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TITLE: White-tailed Deer Research/Management

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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 has remained stable in all WMUs since 2003. Forest habitat health was judged to be good in no WMUs, fair in 17 WMUs, and poor in 2 WMUs. Deer impacts were determined to be acceptable in 16 WMUs and too high in 3 WMUs. Three WMUs (2B, 5C, and 5D) were not included in the forest habitat health assessment because of high levels of human development. Hunters harvested 336,200 deer (127,540 antlered and 208,660 antlerless) in the 2011-12 deer seasons. Deer populations in 18 WMUs remained stable, while 4 WMUs increased. The Board of Commissioners set antlerless allocations to stabilize deer populations in 15 WMUs, decrease deer populations in 3 WMUs, and increase deer populations in 4 WMUs.

OBJECTIVE

To 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), 33 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 Pendragon Forms 5.1 software using a Windows Mobile hand-held computer (Trimble Nomad), and downloaded to a Harrisburg data collection point. 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 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 Forest Inventory Analysis (FIA) by Pennsylvania Department of Conservation and Natural Resources (DCNR), Pennsylvania State University (PSU), and U.S. Forest Service (USFS). Subsets of all plots are collected each year, with a complete sampling of plots occurring every 5 years. ATSSR 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 et al. 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 requested ATSSR data for dominant canopy species and species capable of achieving high canopy status by WMU from the USFS 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 (i.e., carrying capacity). 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 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, 33 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 Pendragon Forms 5.1 software using a Windows Mobile hand-held computer (Trimble Nomad), and downloaded to a Harrisburg data collection point. 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.

A data entry company was contracted to enter deer harvest report card data. The Pennsylvania Game Commission's (PGC'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 sent in 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). This year, we 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 as in Norton 2010.

For WMUs 2D, 2G, 3C, and 4B, we used integrated population models (IPMs) due to the availability of survival and harvest rate data from completed field studies (Rosenberry et al. 2012b). IPMs offer a trade-off between what is logistically feasible to measure and making predictions necessary for wildlife management. IPMs are useful when only a subset of the population can be monitored; in Pennsylvania, count information is only obtained for the harvested portion of the population. Using estimates of fecundity, survival, and mortality, the relationship between the harvested portion of the population and the full population can be incorporated into a population model to estimate abundance. In addition, as long as there are more field-based estimates than there are model estimates, fairly complex models can be developed, including models which can estimate parameters for which there are no corresponding field estimates, such as fawn survival and harvest rates. A detailed description of the IMP is under development as part of a Master of Science program at PSU.

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 more than 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 0.32 in WMU 5A to a high of 0.49 in WMU 5D (Table 1). All WMUs exhibited stable trends from 2003 to the present.

Forest Habitat Health

WMU forest habitat health assessments were based on the 5 years of the Pennsylvania Regeneration Study from 2007 to 2011. We identified no WMUs with good forest habitat health, 17 with fair forest habitat health, and 2 with poor forest habitat health (Table 2). In 3 highly developed WMUs (i.e., 2B, 5C, and 5D) regeneration data were not used or considered in making deer management recommendations. 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. In this year's report, all plots were analyzed. Deer impact was acceptable in 16 WMUs and too high in 3 WMUs (Table 2).

Deer Harvest Estimates and Composition

PGC personnel checked an average of 443 (range: 38 to 757) antlered deer and 739 (range: 188 to 1,689) antlerless deer per WMU during the 2011 firearms season (Table 4). Based on deer checked and report cards sent in by successful hunters, hunters harvested an estimated 336,200 deer in the 2011-12 deer seasons (Table 3). The antlered harvest was 127,540, an increase of 4% from the 2010-11 harvest of 122,930. The antlerless harvest was 208,660, an increase of 8% compared to the harvest of 193,310 in 2010-11.

Antlered harvests were composed of 50% 1.5-year-old males and 50% 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 changed little since 1997-98 hunting seasons (Table 5).

In WMUs 1A, 1B, 2A, 2B, and 2D, the change in antler restriction from 4 points to a side to 3 points not including the brow tine allowed a few more deer to be harvested. At most, 7 percent of the antlered harvest in these WMUs would not have been legal with the antler restriction in 2010. However, junior hunters could have harvested any of these antlered deer regardless of the antler restriction. As a result, the observed change is a maximum value and likely overstates the effect of the regulation change.

Deer Population Trends

Based on PASAK and IPM results, deer population trends were stable in 18 WMUs and increasing in 4 WMUs from 2006 to 2011 (Table 6).

Deer Management Recommendations

We continue to recommend consistent regulations that provide more hunting opportunities and use antlerless allocations to adjust antlerless harvests and population trends. Research in the 4 WMUs (2D, 2G, 3C, and 4B) using a 5-day antlered deer firearms seasons followed by a 7-day concurrent season were unsuccessful in holding populations stable, as stated in study objectives. Surveys of hunters show that time to hunt was the top reason for increasing deer hunter interest in all age classes (Rosenberry et al. 2012a). Although hunters were split on their preference for a 7-day or 12-day antlerless season, younger hunters preferred a 12 day antlerless season. Younger hunters also indicated that they hunt to harvest any deer. The 12-day concurrent season provides more time for harvesting antlerless deer, and is compatible with sustainable deer populations. Consistent regulations reduce uncertainty when interpreting

changes in harvests and population parameters. The regulations we recommended included a 12-day concurrent antlered and antlerless firearms season for all hunters; a 7-day antlerless muzzleloader season in October; a 3-day antlerless rifle season in October for junior, senior, disabled, and military license holders; sale of unsold antlerless licenses, up to 2 per hunter that remain after all hunters have had an opportunity to purchase 1; and field possession regulations that allow a hunter to harvest another deer after tagging the first deer harvested. For antlerless allocations, we provided the Board of Commissioners with allocation options that would increase, decrease, or stabilize the deer population with either a 5-day antlered and 7-day concurrent firearms season or a 12-day concurrent firearm season. To assist the Board of Commissioners in their decisions, we provided 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. 2012).

Action by the Board of Commissioners

The Board of Commissioners retained the 5-day antlered/7-day concurrent firearms season in WMUs 2A, 2C, 2D, 2E, 2F, 2G, 3B, 3C, 4B, 4D, and 4E. Antlerless allocations were provided to stabilize, increase, and decrease the population. Increases and decreases in the population would be achieved by a decrease or increase of 1 deer per square mile in the antlerless harvest. The Board of Commissioners approved antlerless allocation that fall between population stabilization and decreased population levels in WMUs 1B, 2B, and 3D. The allocations in 15 WMUs (1A, 2A, 2C, 2E, 2F, 3A, 3C, 4A, 4C, 4D, 4E, 5A, 5B, 5C, and 5D) are designed to stabilize the populations. The allocations in WMUs 2D, 2G, 3B, and 4B fall between stabilization and increased population levels.

The approved antlerless allocations increased allocations from 2011-12 to 2012-13 season in 7 WMUs, remained the same in 6 WMUs, and decreased in 9 WMUs (Table 7).

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 least 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 and external peer-review. Prioritize research needs based on internal and external reviews.

4. Return to 12-day concurrent antlered and antlerless firearms seasons for all WMUs. Our surveys indicate that hunters are evenly split with their preference for 7 or 12 day antlerless season, but younger hunters prefer the 12 day concurrent season. Time to hunt (opportunity) was the top reason to increase hunter interest for all ages. The 12-day concurrent firearm season

provides more hunting opportunities to hunters and maintains consistency in hunting seasons that is important to monitoring population trends. In addition, the antlerless allocation can control the antlerless harvest without changing season length.

5. Continue antler restriction regulations in accordance with goals and objectives of the 2009-2018 deer management plan. Monitor changes to antler restrictions in WMUs 1A, 1B, 2A, 2B, and 2D using harvest age structure data and antler characteristics.

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

7. Set antlerless license allocations to achieve deer management goals as defined in the deer management plan.

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Table 1. Number of antlerless deer examined, proportion of juveniles in the antlerless harvest, and trend in the proportion of juveniles in the antlerless harvest by WMU from 2003 to 2011, Pennsylvania.

WMU	*n*	Proportion of juveniles in antlerless harvest	Trend
1A	783	0.43	Stable
1B	1,689	0.40	Stable
2A	859	0.39	Stable
2B	417	0.41	Stable
2C	990	0.40	Stable
2D	1,311	0.44	Stable
2E	392	0.41	Stable
2F	774	0.40	Stable
2G	290	0.33	Stable
3A	561	0.36	Stable
3B	676	0.38	Stable
3C	768	0.34	Stable
3D	534	0.34	Stable
4A	537	0.38	Stable
4B	469	0.41	Stable
4C	968	0.38	Stable
4D	458	0.36	Stable
4E	617	0.42	Stable
5A	269	0.32	Stable
5B	1,303	0.40	Stable
5C	396	0.46	Stable
5D	188	0.49	Stable

Table 2. Number of regeneration plots sampled, percent with adequate regeneration, mean deer impact and qualitative assessments of regeneration and deer impact by WMU. Data are based on samples collected from 2007 to 2011, Pennsylvania. Results are based on all forested plots and cannot be compared to some previous years that only included 40% to 75% stocked plots.

WMU	*n*	% plots with adequate regeneration	Forest health assessment	Mean deer impact	Impact assessment
1A	34	52	Fair	3.10	Acceptable
1B	28	45	Fair	3.32	Too High
2A	35	33	Poor	2.82	Acceptable
2B	n/a[a]	n/a[a]	n/a[a]	n/a[a]	n/a[a]
2C	71	53	Fair	2.78	Acceptable
2D	53	44	Fair	3.14	Acceptable
2E	27	46	Fair	2.50	Acceptable
2F	64	48	Fair	3.08	Acceptable
2G	120	49	Fair	2.72	Acceptable
3A	28	55	Fair	3.07	Acceptable
3B	61	58	Fair	3.08	Acceptable
3C	42	49	Fair	3.44	Too High
3D	52	50	Fair	3.51	Too High
4A	29	57	Fair	2.74	Acceptable
4B	38	54	Fair	3.28	Acceptable
4C	34	45	Fair	3.06	Acceptable
4D	57	34	Poor	2.89	Acceptable
4E	21	61	Fair	3.00	Acceptable
5A	17	61	Fair	2.88	Acceptable
5B	22	41	Fair	3.10	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.

Table 3. Number of antlered deer aged, age composition of harvests, and approximate number of 2.5-year-old and older males harvested in Pennsylvania, 1997-98 to 2011-12. Three and 4-point antler restrictions started in 2002-03. In 2011, the 4-point antler restriction was modified to 3-points not including the brow tine. 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	No. 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	11,688	68	32	52,900
2003-04	11,367	56	44	62,600
2004-05	10,555	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	9,747	50	50	63,770

Table 4. Number of deer checked by PGC personnel, number of report cards sent in by successful hunters, and estimated harvests for antlered and antlerless deer by WMU, Pennsylvania, 2011-12.

	Antlered			Antlerless		
WMU	**Deer checked**	**Report cards**	**Harvest[1]**	**Deer checked**	**Report cards**	**Harvest[a]**
1A	291	1,912	5,200	783	3,438	9,800
1B	596	1,976	6,000	1,689	2,908	9,500
2A	410	2,241	7,100	859	2,962	12,700
2B	181	1,744	4,500	417	3,127	17,000
2C	577	2,868	8,200	990	4,040	12,800
2D	615	3,866	11,100	1,311	5,841	19,300
2E	296	1,607	4,100	392	2,069	7,100
2F	501	1,933	5,400	774	2,277	6,700
2G	517	2,636	6,300	290	2,109	5,500
3A	354	1,177	3,300	561	1,982	6,700
3B	651	2,093	5,900	676	2,424	7,700
3C	757	2,595	7,100	768	2,999	9,900
3D	383	1,655	4,500	534	2,262	7,200
4A	357	1,679	4,800	537	2,171	6,500
4B	502	2,208	5,300	469	2,023	5,500
4C	499	2,309	5,500	968	3,028	7,400
4D	556	2,616	7,100	458	2,458	6,600
4E	532	2,142	5,100	617	2,321	6,100
5A	116	1,130	3,600	269	1,627	3,600
5B	552	3,113	7,200	1,303	4,833	12,900
5C	466	3,364	8,900	1,396	7,736	24,200
5D	38	533	1,200	188	1,599	3,800
Unk.		52	140		51	160

[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.

Table 5. Number of antlerless deer aged and age composition of harvests in Pennsylvania, 1997-98 to 2009-10. 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	20,123	22	18	60
2010-11	14,837	23	18	59
2011-12	16,249	21	19	60

Table 6. PASAK model estimates of pre-hunt deer populations by WMU, 2005 to 2011, Pennsylvania.

WMU	2005	2006	2007	2008	2009	2010	2011	Trend
1A	81,482	94,131	63,864	68,861	73,798	68,974	51,591	Stable
1B	84,078	94,054	82,345	97,872	71,504	76,665	64,915	Stable
2A	96,069	99,017	75,950	78,309	72,970	68,028	88,985	Stable
2B	[a]	[a]	[a]	[a]	[a]	[a]	[a]	Stable
2C	125,302	145,410	150,246	133,998	104,698	107,368	77,192	Stable
2D	104,586	101,128[b]	96,917[b]	103,935[b]	112,203[b]	125,616[b]	136,155[b]	Increasing
2E	56,949	62,108	41,687	53,341	43,859	44,783	37,437	Stable
2F	77,660	101,797	69,408	89,561	64,850	89,584	64,799	Stable
2G	64,457	67,875[b]	71,451[b]	84,645[b]	80,729[b]	89,812[b]	109,741[b]	Increasing
3A	45,168	51,146	42,718	37,198	37,457	45,651	41,771	Stable
3B	66,885	69,898	69,521	50,662	55,176	50,245	72,889	Stable
3C	71,046	69,046[b]	65,885[b]	74,255[b]	84,917[b]	98,500[b]	111,199[b]	Increasing
3D	48,296	59,047	45,760	45,621	30,792	32,466	56,067	Stable
4A	36,154	54,823	54,800	33,760	31,318	34,778	56,558	Stable
4B	37,405	38,194[b]	35,263[b]	38,503[b]	46,404[b]	55,857[b]	58,543[b]	Stable
4C	50,238	55,880	43,968	42,515	39,095	46,636	53,808	Stable
4D	55,385	69,902	49,169	59,655	43,982	59,995	84,387	Increasing
4E	72,971	61,983	55,555	56,175	52,840	65,894	50,431	Stable
5A	30,340	26,555	31,290	29,274	29,739	29,825	38,761	Stable
5B	126,342	135,600	115,452	122,279	101,060	102,587	71,650	Stable
5C	[a]	[a]	[a]	[a]	[a]	[a]	[a]	Stable
5D	[a]	[a]	[a]	[a]	[a]	[a]	[a]	Stable

[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] Population estimates in these WMUs based on use of integrated population models (IPMs). IPMs were used to estimate deer populations due to availability of survival and harvest rate data from completed field studies in these WMUs. See Rosenberry et al. (2012b) for more information.

Table 7. Antlerless license allocations by WMU, 2005-06 to 2012-13, Pennsylvania.

WMU	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
1A	40,000	42,000	42,000	42,000	42,000	41,705	42,000	42,000
1B	27,000	30,000	30,000	30,000	30,000	27,844	30,000	33,000
2A	55,000	55,000	60,000	55,000	55,000	54,879	65,000	59,000
2B	68,000	68,000	68,000	68,000	68,000	68,000	71,000	67,000
2C	53,000	49,000	49,000	49,000	49,000	44,107	58,000	50,000
2D	56,000	56,000	56,000	56,000	56,000	50,123	60,000	62,000
2E	21,000	21,000	21,000	21,000	21,000	20,407	25,000	21,000
2F	30,000	28,000	28,000	28,000	28,000	22,148	34,000	27,000
2G	29,000	19,000	26,000	26,000	26,000	15,210	23,000	33,000
3A	27,000	29,000	29,000	26,000	26,000	25,247	26,000	26,000
3B	41,000	43,000	43,000	43,000	43,000	33,761	40,000	40,000
3C	32,000	27,000	27,000	27,000	27,000	26,358	29,000	35,000
3D	38,000	38,000	38,000	37,000	37,000	31,622	39,000	39,000
4A	35,000	29,000	29,000	29,000	29,000	27,521	28,000	29,000
4B	35,000	31,000	23,000	23,000	23,000	22,148	23,000	26,000
4C	39,000	39,000	39,000	35,000	35,000	34,351	35,000	35,000
4D	40,000	40,000	40,000	40,000	40,000	30,052	37,000	36,000
4E	38,000	38,000	38,000	30,000	30,000	26,899	29,000	28,000
5A	28,000	25,000	22,000	19,000	19,000	18,269	19,000	19,000
5B	56,000	53,000	53,000	51,000	51,000	50,812	50,000	51,000
5C	71,000	79,000	84,000	92,000	113,000	121,960	117,000	111,000
5D	20,000	20,000	20,000	22,000	22,000	22,000	22,000	19,000