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TITLE: Deer Health, Forest Habitat Health, Deer Harvests, and Deer Population Trends by Wildlife Management Unit

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COOPERATING AGENCIES: Pennsylvania Cooperative Fish and Wildlife Research Unit, Pennsylvania Department of Conservation and Natural Resources, Pennsylvania State University, and U.S. Forest Service

WORK LOCATION(S): Statewide

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ABSTRACT We monitored Wildlife Management Unit (WMU) deer health, forest habitat health, and deer population trends using proportion of fawns in the antlerless harvest, advanced tree seedling and sapling regeneration and deer impact from the Pennsylvania Regeneration Study, deer harvest estimates and compositions, and field studies. Proportion of juveniles in the antlerless harvest remained stable in 21 of 22 WMUs and was decreasing in 1 WMU from 2017 to 2022. Forest habitat health was judged to be good in 3 WMUs, fair in 15 WMUs, and poor in 1 WMU. Deer impacts were determined to be acceptable in 17 WMUs and too high in 2 WMUs. Hunters harvested an estimated 422,960 deer (164,190 antlered and 258,770 antlerless), during the 2022-23 deer seasons. Deer populations in 20 WMUs remained stable, while 2 WMUs increased.

OBJECTIVE

Monitor deer health, forest habitat health, deer harvests, and deer population trends by Wildlife Management Unit (WMU).

METHODS

Deer Health

To monitor deer health (i.e., population productivity defined as proportion of fawns in the antlerless harvest), 31 data collection teams examined deer in assigned areas across the state. Each team collected data for 3 days during the first week of the regular firearms season, 2 days during the second week of the season, and 2 days after the close of the season. Data were recorded electronically on Flowfinity software using Apple iPad Minis, and transmitted wirelessly to Flowfinity for analysis. Data collected included age, sex, location of harvest (WMU, county, and township), and hunting license number from ear tags. Deer teams determined deer age as 6 months (fawn), 18 months (yearling), or at least 30 months (adult) using tooth wear and replacement (Severinghaus 1949). Data collection teams also recorded points of antlers and when antlers were physically present, presence or absence of a brow tine on each antler to determine antler characteristics by age class.

We assessed population productivity by monitoring trends in proportion of juveniles in the antlerless harvest (Rosenberry et al. 2011b). We identified proportion of juveniles in the antlerless harvest trends as increasing, decreasing, or stable based on graphical and statistical methods, specifically the Mann-Kendall Test for Trend (Mann 1945, Kendall and Gibbons 1990). We chose this test because it provides a statistical test of trend in data without complex calculations and does not require actual differences between years. Since effective state agency deer programs must consider public involvement and perceptions, it is important that we assess trends with a test that is statistically appropriate, utilizes information available to the public (e.g., a graph of estimates over time), and is relatively easy to explain.

Forest Habitat Health

We used forest regeneration and deer impacts to assess forest habitat health. Forest regeneration is not just a measure for the benefit of the forest, but also for deer and wildlife. For deer, seedling and sapling trees provide food and cover. As a result, measuring regeneration is an important measure of the sustainability of a forest, and available food and cover that benefit deer and other wildlife.

To obtain data on forest regeneration, advanced tree seedling and sapling regeneration (ATSSR) data are collected as part of a systematic sampling scheme from public and private lands in WMUs from the Pennsylvania Regeneration Study (PRS). This study is being conducted as part of the U.S. Forest Service (USFS) Forest Inventory Analysis in collaboration with Pennsylvania Department of Conservation and Natural Resources (DCNR) and Pennsylvania State University. Subsets of all plots are collected each year, with a complete sampling of plots occurring every 5 - 7 years. Advanced tree seedling and sapling regeneration from 2 groupings of tree species are available from the PRS. The measure selected for use in deer management is the grouping of dominant canopy species and species capable of achieving high canopy status. “The composition of the ATSSR has a direct impact on the future composition of the forest overstory (Marquis 1994). To cover the range of future forest character and client needs 2 composition groupings are used. The first groups tree species by preference for timber management. The second composition grouping represents the forest’s ability to regenerate the existing dominant canopy. Dominant species include those that contribute at least 2% of the State’s total-tree biomass and are able to grow into the existing canopy; Other High Canopy species include all others that are capable of attaining canopy dominance" (McWilliams et al. 2004).

Based on recommendations from Wildlife Management Institute (Wildlife Management Institute 2010), more plots were included in our analysis of forest regeneration. From 2006 to 2010, only data from plots that were 40 to 75 percent stocked were analyzed. Beginning in 2011, data from all forested plots were analyzed.

We obtained ATSSR data for dominant canopy species and species capable of achieving high canopy status by WMU from the USFS website (USDA 2020) and DCNR. Determination of adequate regeneration was based on levels of deer browse impact observed in the area of each plot. For example, a higher count of seedling and sapling regeneration is required to replace the existing canopy where deer impact is "very high" compared to a lower count of seedling and sapling regeneration where deer impact is "very low." The scaled levels of deer impact indicate deer population size in relation to food availability in a given area. Areas with ample food to support the local deer population will be evident by very low to medium deer impact. Areas lacking food to support the local deer population will be evident by high to very high deer impact. These critical stocking guidelines were derived from extensive literature reviews and decades of research on deer-habitat interactions (Marquis et al. 1992). In 2008 we began using browse impact and associated stocking levels in the habitat health measure. Because of the sampling scheme used in the PRS, it takes 5-7 years to visit all sample plots.

Based on input from cooperating agencies that designed and conduct the PRS and an internal Game Commission review of the forest habitat health measure, we defined forest habitat as "good" if 70% or more of the sampled plots contained adequate regeneration. If less than 50% of the plots contained adequate regeneration, forest habitat health was considered "poor." "Fair" falls between levels for "good" and "poor."

Similar to the deer health measure, the forest habitat health measure is based on a sample of plots from across a WMU and we use a statistical test to assess regeneration levels. By using a statistical test to assess differences from predetermined levels (e.g., 70%), we take into account both the point estimate and associated variation.

When data are collected according to proper sampling design, estimates can be statistically compared to 50% and 70% levels using a t-test. The t-test determines whether the estimate is different from the 50% or 70% level based on standard statistical procedures. Since reliability of statistical tests is related to sample sizes, forest habitat health determinations are made based on 5-year data sets to maximize sample size and reliability of statistical tests.

Decision Rules Used to Determine Forest Habitat Health.--We developed a set of criteria to assign a value of "good," "fair," or "poor" for forest habitat health. A WMU's forest habitat health was considered "good" if the observed percentage of plots with adequate regeneration was greater than, equal to, or not significantly different than 70%. If a WMU's forest habitat health was not significantly different from 70% and not significantly different from 50%, then forest habitat health was considered "fair." A WMU's forest habitat health also was considered "fair" if: 1) the observed percentage of plots with adequate regeneration was equal to 50%; or 2) between 50% and

70% and significantly less than 70%; or 3) not significantly different than 50%. A WMU's forest habitat health was considered "poor" if the observed percentage of plots with adequate regeneration was significantly less than 50%.

In addition to forest health, we also assessed deer impact on the forest. These data were collected as part of the PRS. Deer impact was assessed on a scale from 1 (very low) to 5 (very high). We identified a score of 3 (moderate) as acceptable deer impact. Similar to the deer and forest health measures, the deer impact measure is based on a sample of plots from across a WMU and we use a statistical test to assess deer impact levels. By using a statistical test to assess differences from predetermined levels (e.g., 3), we take into account both the point estimate and associated variation.

When data are collected according to proper sampling design, estimates can be statistically compared to a score of 3 using a t-test. The t-test determines whether the estimate is different from 3 based on standard statistical procedures. Since reliability of statistical tests is related to sample sizes, deer impact determinations are made based on 5-year data sets to maximize sample size and reliability of statistical tests.

Deer Harvest Estimates and Composition

To estimate deer harvests and collect data for monitoring deer population trends, 31 data collection teams examined deer in assigned areas across the state. Each team collected data for 3 days during the first week of the regular firearms season, 2 days during the second week of the season, and 2 days after the close of the season. Data were recorded electronically on Flowfinity software using Apple iPad Minis, and transmitted wirelessly to Flowfinity for analysis. Data collected included age, sex, location of harvest (WMU, county, and township), and hunting license number from ear tags. Deer teams determined deer age as 6 months (fawn), 18 months (yearling), or at least 30 months (adult) using tooth wear and replacement (Severinghaus 1949). Data collection teams also recorded points of antlers and when antlers were physically present, presence or absence of a brow tine on each antler to determine antler characteristics by age class.

Data entry for deer harvest report card data was completed by Pennsylvania Game Commission staff. The Pennsylvania Game Commission's Bureau of Automated Technology Services validated and processed harvest data and ran harvest data analysis programs. For each WMU the analyses included: the number of antlered and antlerless deer checked by aging teams, the number of antlered and antlerless deer checked by deer aging teams and reported by hunters, the total number of antlered and antlerless deer reported by hunters, age and sex composition of the harvest, and reported regular firearms, muzzleloader, and archery harvests.

Deer harvests were estimated using mark-recapture methods. When estimating deer harvests, we used a closed, 2-sample Lincoln-Petersen estimator where deer were considered marked when they were checked in the field by deer aging teams. Recapture occurred when marked deer were reported on report cards, online, or via phone reporting system by hunters.

Because reporting rates in Pennsylvania vary by year, antlered and antlerless deer, and WMU (Rosenberry et al. 2004), deer harvest estimates were calculated for antlered and antlerless deer in each WMU using Chapman's (1951) modified Lincoln-Petersen estimator. This estimator is recommended (Nichols and Dickman 1996) because it has less bias than the original Lincoln-Petersen estimator (Chapman 1951).

Deer Population Trends

We used a modified Sex-Age-Kill (SAK) model to account for Pennsylvania's antler restrictions to monitor deer population trends (i.e., Pennsylvania Sex-Age-Kill [PASAK] model, Norton 2010, Rosenberry et al. 2011a). Modifications involve estimation of 1.5-year-old and 2.5-year-old and older male populations. Population trend monitoring relies on research data from Pennsylvania (e.g., Long et al. 2005, Keenan 2010, Norton 2010), harvest estimates, and deer aging data. Population monitoring began with mature males (males 1.5 years of age and older) and progressed to females and fawns. Step-by-step methods and results of the PASAK model were presented to the Board of Commissioners at the January 2011 meeting and posted on the Game Commission's website (Rosenberry et al. 2011a). We also used additional data and further modified the procedure for estimating antlered harvest rates based on age structure of the antlered harvest. This method provided similar population estimates and the benefit of estimates based on annual data rather than multi-year averages used by Norton (2010).

We identified population trends as increasing, decreasing, or stable based on graphical and statistical methods, specifically the Mann-Kendall Test for Trend (Mann 1945, Kendall and Gibbons 1990). We chose this test because it provides a statistical test of trend in data without complex calculations and does not require actual differences between years. Since effective state agency deer programs must consider public involvement and perceptions, it is important that we assess trends with a test that is statistically appropriate, utilizes information available to the public (e.g., a graph of estimates over time), and is relatively easy to explain.

RESULTS

Deer Health

Age data from over 16,000 antlerless deer were used to assess proportion of juveniles in the antlerless harvest. Proportion of juveniles in the antlerless harvest ranged from a low of 0.29 in WMUs 2G, 3A, 3C, 4A, and 4D to a high of 0.41 in WMU 1A (Table 1). Twenty-one WMUs showed stable trends, while 1 (WMU 2D) had decreasing trends from 2017 to 2022. An important note is that WMU 2H was dissolved back to its original boundary within WMU 2G in 2022, for a total of 22 WMUs.

Forest Habitat Health

Wildlife Management Unit level forest habitat health assessments were based on the 5 years of the Pennsylvania Regeneration Study from 2017 to 2022. We identified 3 WMUs (WMUs 2F, 3B, and 5A) with good forest habitat health, and 15 with fair forest habitat health (Table 2). Deer impact was too high in 2 WMUs (WMUs 2C and 3D) and acceptable in 18 WMUs (Table 2). In 3 highly developed WMUs (2B, 5C, and 5D) regeneration and deer impact data were not used or considered in making deer management recommendations because of insufficient sample sizes. Results from this report cannot be compared to some previous years' reports. In reports from 2006 to 2010, only plots with 40 to 75% stocking levels were analyzed, whereas subsequent reports used all plots.

Deer Harvest Estimates and Composition

Game Commission personnel checked an average of 286 (range: 60 to 511) antlered deer and 729 (range: 195 to 1,279) antlerless deer per WMU during the 2022 firearms season (Table 3). Based on deer checked and harvest reports by successful hunters, hunters harvested an estimated 422,960 deer in the 2022-23 deer seasons (Table 3). The antlered harvest estimate was 164,190, up 13% compared to the 2021-22 harvest estimate of 145,320. The antlerless harvest estimate was 258,770, up 12% compared to the harvest estimate of 231,490 in 2021-22.

Antlered harvests were composed of 33% 1.5-year-old males and 67% 2.5-year-old and older males (Table 4). Compared to years prior to implementation of antler restrictions during the 2002-03 hunting seasons, the age structure of the antlered harvest has increased, as has the number of 2.5-year-old and older bucks harvested (Table 4). Antlerless harvest composition has been slowly changing toward more adult females (1.5-year-old and older) since the 1997-98 hunting seasons (Table 5).

Deer Population Trends

Based on PASAK, deer population trends were stable in 18 WMUs (Table 6). One WMU (2A) had an increasing trend. In WMUs 2B, 5C, and 5D, PASAK cannot be used, but based on antlered harvests and antlerless catch per unit effort estimates, population trends were stable in WMUs 5C and 5D, and increasing in WMU 2B.

Deer Management Recommendations

Staff evaluate measures of deer health (i.e., proportion of juveniles in the antlerless harvest and population trend), forest habitat health (i.e., percent plots with adequate regeneration), deer impact, and deer-human conflicts from a survey of Pennsylvania citizens (Duda et al. 2019) to develop objectives at the WMU-level (to increase, stabilize, or decrease deer populations). The deer plan objectives include population stabilization in 12 WMUs (1A, 1B, 2A, 2B, 2G, 3A, 3B, 3C, 4C, 5B, 5C, and 5D), and reductions in 10 WMUs (2C, 2D, 2E, 2F, 3D, 4A, 4B, 4D, 4E, and 5A). For WMUs 2A and 2B, where the objective is to stabilize numbers, but there is an increasing population trend, the allocation is set to a level to increase harvest by 1 antlerless deer per square mile above the previous 3-year average, to stabilize the increasing trend. In WMUs where CWD has been detected in wild deer (WMUs 2C, 2D, 2E, 2F, 4A, 4B, 4D, 4E, and 5A), the objective is to reduce deer populations to reduce CWD transmission and spread, so antlerless allocations have been set to a level to increase antlerless harvest by 1 antlerless deer per square mile above the previous 3-year average. Deer impacts were observed in WMUs 2C and 3D; however, the allocation was already increased in WMU 2C because of CWD. Further, the allocation was already increased in WMU 3D over the past few years because of forest impacts, so the 2023-24 allocation is set to the previous year’s level to maintain the previous increase in antlerless harvest level. We continue to recommend consistent regulations that provide more hunting opportunities (e.g., 14 day-concurrent firearms season) and use antlerless allocations to adjust antlerless harvests and population trends. However, it is important to note that as hunter numbers decrease, we anticipate an increased number of WMUs that do not sell out of antlerless licenses or that sell out later in the rounds, but antlerless harvest targets are not being met. A further increase in allocation in these WMUs may not lead to an increase in antlerless harvest. Future efforts to increase antlerless harvest in these WMUs may require additional opportunity (e.g., extended firearms seasons) along with increased antlerless allocations to achieve the needed antlerless harvests. In 2023-24, allocations to address CWD were based mainly on the WMU level, but we also recommend providing additional DMAP antlerless permits where necessary to enhance surveillance.

Action by the Board of Commissioners (BOC)

Starting with the 2023-24 antlerless deer license allocations, the Board of Commissioners (BOC) will be discontinuing the practice of annually voting on, potentially changing, and approving the number of antlerless deer licenses to be allocated. Thus, the recommended allocations by staff to meet publicly identified and supported deer plan goals and objectives will move forward as proposed (Table 7). The BOC voted to retain the season-long concurrent firearms season for antlered and antlerless deer season in all WMUs. The BOC voted to keep the opening day of rifle deer season on the Saturday after Thanksgiving, and to allow deer hunting on the Sunday following opening day. The last Sunday of the archery season was again approved as a hunting day. The fall archery season extension was again approved, ending on the Friday before bear season. The limit of DMAP permits per hunter per DMAP area was maintained at 4 (if the landowner provides coupons), and up to two permits in units that the Game Commission designates (offered online with no coupon). The BOC also voted to retain the personal limit of up to 6 unfilled, WMU-specific antlerless licenses at any given time. If one is used, they may purchase another, as long as licenses are available.

RECOMMENDATIONS

1. Identify and develop additional analyses and measurements to improve the forest habitat health measure's ability to account for factors other than deer that affect forest regeneration and to most directly monitor deer impacts on forest regeneration.

2. Maintain deer aging sampling effort. Current numbers of deer checked in the field provide precise harvest estimates in most WMUs. Harvest estimates are less precise in smaller WMUs where it is more difficult to collect sufficient data.

3. Continue to evaluate validity of assumptions and population monitoring procedures through internal review and analyses and external peer review. Prioritize research needs based on internal and external reviews.

4. Investigate alternatives to the current non-parametric tests to determine trends in current metrics.

5. Continue antler restriction regulations in accordance with goals and objectives of the deer management plan.

6. Continue to allow hunters to purchase and use the entire antlerless allocation.

7. In WMUs containing CWD-positive deer in the free-ranging population, continue to allocate antlerless licenses to reduce the deer population and use DMAP permits to further reduce deer numbers in specific areas where CWD-positive deer have been detected. Chronic wasting disease is rapidly increasing and spreading. Reducing deer populations is the most practical management option at this time.

8. Set antlerless license allocations to achieve deer management goals as defined in the deer management plan. Investigate alternative options when the antlerless allocation is no longer able to meet harvest targets (e.g., not selling out, or an increase in allocation does not lead to an increase in antlerless harvest to target levels).

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Table 1. Number of antlerless deer examined in 2022, proportion of juveniles in the antlerless 2022 harvest, and trend in the proportion of juveniles in the antlerless harvest by Wildlife Management Unit (WMU) from 2017 to 2022, Pennsylvania.

WMU	***n***	**Proportion of juveniles in antlerless harvest**	**Trend**
1A	682	0.41	Stable
1B	1,205	0.34	Stable
2A	697	0.30	Stable
2B	472	0.35	Stable
2C	923	0.36	Stable
2D	1,291	0.32	Decreasing
2E	598	0.34	Stable
2F	980	0.31	Stable
2G [a]	577	0.29	Stable
3A	619	0.29	Stable
3B	816	0.32	Stable
3C	896	0.29	Stable
3D	663	0.30	Stable
4A	472	0.29	Stable
4B	597	0.33	Stable
4C	840	0.32	Stable
4D	917	0.29	Stable
4E	1,208	0.33	Stable
5A	221	0.30	Stable
5B	1,100	0.39	Stable
5C	746	0.39	Stable
5D	290	0.36	Stable

[a] WMU 2G is composed of the former WMUs 2H and 2G. In 2022, WMU 2H was dissolved into WMU 2G.

Table 2. Number of regeneration plots sampled, percent with adequate regeneration, mean deer impact and qualitative assessments of regeneration and deer impact by Wildlife Management Unit (WMU). Data are based on samples collected from 2017 to 2021, Pennsylvania. Results are based on all forested plots and cannot be compared to results from 2006 to 2010 that only included 40% to 75% stocked plots.

WMU	***n***	**% plots with adequate regeneration**	**Forest health assessment**	**Mean deer impact**	**Impact assessment**
1A	16	65%	Fair	2.9	Acceptable
1B	10	55%	Fair	2.7	Acceptable
2A	19	34%	Fair	3.3	Acceptable
2B	n/a[a]	n/aa	n/a[a]	n/a[a]	n/a[a]
2C	39	52%	Fair	3.2	Too high
2D	26	36%	Poor	3.2	Acceptable
2E	22	54%	Fair	3.2	Acceptable
2F	19	69%	Good	3.0	Acceptable
2G [b]	61	52%	Fair	2.9	Acceptable
3A	12	66%	Fair	2.8	Acceptable
3B	34	66%	Good	2.8	Acceptable
3C	26	50%	Fair	3.3	Acceptable
3D	34	53%	Fair	3.6	Too high
4A	23	47%	Fair	3.0	Acceptable
4B	21	52%	Fair	3.1	Acceptable
4C	21	53%	Fair	3.2	Acceptable
4D	41	52%	Fair	2.9	Acceptable
4E	17	49%	Fair	3.2	Acceptable
5A	4	73%	Good	3.3	Acceptable
5B	9	57%	Fair	3.1	Acceptable
5C	n/a[a]	n/a[a]	n/a[a]	n/a[a]	n/a[a]
5D	n/a[a]	n/a[a]	n/a[a]	n/a[a]	n/a[a]

[a] Regeneration data from these highly developed WMUs were not analyzed or considered in making deer management recommendations.

[b] From 2013-2021, WMU 2G was split into WMUs 2H and 2G. In 2022, WMU 2H was dissolved into WMU 2G.

Table 3. Number of deer checked by Pennsylvania Game Commission personnel, number of deer reported by successful hunters, and estimated harvests for antlered and antlerless deer by Wildlife Management Unit (WMU), Pennsylvania, 2022-23 (excluding DMAP harvests).

	Antlered			Antlerless		
WMU	Deer checked	Reported	Harvest[a]	Deer checked	Reported	Harvest[a]
1A	196	2337	9,000	677	4191	13,800
1B	351	2746	9,100	1151	4065	15,300
2A	222	2461	8,700	704	3341	11,000
2B	93	2104	6,600	485	3703	15,000
2C	355	3410	10,000	930	5123	16,600
2D	349	4133	14,000	1279	7088	23,000
2E	253	2193	6,700	578	3581	10,600
2F	439	3280	8,800	841	3638	11,800
2G [b]	379	3008	8,600	470	2220	6,900
3A	356	1818	5,700	540	1816	5,600
3B	379	2408	7,300	770	2814	8,900
3C	511	2773	8,000	859	3485	12,000
3D	317	2100	5,500	646	2739	7,400
4A	153	1508	3,800	486	2768	11,100
4B	186	1715	4,800	571	2594	8,400
4C	353	2767	6,900	812	3052	8,200
4D	404	2736	7,900	847	3563	12,200
4E	312	2450	8,000	1123	3903	12,400
5A	60	1488	3,100	195	2486	7,400
5B	275	3315	10,900	1031	5587	16,300
5C	258	2640	7,200	755	5444	16,700
5D	89	1290	2,500	285	2995	6,700
Unk.		371	1,090		499	1,470

[a] Estimated harvests are rounded to the nearest 100 or 1,000 based on precision of harvest estimate. Unknown WMU harvests are rounded to the nearest 10 due to the small number.

[b] From 2013-2021, WMU 2G was split into WMUs 2H and 2G. In 2022, WMU 2H was dissolved into WMU 2G.

Table 4. Number of yearling (1.5) and adult (2.5-year-old and older) male deer aged, age composition of harvests, and estimated number of 2.5-year-old and older males harvested in Pennsylvania, 1997-98 to 2022-23. Percentages may not add up to 100 percent due to rounding.

Year	***n***	**% 1.5-year-old males**	**% 2.5-year-old and older males**	**Estimate of 2.5-year-old and older males harvested**
1997-98	18,563	81	19	33,600
1998-99	21,350	81	19	34,500
1999-00	20,011	80	20	38,900
2000-01	22,145	82	18	36,600
2001-02	18,893	78	22	44,700
2002-03 [a]	11,694	68	32	52,900
2003-04	11,367	56	44	62,600
2004-05	10,559	50	50	62,000
2005-06	9,062	52	48	57,800
2006-07	10,819	56	44	59,500
2007-08	8,014	56	44	48,000
2008-09	9,357	52	48	59,200
2009-10	8,443	49	51	55,200
2010-11	9,032	48	52	64,400
2011-12 [a]	10,311	50	50	63,800
2012-13	10,588	48	52	69,000
2013-14	9,937	47	53	71,200
2014-15	9,225	43	57	68,000
2015-16	9,762	41	59	81,200
2016-17	9,792	44	56	83,400
2017-18	11,404	43	57	93,400
2018-19	9,485	36	64	94,600
2019-20	8,420	34	66	107,700
2020-21	7,591	36	64	111,900
2021-22	6,746	38	62	90,100
2022-23	6,987	33	67	106,812

[a] Three and 4-point antler restrictions started in 2002-03.

[b] In 2011, the 4-point antler restriction was modified to 3-points not including the brow tine.

Table 5. Number of antlerless deer aged and age composition of harvests in Pennsylvania, 1997-98 to 2022-23. Percentages may not add up to 100 percent due to rounding.

Year	***n***	**% 0.5-year-old males**	**% 0.5-year-old females**	**% 1.5-year-old and older females**
1997-98	28,743	24	20	56
1998-99	24,913	23	20	57
1999-00	18,502	24	20	56
2000-01	30,460	22	20	58
2001-02	25,450	22	18	60
2002-03	30,077	22	18	60
2003-04	28,236	21	18	61
2004-05	24,640	22	18	61
2005-06	19,459	23	19	58
2006-07	19,074	23	19	58
2007-08	17,770	24	20	56
2008-09	17,152	22	18	60
2009-10	16,519	22	18	60
2010-11	14,837	23	18	59
2011-12	16,050	21	19	60
2012-13	15,563	22	18	61
2013-14	15,924	21	18	62
2014-15	14,909	20	18	61
2015-16	14,551	20	17	63
2016-17	14,966	20	16	64
2017-18	15,310	19	17	64
2018-19	15,008	17	17	66
2019-20	15,104	16	15	69
2020-21	16,844	17	15	68
2021-22	15,926	16	15	69
2022-23	16,810	17	16	67

Table 6. Pennsylvania Sex-Age-Kill (PASAK) model estimates of post-hunt deer populations by Wildlife Management Unit (WMU), 2013 to 2023, Pennsylvania.

WMU	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	6-yr Trend
1A	48,472	55,114	49,169	62,237	65,707	53,244	46,208	51,804	99,568	57,982	73,334	Stable
1B	55,713	53,799	47,438	71,669	74,053	81,376	60,756	81,659	95,277	74,887	72,506	Stable
2A	53,996	43,379	30,033	48,723	57,963	46,361	44,587	61,486	72,156	65,676	77,599	Increasing
2B	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]
2C	61,386	68,683	66,027	83,350	69,034	113,659	85,400	97,246	76,365	73,906	86,600	Stable
2D	113,774	144,084	110,214	117,823	112,499	140,281	104,622	114,679	93,498	99,753	107,353	Stable
2E	44,546	45,529	50,549	43,081	43,144	56,635	46,170	62,753	52,578	54,143	56,405	Stable
2F	83,063	65,614	61,020	67,152	74,387	108,575	86,836	98,104	112,840	86,470	83,968	Stable
2G [b]	73,375	65,850	57,215	80,951	83,646	120,406	74,138	96,260	128,416	98,923	107,504	Stable
3A	41,358	45,317	36,181	49,307	49,426	55,441	39,832	54,040	71,376	55,494	59,595	Stable
3B	53,709	63,803	55,249	76,808	80,598	76,249	51,976	62,489	90,795	56,589	74,283	Stable
3C	67,720	58,925	67,997	83,206	85,083	79,925	57,169	75,360	94,807	61,771	69,345	Stable
3D	29,225	25,127	33,778	28,957	33,302	30,727	33,798	48,663	45,355	32,058	52,788	Stable
4A	36,579	42,196	23,772	48,538	29,746	39,238	40,344	47,047	39,911	35,442	19,763	Stable
4B	52,903	50,517	45,362	57,846	55,941	52,407	50,136	54,044	44,691	26,808	43,771	Stable
4C	45,586	49,072	50,265	55,068	55,311	61,317	55,122	55,238	77,639	52,314	64,683	Stable
4D	67,011	61,428	56,905	60,398	63,984	99,997	61,441	71,983	89,963	66,855	67,514	Stable
4E	48,318	50,707	59,206	64,923	62,285	70,064	60,055	59,120	77,399	67,325	67,790	Stable
5A	28,014	29,715	25,032	20,081	28,581	33,243	25,162	49,801	28,772	20,313	21,887	Stable
5B	75,260	63,591	60,538	66,282	73,573	85,790	77,485	76,623	91,713	62,401	101,325	Stable
5C	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]
5D	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]

[a] PASAK model estimates are not available for these WMUs. See Rosenberry et al. 2011 for further information. Population trend assessment in these WMUs is based on antlered harvests and antlerless catch per unit effort estimates.

[b] From 2013-2021, WMU 2G was split into WMUs 2H and 2G. In 2022, WMU 2H was dissolved into WMU 2G.

Table 7. Antlerless license allocations by Wildlife Management Unit (WMU), 2013-14 to 2023-24, Pennsylvania.

WMU	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
1A	49,000	47,000	46,000	46,000	52,000	48,000	49,000	49,000	40,000	43,000	46,000
1B	31,000	30,000	29,000	29,000	35,000	37,000	35,000	41,000	32,000	34,000	37,000
2A	49,000	46,000	43,000	43,000	50,000	49,000	46,000	46,000	39,000	39,000	46,000
2B	62,000	60,000	61,000	61,000	60,000	58,000	54,000	49,000	49,000	49,000	53,000
2C	43,000	38,000	31,000	31,000	31,000	44,000	52,000	58,000	67,000	67,000	88,000
2D	61,000	61,000	55,000	55,000	55,000	63,000	66,000	60,000	74,000	74,000	86,000
2E	22,000	21,000	21,000	21,000	22,000	27,000	32,000	39,000	42,000	42,000	52,000
2F	29,000	27,000	22,000	22,000	24,000	23,000	31,000	36,000	32,000	37,000	49,000
2G[a]	34,000	27,500	28,500	27,000	32,500	36,000	32,000	34,000	32,000	31,000	35,000
3A	23,000	18,000	19,000	15,000	20,000	22,000	20,000	21,000	19,000	19,000	21,000
3B	39,000	33,000	28,000	28,000	30,000	29,000	38,000	33,000	30,000	33,000	32,000
3C	35,000	32,000	36,000	36,000	42,000	38,000	46,000	49,000	33,000	37,000	40,000
3D	32,000	25,000	25,000	25,000	25,000	25,000	25,000	36,000	36,000	41,000	41,000
4A	28,000	28,000	30,000	30,000	30,000	38,000	41,000	49,000	50,000	50,000	61,000
4B	24,000	26,000	26,000	26,000	26,000	26,000	32,000	33,000	34,000	34,000	46,000
4C	27,000	25,000	25,000	25,000	29,000	30,000	36,000	32,000	29,000	31,000	32,000
4D	35,000	33,000	33,000	34,000	34,000	34,000	46,000	45,000	55,000	55,000	77,000
4E	26,000	21,000	25,000	25,000	27,500	32,000	34,000	37,000	42,000	42,000	54,000
5A	19,000	19,000	19,000	19,000	22,000	23,000	22,000	26,000	31,000	31,000	40,000
5B	50,000	49,000	50,000	50,000	57,000	58,000	67,000	60,000	60,000	60,000	60,000
5C	103,000	95,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000
5D	18,000	18,000	24,000	30,000	30,000	28,000	29,000	29,000	29,000	29,000	29,000

[a] From 2013-2021, WMU 2G was split into WMUs 2H and 2G. In 2022, WMU 2H was dissolved into WMU 2G.