). In the Muscatatuck Plateau DMU, there was a 3.1 ± 2.2% increase in the number of does harvested per hunter; however, there was a corresponding increase in CBAQ in half of the counties in the DMU.

Because overall effort increased in 2020, we normalized the increase in antlerless harvest by subtracting the increase in antlered harvest to determine the overall effect of establishing a statewide Special Antlerless Firearms season. There was a net increase in antlerless firearms harvest in all DMUs with a newly established special antlerless firearms season, except for the Wabash Valley DMU, which saw a decrease. There was a net decrease in antlerless firearms harvest in DMUs with previous late-season hunting opportunities. Statewide, the net increase in antlerless firearms harvest was 7.5%. Similar results were observed for total antlerless harvest (Figure 9-5), with a statewide net increase in total antlerless harvest of 2.5%. The preseason analysis predicted an overall increase of 6.3% in total antlerless harvest. This lower-than-expected increase in antlerless harvest may be a result of a spatial shift in hunting effort with the establishment of a statewide Special Antlerless Firearms season, changing hunting behavior because of the COVID-19 pandemic, a shift in effort from regular Firearms season to the Special Antlerless Firearms season, or other factors affecting hunter behavior.

Literature Cited

Caudell, J. N. and O. D. L. Vaught. 2020. 2019 Indiana White-tailed Deer Report. Indiana Department of Natural Resources, Bloomington, USA.

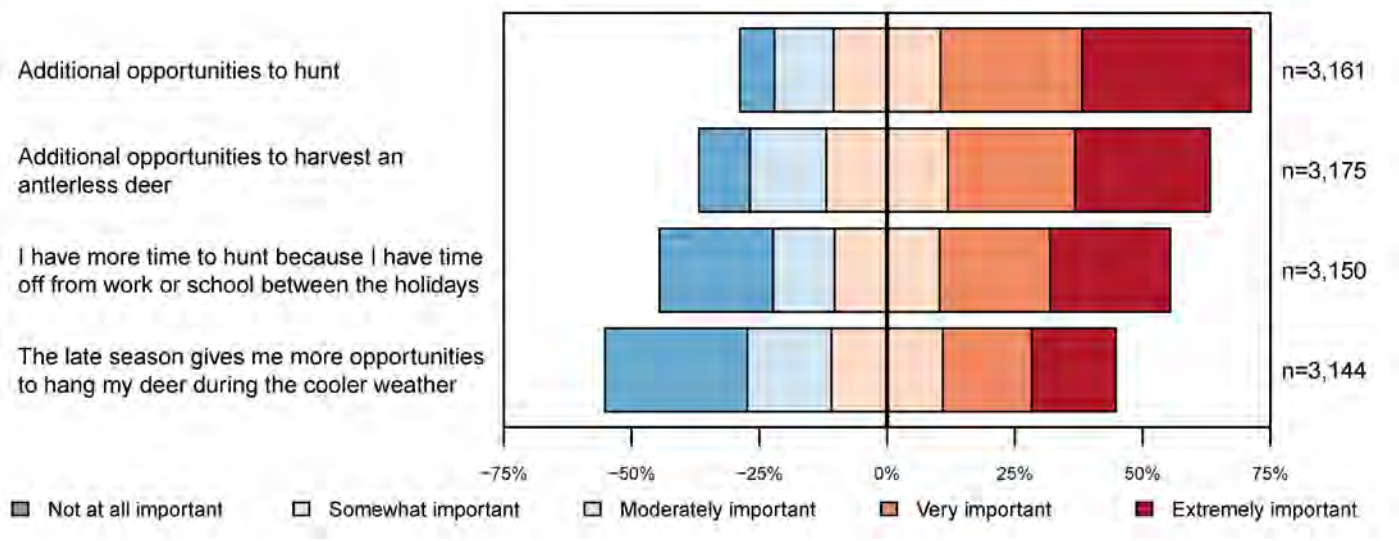

Figure 9-1. Hunters in Indiana who hunted in the 2020-2021 Special Antlerless Firearms season were asked how important these considerations were in deciding to participate in the season.

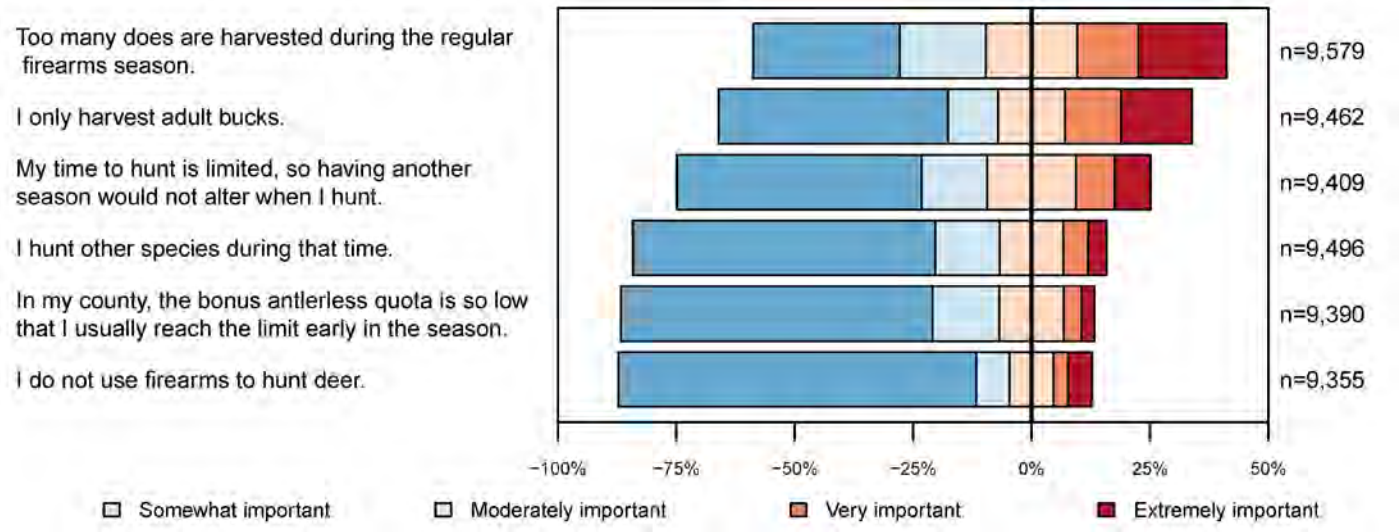

Figure 9-2. Hunters in Indiana who did NOT hunt in the 2020-2021 Special Antlerless Firearms season were asked how important these considerations were in deciding NOT to participate in the season.

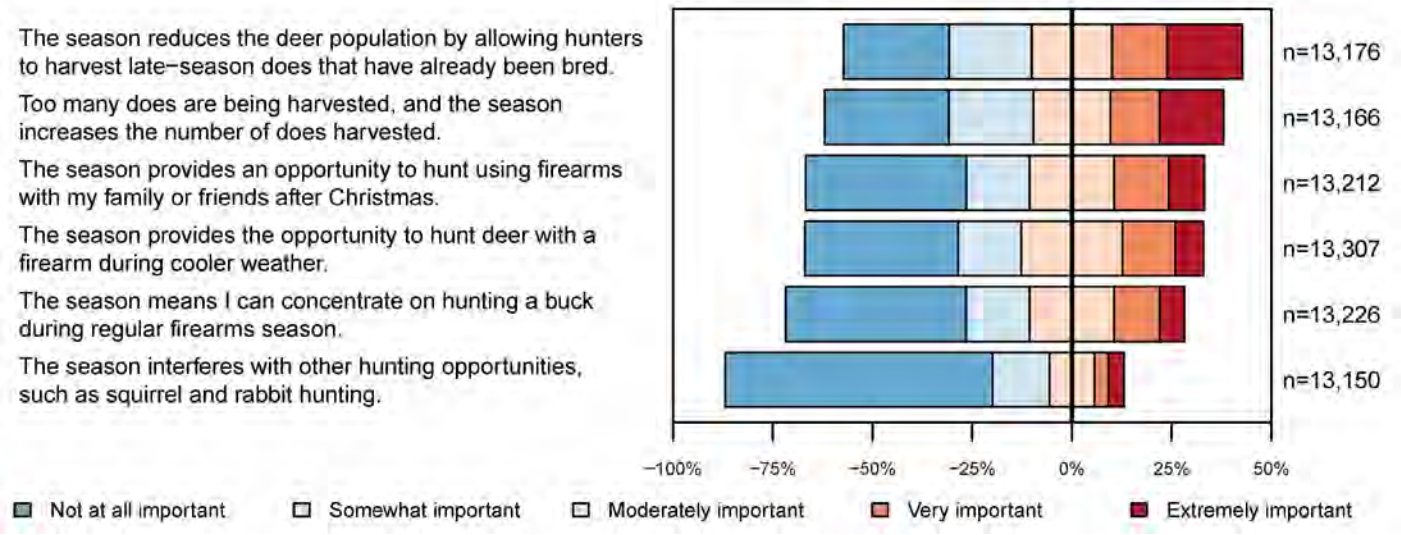

Figure 9-3. Hunters in Indiana were asked how important these considerations are when deciding to support or oppose the Special Antlerless Firearms season.

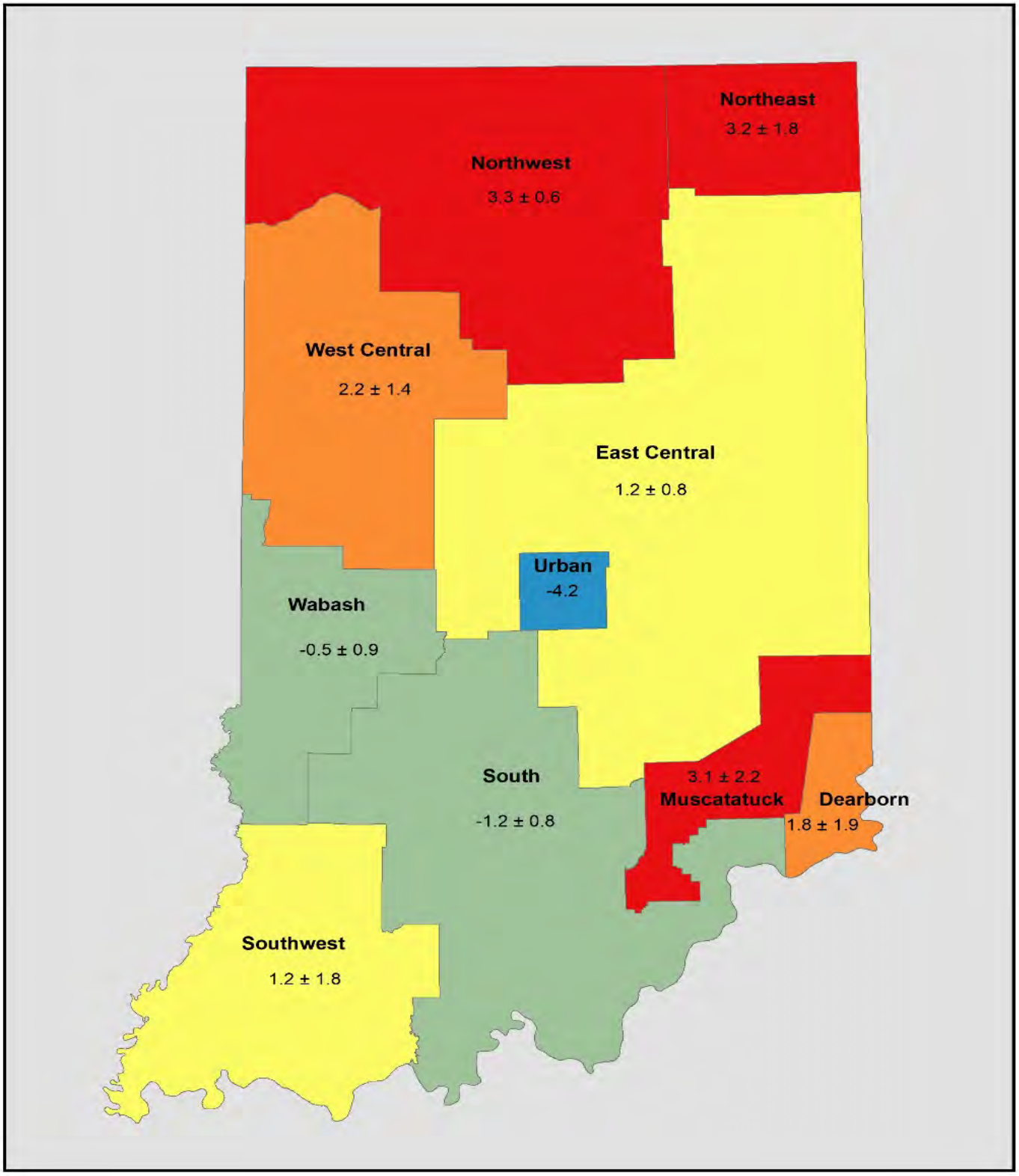

Figure 9-4. Average percentage change in the number of antlerless deer harvested per successful antlerless deer hunter from 2019 to 2020 in Deer Management Units in Indiana.

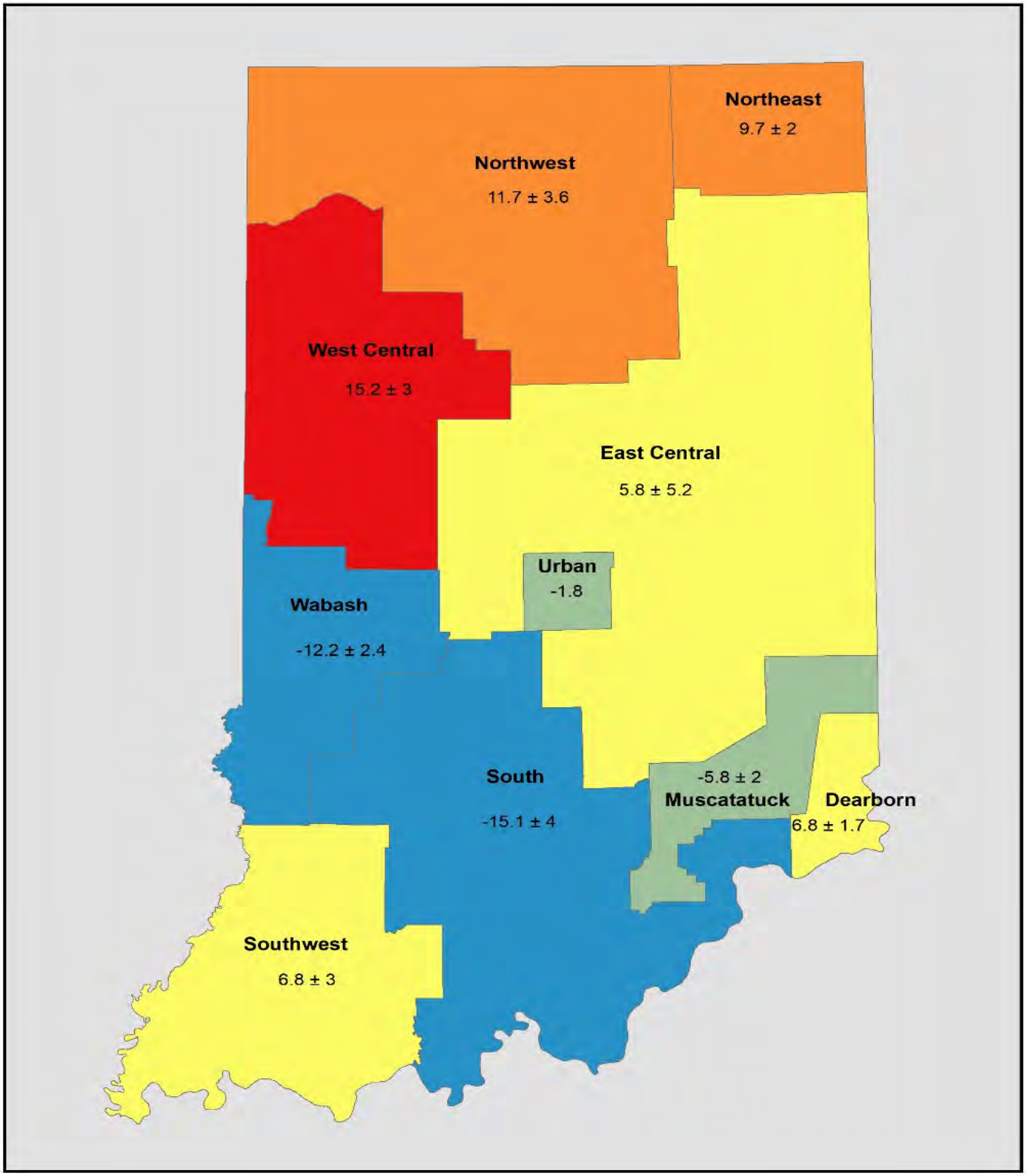

Figure 9-5. Average percent change in the net antlerless total harvest. This was calculated by subtracting the average percent change in antlered harvest from the average percent change in antlerless harvest from 2019 to 2020 in Deer Management Units in Indiana.

REGIONAL CWD RISK ASSESSMENT FOR THE MIDWEST

Emily McCallen, *Indiana Department of Natural Resources*

Surveillance is key for detecting and monitoring emerging chronic wasting disease (CWD) outbreaks. Given the limited resources of state wildlife agencies, effective disease surveillance programs must be carefully designed to minimize costs while maximizing the ability to detect the disease on the landscape (Walsh and Otis 2012). This can be achieved by targeting deer for sampling based on their age and condition or by targeting counties based on disease risk factors. Indiana has incorporated demographic weighting (Jennelle et al. 2018) in our CWD surveillance program (Caudell and Vaught 2020), but the only disease risk factor currently considered to define targeted surveillance regions is distance to the nearest infected deer herd (Caudell and Vaught 2020). However, other hazards may make deer herds in a particular county or township more likely to experience CWD infection even if they are not close to an infected deer herd.

Several risk hazards for CWD infection have been hypothesized, including the presence of captive cervid facilities, processors, and taxidermists; movement of deer carcasses across state lines; soil type; and deer population size (Walsh and Otis 2012; Schuler et al. 2018); but with little data available to quantify estimates, we rely on expert judgment to assign weights to these factors. Structured expert elicitation combines the judgment of multiple experts, which often increases accuracy and is designed to minimize common biases (Burgman 2016). Using structured-expert elicitation instead of relying on the judgment of a single expert can lead to positive outcomes, including increased transparency (Burgman 2016). We conducted a structured expert elicitation of Midwest deer biologists to identify CWD disease risk factors and estimate surveillance weights for spatial sampling units. The ultimate objective of this study was to develop a tool to inform CWD surveillance in sampling units where CWD has yet to be detected, based on measurable characteristics judged by experts to influence disease risk.

Methods

This project was a collaboration between the Indiana Division of Fish & Wildlife and the Ohio Division of Wildlife. We proposed the regional risk assessment via expert elicitation to the Midwest Deer Study Group in August 2020; and upon agreement from representatives from the 12 member states and one member Canadian province, completed the process during the fall and winter of 2020. We invited any biologist chosen to represent their state at the 2020 Midwest Deer Study Group meeting to participate. The expert elicitation included two phases: CWD risk hazard identification and CWD risk assessment.

During CWD risk hazard identification, we asked participants to rank the importance of 10 risk factors that have previously been hypothesized to increase the probability of CWD introduction or increase the rate of spread or persistence in a deer population (Table 9-1). We also asked about the availability of data for each risk factor, to ensure we developed a tool that was applicable for most states. After the survey, we chose four risk factors to include in the risk assessment that were universally highly ranked and for which most participants had available data to measure. The risk factors included in the assessment were number of captive cervid facilities, number of taxidermists and processors, number of out-of-area hunters, and wild cervid density/abundance.

For the CWD risk assessment, we asked the experts to evaluate the risk of 12 scenarios with different levels of risk hazards and used values from these responses to estimate risk for another 12 scenarios (Cain 2001). For each representative scenario, we asked participants to consider a township with a specific combination of risk factors. For example, our lowest risk scenario was a township with no captive cervid facilities, no taxidermists or processors, a low number of people who travel out-of-area to hunt, and low wild cervid abundance. We then asked participants to estimate the lowest, highest, and most likely probability of CWD occurring annually. We also asked participants to rate their confidence that the true probability falls within the given range. This four-step procedure provides an explicit accounting of expert uncertainty and can help reduce overconfidence in estimates (Speirs-Bridge et al. 2010). After experts assessed all scenarios, we asked them to rank the four hazards and provide a rationale for their responses.

We provided all participants with a comparison of their answers and the anonymized answers of the other participants and allowed them to update any of their estimates. We then graphed risk values to estimate a unique probability distribution for each of the remaining scenarios for each participant (Cain 2001). These individual estimates and interpolations were combined with simple averaging to develop a group distribution for each scenario (Clemen and Winkler 1999). We estimated the relative importance of each risk factor by subtracting the average risk of all scenarios containing the lowest level of the factor from the average risk of all scenarios containing the highest level of the factor.

We used the unique risk estimates for the 24 scenarios to quantify risk at the township and county scales in Indiana. The number of captive cervid facilities and taxidermist/processors were assessed at the township level. All captive cervid facilities, taxidermists, and processors are required to register with the Indiana Department of Natural Resources (DNR). If at least one captive cervid facility or taxidermist/processor fell completely within a township, that risk factor was considered present.

Out-of-area hunters and wild cervid density were assessed at the county level. To estimate out-of-area hunters, we used data from the 2020 Indiana Deer Management Survey (Caudell and Vaught 2020). We estimated the percentage of individuals in each county who had hunted in a state with confirmed CWD infections and categorized counties as low or high risk for out-of-area hunters.

Wild cervid density was estimated using the five-year average antlered deer harvest divided by the county area (mi^2). We used antlered deer harvest as a proxy for wild cervid abundance because most Indiana hunters want to harvest a buck, and antlered deer limits are spatially consistent across the state (Caudell and Vaught 2020). We then categorized counties as low, medium, or high risk for the wild cervid density risk factor.

Townships were assigned the risk levels of the counties that they fell completely within for county-level risk factors. Once townships had risk assignments for all identified risk factors, they were assigned most likely, lower, and upper risk estimates from the estimated and interpolated risk scenarios. County-level risk estimates were aggregated using a simple average of estimates from townships within each county.

Results

The survey for the CWD risk hazard identifications was sent to 28 individuals identified as agency contacts for the Midwest Deer Study Group. We received completed surveys from 21 individuals representing all 13 of the geographical units associated with the group. We chose four risk factors that ranked highly to include in the risk assessment (Table 9-1). We decided not to include the highly ranked hazard distance to nearest free-ranging CWD positive infection (median rank=1), because this risk factor can be quantified using spatial modeling. Likewise, we chose not to include amount of prior CWD surveillance (median rank=4.5), because it does not affect the disease process but rather the detection probability.

The materials for the risk assessment were sent to the 21 individuals who completed the CWD risk hazard identification survey. We received completed estimates from 13 individuals representing 11 of the geographical units associated with the Midwest Deer Study Group. There were no individuals who opted to update their estimates after the initial reporting of results. There was a high level of agreement between biologists' risk factor rankings and the importance of each risk factor based on the scenario estimates (Table 9-2). The presence of captive cervid facilities had the greatest estimated importance, followed by number of out-of-area hunters, the presence of taxidermists/processors, and wild cervid abundance. Mean risk estimates ranged from 0.07 (0.03-0.18; 80% CI_{80}) for the lowest risk scenario to 0.51 (0.32-0.74;80% CI_{80}) for the highest risk scenario.

Applying the Risk Analysis to Indiana

In Indiana, 318 registered captive cervid facilities were present in 186 townships (n=1,011), and 841 registered taxidermists and/or processors were present in 526 townships. Of 92 counties, 52 were classified as low for out-of-area hunters (6%-16% hunt in CWD-positive states), and 40 were classified as high for out-of-area

hunters (17%-27% hunt in CWD-positive states). For wild cervid abundance, 45 counties were classified as low density (0.06-0.16 antlered deer harvested/mi^2), 40 counties were classified as medium density (1.64-2.96 antlered deer harvested/mi^2), and seven counties were classified as high density (3.19-4.60 antlered deer harvested/mi^2). Townships within counties had similar risk estimates. The highest risk counties occurred in the northwestern portion of the state (Figure 9-6), though there are also high-risk clusters in the central region of the state. These risk estimates, along with CWD sampling history will be used to prioritize counties with high estimated risk and low historical sampling for rotational CWD disease surveillance.

Literature Cited

Burgman, M.A. 2016. Trusting judgements: how to get the best out of experts. Cambridge University Press, Cambridge, UK.

Cain, J. 2001. Planning improvements in natural resource management. Centre for Ecology and Hydrology, Wallingford, UK.

Caudell, J. N. and O. D. L. Vaught, editors. 2020. 2019 Indiana White-tailed Deer Report. Indiana Department of Natural Resources. Bloomington, Indiana.

Clemen, R. T. and R. L. Winkler. 1999. Combining probability distributions from experts in risk analysis. Risk Analysis 19:187-203.

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 surveillance approach to detect chronic wasting disease in white-tailed deer. Journal of Applied Ecology 55:2944-2953.

Schuler, K. L., N. Hollingshead, J. D. Kelly, R. D. Applegate, and C. Yoest. 2018. Risk-based surveillance for chronic wasting disease in Tennessee. Tennessee Wildlife Resources Agency. Nashville, Tennessee.

Speirs-Bridge, A., F. Fidler, M. McBride, L. Flander, G. Cumming, and M. Burgman, 2010. Reducing overconfidence in the interval judgments of experts. Risk Analysis: An International Journal 30:512-523.

Walsh, D. P., and D. L. Otis. 2012. Disease surveillance: incorporating available information to enhance disease-detection efforts. Pages 11-23 in D. P. Walsh editor. Enhanced surveillance strategies for detecting and monitoring chronic wasting disease in free-ranging cervids. U.S. Geological Survey, Reston, Virginia, USA.

Table 9-1. CWD risk factors ranked by Midwestern deer biologists for inclusion in the regional CWD risk assessment.

CWD Risk Factor	Median Ranking
Deer density/abundance	3
Number of captive cervid facilities	3
Number of wildlife rehabilitators	8.5
Number of taxidermists and processors	6
Number of resident hunters that hunt out of management unit	6
Distance to nearest free-ranging CWD positive detection	1
Hunter density	8
Amount of deer habitat	6.5
Presence of deer wintering areas	9
Amount of prior CWD surveillance	4.5

Table 9-2. CWD risk factors included in the regional CWD risk assessment and their assigned importance based on ranking and scenario assessment by Midwestern deer biologists.

CWD Risk Factor	Median Ranking	Mean Importance
Captive cervid facilities	1	0.14 ± 0.03
Out-of-area hunters	2	0.09 ± 0.02
Taxidermists/processors	3	0.07 ± 0.02
Wild cervid abundance	3.5	0.04 ± 0.01

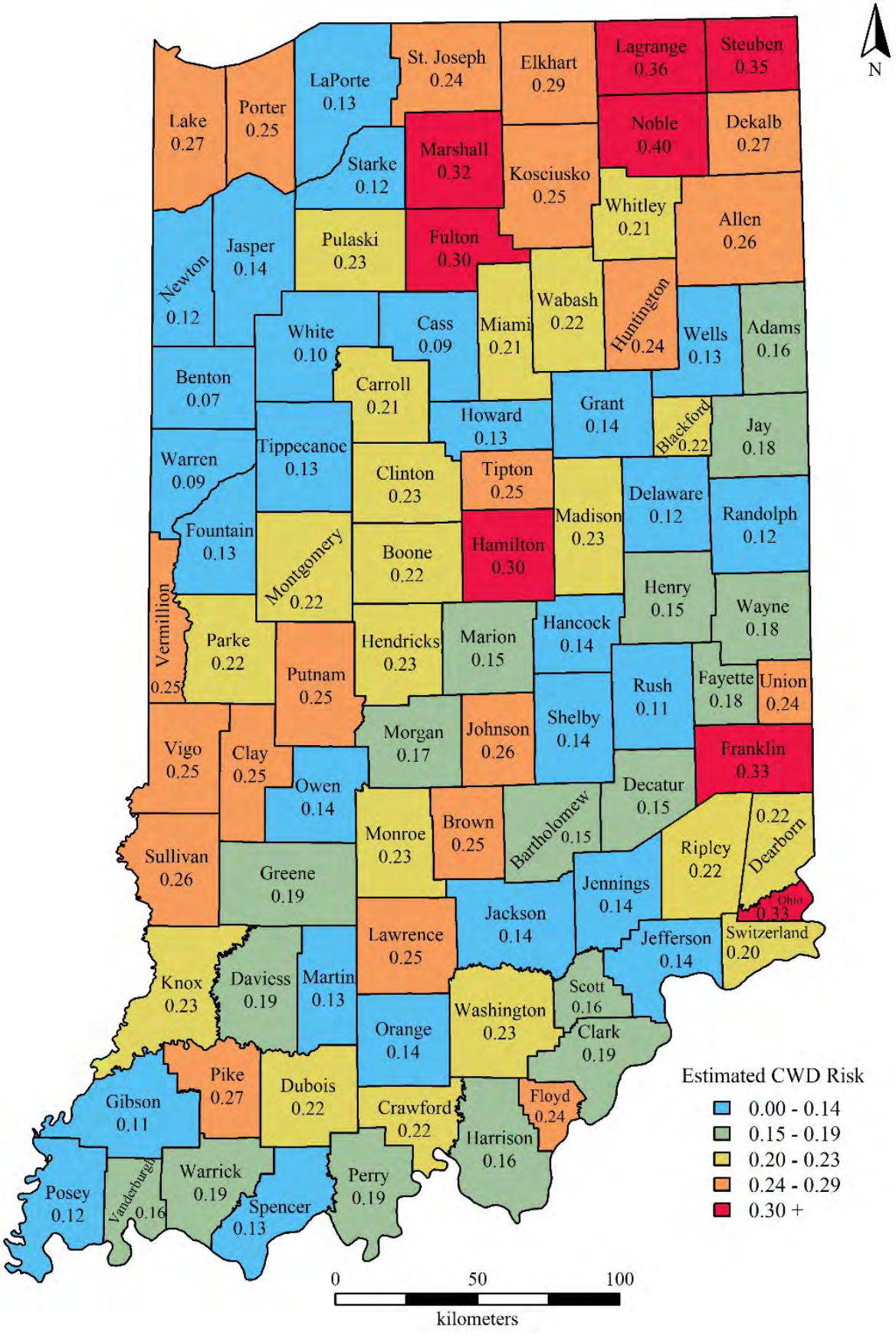

Figure 9-6. Indiana county CWD risk estimates based on the presence of captive cervid facilities, the number of out-of-area hunters, the presence of taxidermists/processors, and deer densities.

Snapshot IN Photo

CHAPTER 10.
EXTERNAL DEER RESEARCH

Studies described in the External Deer Research chapter are projects being conducted by university partners to better understand deer and inform management decisions in Indiana.

Integrated Deer Management Project. Three of the following studies are part of a collaborative deer management project between Indiana DNR and Purdue University. The project identified 10 regional management units (RMUs) in Indiana that serve as project study areas. Currently, studies are being conducted in RMUs 3, 4, and 9 (Figure 10-1). RMU 3 includes nine primarily agricultural counties spanning from Newton County south to Montgomery County. RMU 4 stretches from Morgan County south to the Ohio River. These 16 counties are mostly forested and unglaciated; they include many state and federal properties such as Brown County State Park, Martin State Forest, and Hoosier National Forest. RMU 9 is in Indiana's natural lakes region in the northeast corner of the state. Land cover is a mix of woodlots, wetlands, forested riparian areas, cultivated crops, and pasture.

Indiana DNR adapted the RMUs into deer management units (DMUs; Figure 3-13) to make them more suitable for management applications. The DMUs are referenced throughout the Indiana White-tailed Deer Report and have slightly different county groupings and labels than the RMUs.

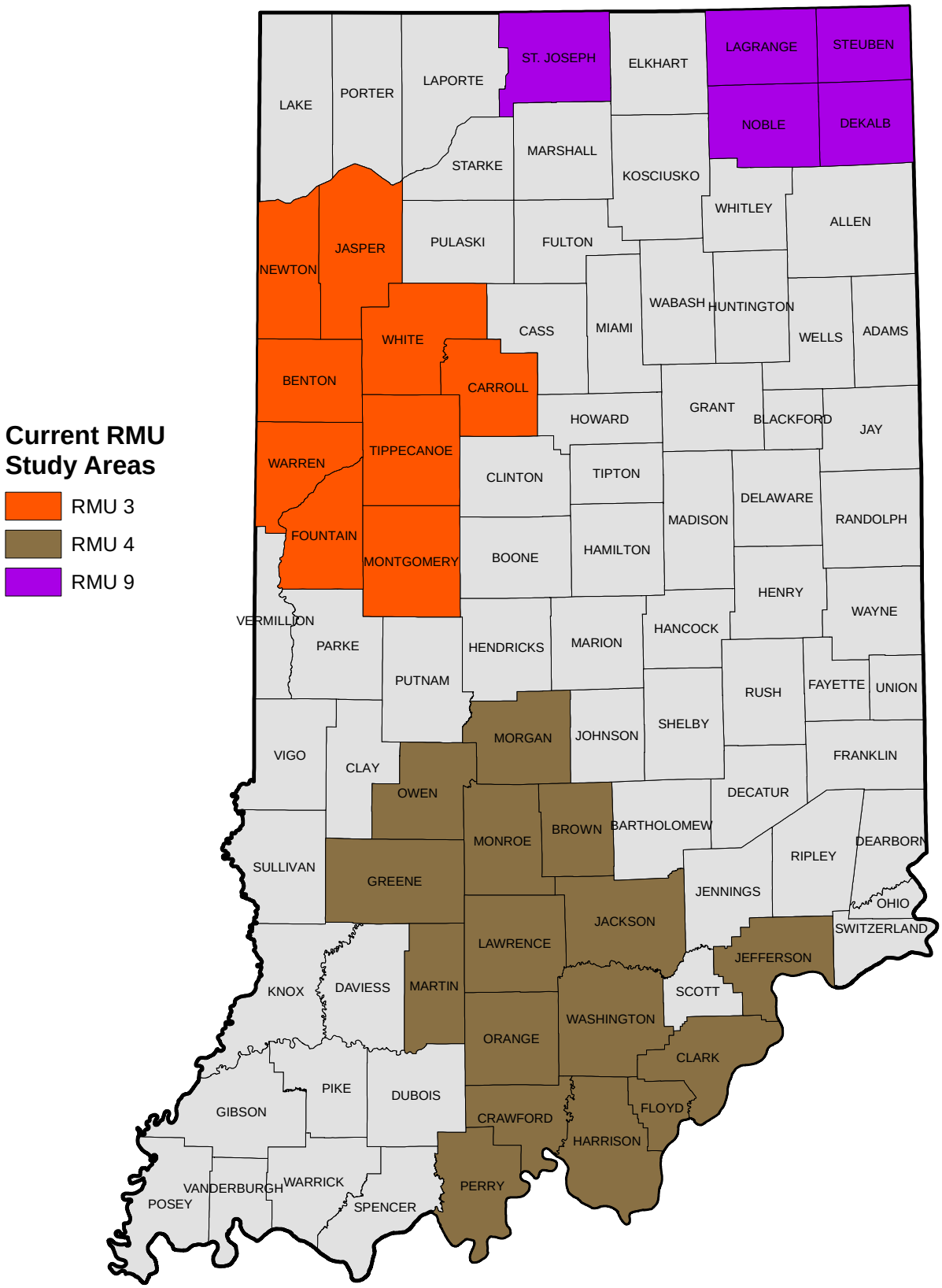

Figure 10-1. Current regional management unit (RMU) study areas for Purdue University deer management research projects.

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 an important metric used when making management decisions. Several methods for estimating deer population density are effective (Mandujano and Gallina 1995), but many 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 has collaborated with Purdue University to evaluate density estimation methods and increase reliability and cost-effectiveness in large-scale monitoring. To accomplish this, Zackary Delisle, a Ph.D. student from the Department of Forestry and Natural Resources at Purdue University, is estimating deer density in Regional Management Units (RMUs) 3, 4, and 9 (Swihart et al. 2020) using three different methods: fecal-pellet transects, trail cameras, and aerial surveying from a small airplane. These density estimates will be conducted from 2019 to 2021 and then later evaluated for cost, accuracy, and precision.

Each method uses a "distance sampling" approach to estimate deer density (Buckland et al. 2001, Buckland et al. 2004). The concept of distance sampling is simple and logical: as the distance between a surveyor and a deer increases, the surveyor is less likely to detect the 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 generate deer density estimates using 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, deer density estimates can be calculated using the following: 1) the defecation rates of deer (how many times a deer defecates per day); 2) how long fecal-pellet groups persist in nature before degrading beyond recognition; and 3) the time period during which fecal pellets could have been deposited. Surveyors walk and search along randomly placed 200-meter paths, or transects, for fecal-pellet groups during March and April. The distance from the transect line to each detected pellet group is measured to calculate the detection function for density estimation. Separate projects also are being conducted to determine how long fecal-pellet groups persist in nature before degrading beyond recognition and the time over which fecal pellets have been deposited. Deer defecation rates from prior projects will also be incorporated.

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

Purdue University will also 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 similar to walking transects and searching for fecal-pellet groups on foot; however, instead of walking randomly placed transects, transects are systematically flown in an airplane; and instead of searching for fecal-pellet groups, infrared cameras are used to search for deer from the airplane. A high-resolution digital camera also is used to confirm that an infrared signature detected by the camera is a deer rather than a goat, cow, sheep, coyote, or other mammal generating a similar infrared signature (Franke et al. 2012). Distance from the centerline of the transect to each infrared signature is measured using

Snapshot IN Photo

computer software and is used to calculate the detection function for estimating deer density. Aerial transects are conducted during February in the same areas fecal-pellet and trail-camera surveys 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. We thank every landowner that has provided us access to their property to conduct this research. Your support has made this project possible.

2020 Project Results

From February 20 to March 18, 2020, we surveyed at total of 281 pellet transects (34.9 mi) and found 1,438 pellet groups. In permanent cover, we surveyed 199 transects and found 1,248 pellet groups, and in row crop, we surveyed 82 transects and found 190 pellet groups. Deer density estimates (deer/mi^2) from pellet sampling were 12.483 (CI_{95}=7.953, 12.595), 43.242 (CI_{95}=32.771, 57.058), and 31.438 (CI_{95}=22.458, 44.009) for RMUs 3, 4, and 9, respectively. These estimates will be adjusted further as more information from an ongoing pellet-decay study is incorporated into the model.

From February 4 to March 22, 2020, we deployed 478 trail cameras; of these, 143 were deployed in row crops and 335 in permanent cover. Two cameras were stolen from the project during their deployment. In total, we captured 1,121,406 photos from the remaining 476 cameras, and estimated deer densities of 3.326 (CI_{95}=1.895, 5.836), 6.077 (CI_{95}=4.459, 8.281), and 14.757 (CI_{95}=10.645, 20.456) deer/mi^2 for RMUs 3, 4, and 9, respectively.

Due to equipment complications and COVID-19-induced shutdowns, limited transects were only flown in RMU 3 during 2020.

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, 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.

Swihart, R.K., J.N. Caudell, J.M. Brooke, and Z. Ma. 2020. A flexible model-based approach to delineate wildlife management units. Wildlife Society Bulletin 44:77–85.

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 HABITAT INDICATORS AND DEER

Richard D. Sample, Michael A. Jenkins, Jarred M. Brooke, *Purdue University*

White-tailed deer rely on nutrients obtained from plants for reproduction, growth, and antler production (Tajchman et al. 2018), but high deer browsing intensity may reduce habitat quality (Rooney and Waller 2003). Thus, there is a need to accurately assess the impact deer have on plant communities to inform evaluations of deer densities in relation to their habitat. Deer densities and landscape characteristics vary across Indiana; because of this, techniques are needed to assess deer browsing impacts across a range of conditions. We are using three different techniques to evaluate the effects deer have on landscapes across the state. First, we are evaluating different methods to measure deer browse intensity in woodlots. Second, we are examining the effects of deer densities, browsing intensities, and landscape characteristics on woodlot plant communities. Last, we are examining diet composition of deer and how it relates to plant species availability.

We also developed a smaller-scale study to evaluate the use of stump sprouts for monitoring impacts of deer browsing. Ecological indicators of deer browse intensity need to be both highly available to deer and tolerant to deer browse. Stump sprouts meet both criteria. Root stock of stumps have large carbohydrate reserves, which allows sprouts to grow quickly and tolerate deer browsing (Bond and Midgley 2001, Poorter et al. 2010). Deer browsing directly impacts the growth rate of sprouts, which makes sprout growth an indicator of browsing intensity (Royo et al. 2016). Given that rapid growth requires many nutrients and that uptake by large root systems may concentrate nutrients in sprouting tissues, stump sprouts potentially offer a more nutritious food source than parent stems. Due to its glacial history, Indiana has variable soil productivity across the state and differences in historic and contemporary land use. Therefore, it is likely that stump sprout nutritional composition varies across the state. Many tree species common in Indiana sprout prolifically (Murphy et al. 2006, Kashian 2016, Royo et al. 2016), making them ideal candidates for the creation of stump sprouts. We designed our study to evaluate different sprouting capabilities, nutrient responses, deer browsing response, and regional effects across stump sprouts from six common hardwood species that occur in Indiana.

Methods

Along paths, or transects, within woodlots, we measured the density of overstory trees, saplings, and seedlings by species, the number of browsed and available twigs, and browsing intensity. We measured browsing intensity using three different methods. First, proportional browse, which is calculated by tallying all browsed and available twigs, indicates the proportion of available twigs that are browsed. A twig is considered available for browse if it is 8-71 inches off the ground, which is known as the “molar zone” where deer browse the most. Using these data, we also determined which species are preferred or avoided for browse. Second, we determined twig age, which represents the number of years since a twig has been browsed (Waller et al. 2017); a low twig age indicates a high browsing intensity because it has been fewer years since the twig was last browed. The final method we used was the oak sentinel method, which involves planting red oak species, a highly preferred species by deer (Wakeland and Swihart 2009). For this, we planted 10 seedlings inside and 20 seedlings outside of exclosures and monitored the growth, browsing, and survival rates of these seedlings, all of which may be indicators of deer browsing intensity.

In 2020, we sampled five new test landscapes in RMUs 4 and 9, and three new test landscapes in RMU 3. We repeated two test landscapes in each RMU to control for year-to-year variation. In total, we sampled 68 woodlots, 47 of which were new. RMU 9 had the most woodlots (36), 29 of which were new. RMUs 3 and 4 had 17 and 15 woodlots respectively, nine of which were new in each. In total, we sampled 247 transects, including 172 new transects. We constructed 39 new exclosures and planted 1,680 red oak seedlings across all RMUs (630 in RMUs 4 and 9, and 420 in RMU 3).

For our stump sprout study, we created 540 stumps at nine different stands across the southern, central, and northern regions of Indiana during June and July of 2020; however, sites were not selected based on RMUs because of logistic constraints. At each site,

we created 60 stumps (30 from each of two preferred hardwood species depending on what was available at the site). We protected 10 stumps per species with an exclusion cage, and the remaining 20 stumps per species were left unprotected. After felling trees, we collected leaf samples to use for nutrient analysis and later compared these results from parent trees to their stump sprouts. We returned to our stands later in the summer to assess the abundance, height growth, browsing frequency, and survival rates of the sprouts. We also collected leaf samples from stump sprouts and neighboring stems of the same species to compare nutrient concentrations of available browse between stump sprouts and standing stems.

Preliminary Results

Browsing Intensity. In year two of our data collection, proportional browse of species that were not strongly avoided was highest in RMU 4, with 31% of all available twigs browsed. The respective percentages of browsed non-avoided twigs in woodlots in RMUs 3 and 9 were lower with 14% and 18% of twigs browsed.. For twig age, our target species were originally maple and ash because they are common throughout the state and tolerant to deer browse; however, we also sampled sassafras and hackberry in some woodlots because they were locally abundant, could be aged with this method, and were browsed by deer. Twig age was similar across all RMUs, with an average age of 2.9 years in RMU 4, 3.0 years in RMU 3 and 3.1 years in RMU 9. The proportion of planted oak seedlings browsed was similar in RMUs 3 and 4 at 43%. Proportion of oaks browsed was lowest in RMU 9 at 31%. Browsing did not seem to impact oak height growth, as RMUs 3 and 9 had similar increases in height (19% and 18%, respectively), while heights in RMU 4 increased by 24%. Overall, browsing intensity results were similar to those measured last year (see 2019 Indiana White-tailed Deer Report): browsing intensity appears to be lowest in RMU 9 and similar in RMUs 3 and 4 (Table 10-1).

Vegetation Communities. Identifying preferred browse species is beneficial to landowners who manage their forest for quality deer habitat, as it provides managers with guidance on what species to increase in availability (preferred species) and what species to decrease in availability (avoided species). Using the number of available and browsed twigs sampled in 2020, we sorted species into five different browse preference groupings: strongly preferred, marginally preferred, intermediate, marginally avoided, and strongly avoided (Tables 10-2, 10-3, and 10-4).

Basal area of oak species is a strong predictor of acorn production (Long et al. 2018) because the number of acorns produced increases with oak basal area. Basal area estimates the average amount of area occupied by tree trunks. Red oak group species (including northern red oak, black oak, pin oak, scarlet oak, and shingle oak) had the highest basal area in RMU 4 at 22 ft^2/acre. Basal areas of red oak group species in RMUs 3 and 9 were similar at 15 and 13 ft^2/acre, respectively. Basal area of white oak group species (including white oak, swamp white oak, chinkapin oak, bur oak, and chestnut oak) was also highest in RMU 4 at 22 ft^2/acre; However, basal area of white oaks in RMU 3 was lower at 13 ft^2/acre, and RMU 9 only had 4 ft^2/acre (Table 10-5).

Density of saplings (individual stems greater than 4.5 feet tall and smaller than 4 inches in diameter) with branches in the molar zone was highest in RMU 9 (903 saplings/acre), followed by 738 saplings/acre in RMU 3, and lowest in RMU 4 at 636 saplings/acre. Density of non-avoided seedlings in the molar zone (8-71 inches tall) was also highest in RMU 9 with 10,361 seedlings/acre, while RMUs 4 and 3 had 8,136 and 7,297 seedlings/acre, respectively (Table 10-5).

Diet composition. In 2020, we collected 89 pellet groups across all three RMUs. We collected the most groups in RMU 4 (36), followed by RMU 3 (32) and RMU 9 (21). We are currently working to identify plant species found in collected pellet groups using genetic analysis.

Stump sprouts. We created stump sprouts using hackberry, sugar maple, white ash, red oak, sassafras, and red maple midstory trees (Table 10-6). Overall, species had the greatest influence on sprouting performance. All hackberry, red oak, and white ash stumps sprouted. Maple species sprouted less consistently at 85% for red maple, followed by sugar maple (59%). Sassafras was the worst sprouter with only 37% of stumps producing sprouts. Region (e.g. north, central, or south) had no effect on whether a stump sprouted; however, in the central and northern regions, diameter at breast height (DBH) of the parent

tree (measured before the tree was cut to a stump) and canopy cover influenced sprouting, with stumps created from smaller trees under more-open canopies sprouting better. Hackberry stumps produced an average of 31 sprouts per stump, which was more than any other species. Red maple, red oak, and white ash all produced a similar average number of sprouts per stump, with 12, 17, and 14 sprouts, respectively. Sassafras had the lowest average number of sprouts per stump (<1 per stump), and sugar maple averaged four sprouts per stump. As expected, the presence of an exclusion cage impacted the height of the tallest sprout, as sprouts not protected from deer were shorter than those protected from deer (Figure 10-2); however, this was only true for hackberry, sassafras, and sugar maple, as there was no difference in the height of protected and unprotected sprouts of other species (Figure 10-3). These results suggest that hackberry is the best indicator species of deer browse intensity among those we assessed because it was a prolific sprouter (both in number of stumps sprouting and number of sprouts per stump), and the height of the sprouts was affected by deer browsing.

In general, stump sprouts had greater nutrient content than parent and uncut neighbor stems (Table 10-7). This suggests that stump sprouts are a higher quality food source than seed-origin stems. Similar to the sprouting performance data, region of the state had little influence on nutrient content, but there were noticeable differences among species. Overall, hackberry sprouts were the most nutritious while the nutrient contents of other species varied; however, the total digestible nutrients in white ash were noticeably lower than those of other species (Table 10-8). We were unable to examine nutrient contents in sassafras due to their poor sprouting.

We are currently working to determine deer impacts on stump sprouts and evaluate the usage of stump sprouts for deer population and deer browsing intensity indicators. We will also return to stump sprout sites during the 2021 summer to re-collect browsing, height, and nutrient data for stump sprouts and their neighboring trees to determine if nutrient content and browse rates persist as these stump sprouts age.

Literature Cited

Bond, W. J., and J. J. Midgley. 2001. Ecology of sprouting in woody plants: the persistence niche. Trends in Ecology & Evolution 16:45–51.

Kashian, D. M. 2016. Sprouting and seed production may promote persistence of green ash in the presence of the emerald ash borer. Ecosphere 7:e01332.

Long, J. W., A. Gray, and F. K. Lake. 2018. Recent Trends in Large Hardwoods in the Pacific Northwest, USA. Forests 9:651.

Murphy, H. T., J. VanDerWal, and J. Lovett-Doust. 2006. Distribution of abundance across the range in eastern North American trees. Global Ecology and Biogeography 15:63–71.

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.

Rooney, T. P., and D. M. Waller. 2003. Direct and indirect effects of white-tailed deer in forest ecosystems. Forest Ecology and Management 181:165–176.

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.

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., 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.

Table 10-1. The proportion of twigs browsed and twig ages of non-strongly avoided species, and the proportion of planted red oak seedlings browsed and their growth in woodlots across all RMUs in 2020.

RMU	Test Landscape	County	Browse of Non-Avoided Species (%)	Average Twig Age (years)	Oaks Browsed (%)	Increase in Height Growth (%)
3	29	Montgomery	10	3.21	35	22
3	67	Warren	21	2.43	56	16
3	71	Warren	11	2.09	60	29
3	171	White	21	3.22	33	15
3	172	White	8	4.24	33	14
4	46	Harrison	30	3.54	44	19
4	64	Orange	39	3.46	39	15
4	80	Washington	31	3.22	46	23
4	239	Monroe	29	2.77	38	38
4	261	Brown	25	2	48	19
4	269	Monroe	31	2.64	56	25
4	270	Brown	33	2.84	31	29
9	2	Noble	25	2.51	49	11
9	39	Noble	21	2.84	50	15
9	43	DeKalb	15	3.33	35	15
9	45	DeKalb	15	3.54	30	22
9	46	St. Joseph	18	3.33	25	17
9	52	LaGrange	9	3.05	15	26
9	64	LaGrange	21	3.2	10	17

Table 10-2. Browse preference rankings for species sampled in RMU 3 during 2020.

RMU 3				
Strongly Preferred	Marginally Preferred	Intermediate	Marginally Avoided	Strongly Avoided
Green ash	Slippery elm	American elm	Multiflora rose	Autumn olive
Hackberry		Amur honeysuckle	Swamp dewberry	Spicebush
		Black cherry		
		Black raspberry		
		Blackhaw		
		Pawpaw		
		Sassafras		
		Sugar maple		

Table 10-3. Browse preference rankings for species sampled in RMU 4 during 2020.

RMU 4				
Strongly Preferred	Marginally Preferred	Intermediate	Marginally Avoided	Strongly Avoided
Black oak	Downy serviceberry	Bitternut hickory	Autumn olive	American beech
Blackgum	Dryland blueberry	Black cherry		Common blackberry
Chestnut oak	Sugar maple	Deerberry		Coralberry
Flowering dogwood	White oak	Eastern redbud		Ironwood
Greenbrier		Slippery elm		Multiflora rose
Hackberry		Tulip poplar		Musclewood
Mapleleaf viburnum				Northern Dewberry
Red oak				Spicebush
Red maple				
White ash				
Wild strawberry bush				
Winged burningbush				

Table 10-4. Browse preference rankings for species sampled in RMU 9 during 2020.

RMU 9				
Strongly Preferred	Marginally Preferred	Intermediate	Marginally Avoided	Strongly Avoided
Chokecherry	Bitternut hickory	Black raspberry	American beech	Amur honeysuckle
Green ash	Blackhaw	Common blackberry	Ironwood	Black cherry
	Gooseberry	Hawthorn	Swamp dewberry	Spicebush
	Gray dogwood	Multiflora rose		
	Hackberry	Musclewood		
	Sugar Maple	Red maple		

Table 10-5. Basal area of red and white oak group species, sapling densities, and non-avoided seedling densities in woodlots across all test landscapes studied in 2020.

RMU	Test Landscape	County	Red Oak Group Basal Area (ft^2/acre)	White Oak Group Basal Area (ft^2/acre)	Sapling Density (per acre)	Non-Avoided Seedling Density (per acre)
3	29	Montgomery	7	11	637	10,872
3	67	Warren	8	13	513	7,587
3	71	Warren	1	0	1,295	5,284
3	171	White	16	33	673	5,944
3	172	White	43	8	574	6,799
4	46	Harrison	4	7	243	6,852
4	64	Orange	10	1	857	15,297
4	80	Washington	38	27	397	6,368
4	239	Monroe	19	7	544	7,804
4	261	Brown	41	87	574	8,646
4	269	Monroe	16	11	960	6,612
4	270	Brown	24	15	878	5,391
9	2	Noble	11	1	518	8,942
9	39	Noble	14	0	513	10,026
9	43	DeKalb	17	1	964	12,397
9	45	DeKalb	12	12	1,083	13,413
9	46	St. Joseph	4	0	1,133	7,723
9	52	LaGrange	29	8	1,007	8,942
9	64	LaGrange	2	3	1,104	11,085

Table 10-6. A table of all species used for creating stump sprouts, and how many sites they were found at within each region they were found.

Species	Region	Number of Sites
Hackberry	North	3
Hackberry	Central	2
Red Maple	South	2
Red Oak	North	1
Sugar Maple	North	2
Sugar Maple	Central	2
Sugar Maple	South	2
Sassafras	Central	1
Sassafras	South	2
White Ash	Central	1

Figure 10-2. A protected sugar maple stump with sprouts (A) compared to an unprotected sugar maple stump with sprouts that has been browsed by deer (B).

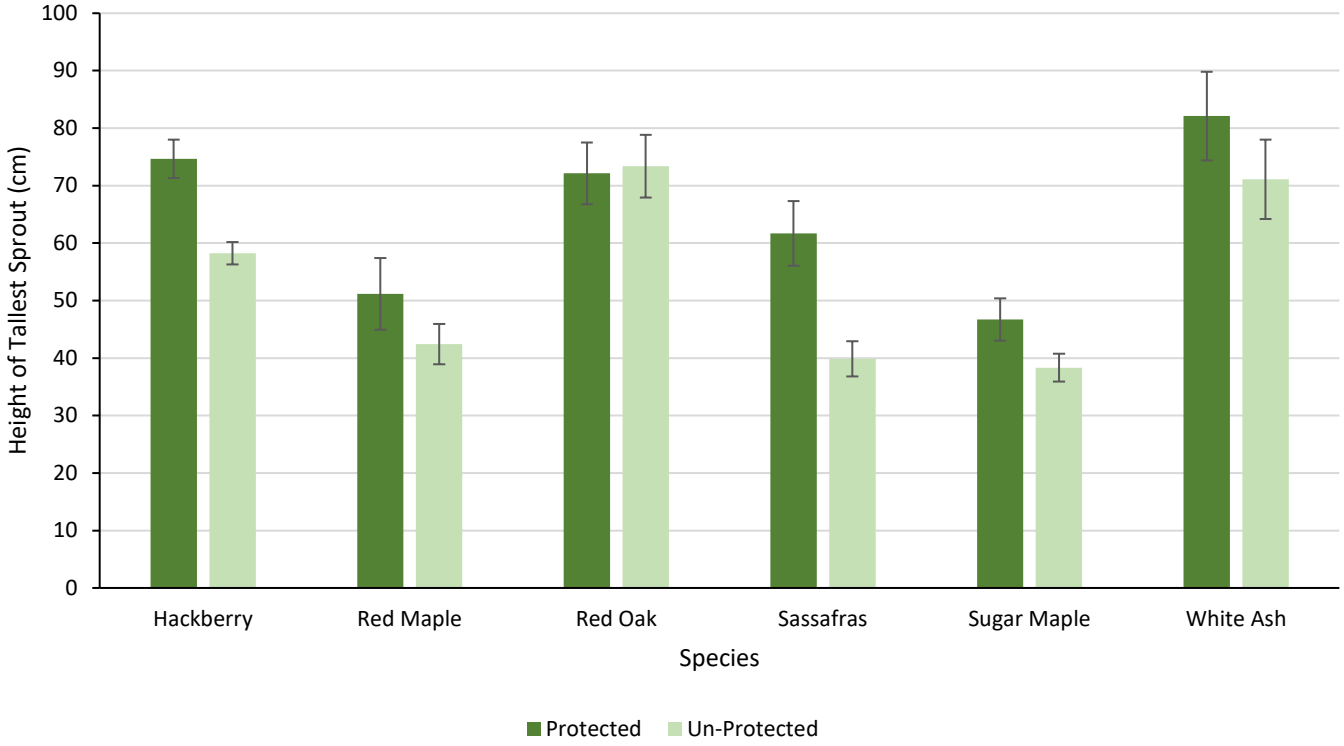

Figure 10-3. Height of tallest sprout for protected and unprotected stumps of all species.

Table 10-7. Nutrient contents in parent trees, stump sprouts, and uncut neighbor trees.

Sample Type	Crude Protein %	Calcium %	Phosphorus %	Potassium %	Total Digestible Nutrients %
Parent Tree	16	1.8	0.23	1.3	68
Stump Sprout	20	1.3	0.35	2	70
Neighbor Tree	15	2.4	0.219	1	64

Table 10-8. Nutrient contents in hackberry, red maple, red oak, sugar maple, and white ash stump sprouts.

Species	Crude Protein %	Calcium %	Phosphorus %	Potassium%	Total Digestible Nutrients%
Hackberry	21	2.5	0.44	2.7	73
Red Maple	11	0.4	0.35	1.5	69
Red Oak	16	0.6	0.2	1.2	63
Sugar Maple	12	0.6	0.34	1.6	72
White Ash	18	1.2	0.29	1.8	56

MEASURING HUMAN VALUES TOWARD DEER OF INDIANA RESIDENTS

Taylor Stinchcomb and Zhao Ma, *Purdue University*

As both white-tailed 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 white-tailed 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 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 the Indiana DNR carry the primary responsibility for applying these goals to local contexts and manage wildlife populations for the equal benefit of their constituents (i.e., all residents of Indiana).

Attaining the public trust ideal in white-tailed deer management faces several challenges. These include arriving at shared goals and clear responsibilities among resource managers and diverse stakeholder groups; accounting for the emotional, cultural, and situational factors that can lead to human-human conflicts over white-tailed deer; and increasing both state transparency about management decisions and public awareness about white-tailed deer ecology and management.

Our study begins to integrate the social dimension into deer management in Indiana to address the above challenges. We use a mixed-methods approach involving semi-structured interviews, a statewide survey, and an integrative phase 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 role do emotions and personal experiences play in shaping perceptions about deer and deer management? How do these interact with other factors such as wildlife values, social-environmental contexts, perceived barriers to engagement, and social group?**

3. **How can social and ecological data be integrated effectively to inform white-tailed deer decision-making in Indiana?**

Phase 1: Qualitative Interviews

During the summer of 2019, we conducted 59 semi-structured interviews and two focus groups (14 participants total) with broad white-tailed deer stakeholder groups including woodland owners (n=15), farmland owners and producers (n=11), deer hunters (n=16), and urban area residents (n=17). Interviewee properties, including hunting lands and farmlands or woodlands, were widely distributed across the state (see 2019 Indiana White-tailed Deer Report). Interview transcription, thematic coding, and analysis was conducted throughout 2020. We present the primary findings from our interviews with Indiana stakeholders below.

Results

Across Indiana, residents expressed mixed emotions toward white-tailed deer, regardless of their stakeholder identity. These mixed emotions typically involved an appreciation or awe toward seeing deer, but frustration with deer-related damage to crops, trees, shrubs, ornamentals, or gardens, and anxiety over perceived risks to personal safety. Emotions expressed about deer depend on a suite of situational factors, including people's livelihood, involvement in land management activities, participation in environmental programs or outdoor recreation, when and where deer are encountered, prior experiences with deer or deer

management, and current socio-political circumstances.

Livelihoods and factors of scale. The interviewee's livelihood or land management activities appeared to be the most influential factor shaping their feelings toward deer. When deer interfere with crop and timber yields or hardwood forest regeneration, they elicit frustration and blame. As one woodland owner explained, it *"take[s] a lot of work and expensive money"* to *"replace the walnuts…in our woods" and the deer "come up every night … and they browse around, biting [the walnut seedlings] off"* (WLO08). Conversely, when deer minimally affect livelihoods or land management practices, landowner emotions remain largely positive or tolerant. For example, woodland owners "*enjoy watching the deer"* when they have *"a fairly mature woods"* (WLO13) while farmers who "*don't raise soybeans for a living"* view deer damage to non-market crops as *"inconsequential"* (FARM05). One farmer expressed love for *"seeing the little fawns,"* and admitted that *"I carry them out and put them in the grass … and try and protect them"* despite facing scrutiny from other farmers:

> *"And everybody says, 'Why in the devil didn't you take a hammer and knock them in the head while you had them?' Well, I can't do that. I can shoot them if they're eating my beans, but I can't kill them if they're not doing anything wrong."—FARM08*

Such factors of 'scale'—when and where an encounter occurs and the deer's age or behavior—can change landowner emotions, even when their livelihood and land management practices are impacted in different spaces or times.

Values and motivations. Values and motivations substantially influence residents' deer-related emotions and understandings. Among rural landowners, values for environmental stewardship and living close to nature led them to express an overall enjoyment or tolerance of deer populations, particularly when they experience minimal deer-related damage. One farmer put it best, explaining that deer are *"a big part of who I am and how I feel and why I live where I live, and it's exciting to me [that] I see [deer] so frequently. It's interesting to me. I study them, I watch them, we have names for some of them. It's a big part of why I live where I live"* (FARM05). For urban residents, valuing the well-being of deer or striving to coexist with them influenced their willingness to change what they plant in their yards to try to live with deer browsing, rather than prevent it.

Hunters also expressed concern about the health of deer populations, but their concern stemmed from different motivations than those of other stakeholders. Whereas many urban area residents expressed a fundamental concern for deer well-being, hunters were generally motivated to maintain a huntable population. One hunter expressed concern about chronic wasting disease (CWD) as something that *"could not only affect that animal but it could affect your lifestyle"* and anxiety about CWD *"killing off"* deer near their hunting property because *"on your property you want your deer as healthy as you can get"* (HUNT04). In contrast, a resident of Beverly Shores made the connection that if they had ever *"seen deer that were emaciated, I would feel differently about the deer cull"* (RES01). An Indianapolis resident and longtime deer hunter felt it *"would be devastating"* if deer were *"infected with that [chronic wasting] disease, and we wipe out a population of animals that have been here forever"* so they firmly stated, *"I think [deer should be managed] for the health of the ecosystem … you lose one part, and it can have trickling down effects on other parts including humans"* (RES11). For both hunters and urban residents, personal values and motivations thus influenced individual beliefs about the purpose of deer management.

Power dynamics and hopelessness. We found that individuals' emotions and beliefs about deer management were driven not only by their experiences and values, but by their perceptions of power or powerlessness over deer management. A sense of powerlessness emerged among stakeholders who have experienced repeated deer-related damage and tried every approach they know to prevent it. Several said that the damage has *"gotten to the point where there's nothing I can do about it"* (RES05, Bloomington) and *"I'm just numb to it right now"* (FARM10). With exasperation, WLO13 said they do not even *"know what DNR could do. Come in to scold the deer, tell them not to cross?"* because the deer *"move about on their own"* and their behavior seems uncontrollable.

This lack of perceived control over the impacts of deer influences stakeholder beliefs about management responsibility. Among rural landowners, powerlessness over minimizing deer damage leads to beliefs that they

"should be able to get rid of [deer] without repercussion" (FARM10), that the DNR has *"a reputation for not being [responsive]"* to landowners but being *"restrictive on depredation permits"* (WLO06), and that deer on private land are *"our [private landowners'] responsibility and concern"* (WLO11). Among urban residents, a lack of information and transparency about how authorities are currently managing deer populations also contributes to their sense of powerlessness in deer management. As one Bloomington resident said in frustration: *"that seems to be a joke. I don't see any management going on"* (RES05).

On the other hand, many Indiana deer hunters believed they had a personal responsibility to manage deer populations stemming from their investment in the DNR through hunting licenses and their role as the primary predator for deer in Indiana. For example, one hunter shared:

> *"I think we play a vital role. I can let the population get out of control if I want to … I can shrink it by taking the does out of the herd … On the other side, I protect that herd … We go out and actually do coyote hunts outside of deer season just to keep the coyote population down in our properties. So we do a lot to manage the herd, the herd size, the age structure of our deer, everything."—HUNT02*

Hunters typically shared a belief that the general public does not fully understand that *"the enjoyment of hunting is not the killing"* (HUNT01) and hunting is necessary to *"help the [deer] population"* (HUNT04), which contributed to hunters' desire for the DNR to place *"more emphasis on what [hunters are] saying"* (HUNT03) and reduce its focus on engaging the wider public.

These quotes across stakeholder groups elucidate an iterative process in which prior experiences, or a lack thereof, with deer populations, hunting or hunters, and management, feed back into people's emotions, which in turn affect their beliefs about deer and deer management. Dynamics of power and powerlessness thus comprise a critical component of mental models about deer, but also present a significant barrier for engaging diverse stakeholders in deer management.

Conclusions

The social dynamics captured by our interviews contribute an important layer of complexity to deer and wildlife management. Complexity has traditionally implied "adding more demographics of people" to wildlife management plans, rather than envisioning the multiple and often opposing emotions, beliefs, norms, and values that one person or group simultaneously holds towards wildlife and social "others." Conflicts over whose rights, values, and experiences are privileged through management decisions could undermine the cooperation required under multi-stakeholder contexts, like that of the public trust ideal.

Our research suggests that wildlife managers could benefit from using value-based approaches to establish a direct and iterative collaboration with diverse stakeholders, which will help to integrate abstract goals like social-ecological balance with specific strategies to reduce human-wildlife conflict. One value-based approach known as Structured Decision-Making (SDM) has found success across wildlife management scales and was specifically successful for deer management in Ohio. Although value-based approaches are not the silver bullet, they provide a rigorous, proven approach to establish neutral decision--spaces and achieve compromise among competing and complex perspectives.

Phase 2: Quantitative Survey

Guided by our interview findings, we developed a survey that measures deer-related values, attitudes, and experiences among a much larger and more representative sample of Indiana residents. The survey instrument was created in Fall 2020 and went through several rounds of revision. We pilot-tested our revised survey in December 2020 within academic networks and with external residents of Indiana who represent our primary stakeholder groups: woodland owners, farmland owners or producers, urban area residents, and deer hunters. Our survey will be distributed by mail to randomly selected residents in late May 2021. Two additional waves of the survey will be sent out between June and July 2021 to residents within our initial sample who have not yet responded. All residents sampled will be provided with the option to take the survey online.

Sampling. We will sample a total of 6,000 residents across the state of Indiana. Survey respondents will be drawn at random from publicly available tax parcel data, separated by forestland, rural farmland, and developed land. Half of the sample (3,000 residents) will be Division of Fish & Wildlife (DFW) customers including licensed hunters and non-hunting license holders. License-holder information was obtained directly from DFW, and addresses were geocoded to align with tax parcel data. Within these, a sample of 1,500 residents (750 DFW customers and 750 non-DFW customers) will be taken from tax parcels within 4x4 mile grids that contain ecological sampling locations ("Test Landscapes") from years 1 and 2 of the Integrated Deer Management Project. Survey data from these residents will allow us to compare social perceptions of deer with estimated deer population densities and habitat conditions.

Survey Details. Our survey contains six sections in total. It begins with introductory questions about the resident, their interests and activities, and their general concerns about deer. Section two asks about the resident's experiences with deer in Indiana and whether they have taken specific actions to manage deer on their residence or property. The third section asks for resident opinions about deer management and their levels of trust in the DNR and sources of deer-related information. Section four provides four hypothetical human-deer encounters and asks the resident to imagine how they would feel in that scenario and rate the acceptability of management actions for that scenario. Section five contains a single question to determine the resident's values for wildlife. The final section asks for demographic information about the resident. We provide space at the end of the survey for the resident to contribute additional comments about our research or deer and deer management in Indiana.

Analysis Plan. After distribution of the survey in May 2021, we will begin to analyze responses as they are returned. Our analysis will focus on study objectives 1 and 2 above. We will also examine how residents' perceptions distribute across the state in terms of conflicting with, coexisting with, or tolerating deer populations. Integrating social and ecological data, we will compare these perceptions to deer density estimates to assess where potential trade-offs exist among social interests, ecological conditions, and management decision-making.

SIMULATING CHRONIC WASTING DISEASE USING AN AGENT-BASED MODELING APPROACH

Jonathan D. Brooks[1], Aniruddha V. Belsare[2], Patrick A. Zollner[1], *[1]Purdue University and [2]Emory University*

Disease outbreaks are an increasingly common cause of severe declines in wildlife populations (Sillero-Zubiri et al. 1996, Roelke-Parker et al. 1996, Frick et al. 2010, Reeder and Moore 2013). One disease with the potential to cause declines in large ungulates, such as white-tailed deer, is chronic wasting disease (CWD). CWD has been detected in free-ranging cervids in 25 states including Illinois, Michigan, and Ohio, but has not been detected in Indiana as of the publication of this report (USGS National Wildlife Health Center 2021). The nearest documented occurrences of CWD to Indiana were in four infected deer near Kankakee, Illinois approximately 30 miles from the Indiana border (Illinois Department of Natural Resources 2021). Given the history of CWD spread and its proximity to Indiana, there is a clear need to consider strategies that may mitigate the risk of CWD infecting Indiana's white-tailed deer populations.

Forested corridors along the Kankakee River provide one of the mostly likely routes by which CWD-infected deer may enter Indiana through deer movement. This narrow strip of permanent forest cover amid an agriculture-dominated landscape connects deer populations in Illinois, where CWD has been detected, to deer populations in Indiana, where CWD has not been detected. Given the significance of this forested cover for deer movement, it may be possible to reduce the likelihood of CWD spreading to Indiana by reducing deer density within this corridor. Such reductions could be accomplished by establishing a zone with increased hunting pressure or implementing a sharpshooter culling program within a focal area.

Measuring the effect of increased hunting or sharpshooter culling as a preventive measure against CWD spread along the Kankakee River through field experiments would be challenging. Alternatively, quantitative approaches like mathematical models or computer simulations provide an effective means to investigate such questions. One such approach that is particularly well suited to modeling disease in large mammal populations is the agent-based model (ABM). An ABM simulation of CWD spread in white-tailed deer would use virtual representations of deer movements and behaviors on the landscape (Kjaer 2010, Belsare et al. 2020, Van Buskirk et al. 2021). The virtual deer are given characteristics such as age, sex, and disease infection status and perform actions in the virtual landscape such as moving, giving birth, dying, and transferring infection. By tracking the location and number of infected individuals over time, population-level metrics such as disease prevalence and rate of contact can be estimated using simple statistics. ABMs make it easy to simulate rare events and individual differences in behaviors like dispersal because they track each individual deer instead of a population. Similarly, ABMs make no assumptions about rates of contact because those emerge from model inputs specifying the behavior of individuals.

The objective of this project is to develop an ABM to simulate the spread of CWD along the Kankakee River. The ABM will be used to test the effect of a deer management zone or sharpshooter culling on mitigating the spread of CWD. To accomplish this, we will build an ABM with virtual deer that move around a virtual Kankakee River landscape. The model will track the age, sex, and CWD infection status of each virtual deer. Groups of virtual deer will form doe or bachelor herds that move across the landscape and select habitat in a manner consistent with real deer. Virtual does will give birth to fawns, and yearling bucks will disperse from their natal herd and join bachelor herds. Dynamics within virtual herds will be represented by deer dispersing when a herd becomes too large. The simulation will also track the spread of CWD. Uninfected deer will become infected through contact with infected deer. The amount of time a deer is infected will be tracked, and the likelihood of dying will increase as the infection progresses. Because evidence suggest that CWD can remain infectious in the environment (Johnson et al. 2006), infected deer will also be able to contaminate the environment, and non-infected deer will be able to contract CWD from this environmental contamination. Finally, CWD management with deer management zones or sharpshooter culling will be simulated by increasing deer mortality within these areas.

In addition to developing the ABM simulation, we will also develop a web-based tool that people can use to compare simulations across different scenarios. The tool will allow users to select different management scenarios, and an animated map and graphs will show how CWD spreads over time. To assess the effectiveness of the tool and the acceptability of different CWD management options to stakeholders, users will be given a survey to measure these attitudes before and after, using the web-based tool. Our analysis of responses to the surveys will help us understand how to improve the web-based tool and what management strategies stakeholders find most acceptable. Our intention is that this web-based tool will increase stakeholder understanding of options for managing CWD by allowing them to engage with our ABM simulation results.

Currently, we are building the ABM and intend to begin testing CWD management scenarios by September 2021. Scenario tests will be completed by December 2021 and the web-based tool will be ready for initial testing by May 2022.

Managing white-tailed deer in the face of CWD poses many challenges, and there are still considerable knowledge gaps around the effects of various population management actions and their efficacy on reducing CWD spread. When the ABM simulation is built, Indiana DNR will have a tool for comparing the effects of different management options on the spread of CWD. Furthermore, information gathered through stakeholder surveys with the presentation of the final web-based tool will provide DNR with metrics of stakeholder acceptability of various management approaches.

Literature Cited

Belsare, A. V., M. E. Gompper, B. Keller, J. Sumners, L. Hansen, and J. J. Millspaugh. 2020. An agent-based framework for improving wildlife disease surveillance: A case study of chronic wasting disease in Missouri white-tailed deer. Ecological Modelling 417:108919.

Frick, W. F., J. F. Pollock, A. C. Hicks, K. E. Langwig, D. S. Reynolds, G. G. Turner, C. M. Butchkoski, and T. H. Kunz. 2010. An emerging disease causes regional population collapse of a common North American bat species. Science 329:679–682.

Illinois Department of Natural Resources. 2021. Chronic Wasting Disease Management. https://www2.illinois.gov/dnr/programs/CWD.

Johnson, C. J., K. E. Phillips, P. T. Schramm, D. McKenzie, J. M. Aiken, and J. A. Pedersen. 2006. Prions adhere to soil minerals and remain infectious. PLoS Pathogens 2:296–302.

Kjaer, L. J. 2010. Individual-based modeling of white-tailed deer (Odocoileus virginianus) movements and epizootiology. Southern Illinois University Carbondale, Carbondale, Illinois.

Reeder, D. M., and M. S. Moore. 2013. White-nose Syndrome: A deadly emerging infectious disease of hibernating bats. Pages 413–434 in R. A. Adams and S. C. Pedersen, editors. Bat Evolution, Ecology, and Conservation. Springer New York, New York, NY.

Roelke-Parker, M. E., L. Munson, C. Packer, R. Kock, S. Cleaveland, M. Carpenter, S. J. O'Brien, A. Pospischil, R. Hofmann-Lehmann, H. Lutz, G. L. M. Mwamengele, M. N. Mgasa, G. A. Machange, B. A. Summers, and M. J. G. Appel. 1996. A canine distemper virus epidemic in Serengeti lions (Panthera leo). Nature 379:441–445.

Sillero-Zubiri, C., A. A. King, and D. W. Macdonald. 1996. Rabies and mortality of Ethiopian wolves (Canis simensis). Journal of Wildlife Diseases 32:80–86.

USGS National Wildlife Health Center. 2021. Expanding Distribution of Chronic Wasting Disease. https://www.usgs.gov/centers/nwhc/science/expanding-distribution-chronic-wasting-disease?qt-science_center_objects=0#qt-science_center_objects.

Van Buskirk, A. N., C. S. Rosenberry, B. D. Wallingford, E. J. Domoto, M. E. McDill, P. J. Drohan, and D. R. Diefenbach. 2021. Modeling how to achieve localized areas of reduced white-tailed deer density. Ecological Modelling 442:109393.