PENNSYLVANIA GAME COMMISSION
BUREAU OF WILDLIFE MANAGEMENT
PROJECT ANNUAL JOB REPORT

PROJECT CODE NO.: 06210

TITLE: White-tailed Deer Research/Management

JOB CODE NO.: 21015

TITLE: Biological and social implications of a 7-day concurrent firearms season

PERIOD COVERED: 1 July 2009 through 30 June 2010

COOPERATING AGENCIES: Pennsylvania Cooperative Fish and Wildlife Research Unit, Pennsylvania State University

WORK LOCATION(S): Private and public lands in Wildlife Management Units 2D, 2G, 3C, and 4B

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ABSTRACT In 2008, the Board of Commissioners modified the firearm season length for antlerless deer in Wildlife Management Units (WMU) 2D, 2G, 3C, and 4B from a 12-day concurrent antlered and antlerless season to a 5-day antlered followed by a 7-day concurrent antlered and antlerless season. We investigated potential biological and social management implications that could occur due to this change to the firearms season. From January-April 2010, we captured 724 deer, marking 521 with $100 reward ear tags and 104 with radio collars. From July 2008-April 2009, 89 radio collared deer died, with the main cause of death being legal harvest. Compared to 2007-08, antlerless harvests and catch-per unit effort declined in all four experimental WMUs. Since 2007-08, antlerless catch-per-unit-effort has remained relatively stable in all 4 control units (WMUs 1A, 2F, 3A, and 4A). The proportion of yearling bucks in the harvest decreased slightly in most control and treatment WMUs. To monitor social implications, 2,171 deer hunter diaries were mailed to hunters in the study WMUs with a 52% response rate. In addition, 3,521 surveys were mailed to hunters in the study WMUs following the 2009-10 deer hunting seasons with 68% response rate. Survey and diary data analysis will occur when data collection is completed in 2012.

OBJECTIVES

1. Estimate deer population abundance on each study area.

2. Determine relationship between deer population estimates, antlered harvest and antlerless hunter success rate indices.

3. Determine changes in antlerless hunter success rates from a 12-day concurrent to a 7-day concurrent firearm season.

4. Understand deer hunter experiences, satisfaction, and activity and the relationship from a 2-week concurrent to a 7-day concurrent firearms season.

5. Estimate changes in age structure of antlered harvest.

6. Determine whether deer population objectives can be achieved with a 7-day concurrent firearms season.

METHODS

Deer Capture, Survival, and Mortality Causes

Fieldwork to capture and monitor white-tailed deer (*Odocoileus virginianus*) was conducted in Wildlife Management Units (WMUs) 2D, 2G, 3C, and 4B. Field activities occurred across a broad area within each WMU to increase variability of survival and harvest covariates, thus improving biological inference of the relationship between survival and harvests and covariates (Steury et al. 2002).

We used drop nets (Conner et al. 1987), rocket nets, and modified Clover traps (Clover 1954, McCullough 1975) baited with corn to capture deer. Deer captured using drop-nets and rocket nets were sedated with a light, intramuscular (IM) dose of xylazine hydrochloride (XYL), and face-masked. XYL was delivered via hand syringe at about 0.6 mg/kg body weight, or about 20 mg for a fawn, 30 mg for a yearling, and 40 mg for an adult. These dosages were well below the dosage recommended by Bubenik (1982) for immobilization of white-tailed deer using xylazine alone; complete sedation was not required to facilitate handling deer tangled in the nets. Deer captured with Clover traps were manually restrained and face-masked.

When captured, all deer were fitted with an ear tag in each ear. For deer receiving radio collars, the ear tags contained numbers and a toll-free number. All remaining deer received bicolored ear tags (white on the inside of the ear and black on the outside) to reduce visibility of tags to hunters while hunting. The tag was labeled with a random identification number, toll-free phone number, and $100 reward for reporting the tagged animal. Rewards would be paid by the Pennsylvania Cooperative Fish and Wildlife Research Unit (PCFWRU) through a grant agreement with the Pennsylvania Game Commission (PGC). Handling protocols for deer were approved by the Pennsylvania State University (PSU) Institutional Animal Care and Use Committee.

Deer manually restrained by personnel were immediately released after individual markers were applied. Chemical immobilizations were antagonized with IM injections of tolazoline hydrochloride (TOL; 2.0 mg/kg) because it provides a more consistent antagonism of xylazine than yohimbine hydrochloride (Kreeger 1996).

We monitored survival using radio telemetry. Frequency of monitoring was a minimum of one time per month during the winter trapping season, and at least one time per week during the remainder of the year.

Mortality causes were determined by gross examination of the carcass or a necropsy by the PGC veterinarian. If a tagged deer was legally harvested, hunters were interviewed by biologist aides immediately after being notified to determine the time and circumstances of death.

Unbiased Population Estimates

Changing the firearms season format can potentially bias current methods of monitoring deer population abundance and trends. Some methods may be biased high, and others may be biased low. This creates confusion from which accurate assessment of changes in deer population abundance would not be possible. Unbiased population estimates and trends will be required to evaluate and explain observed changes in hunter success, behavior, and satisfaction.

In addition, combining deer population estimates with population indices provides an opportunity to investigate index calibration. Calibrating population indices with actual population estimates would strengthen the basis for future deer population monitoring and management recommendations.

Antlerless Harvest Success Rates and Effectiveness of 7-Day Season

We used a repeated-measures ANOVA with 4 experimental WMUs (WMUs 2D, 2G, 3C, and 4B) and 4 control WMUs (WMUs 1A, 2F, 3A, and 4A). Analysis compared antlerless catch-per-unit-effort (CPUE) defined as antlerless harvest divided by number of antlerless licenses sold. The analysis is based on CPUEs before the season change (2004-2007) and after the season change (2008-2011).

For the first 2 years of the study, 2008-09 and 2009-10 hunting seasons, antlerless allocations are to remain unchanged in each treatment and control WMU. Following the 2009-10 hunting season, we assessed whether deer populations trends are meeting our objective of population stabilization. Increases in antlerless allocations for the 2010-11 hunting seasons were recommended. However, in April 2010, the Board of Commissioners decided to lower antlerless allocations below recommended levels. Consequently, greater uncertainty about the impact of the change in season length will result.

Hunter Satisfaction

We used hunter surveys to assess changes in hunter satisfaction with the modified antlerless season. In 2010, we sent a survey to hunters in the study WMUs. The 2010 survey was similar to the 2008 survey and mailed at the same time. In this way, we can standardize any recall bias across surveys.

Deer Hunting Experiences

We used hunter diaries (Appendix 1) to determine changes in deer sightings and hunter activity, opinions, and satisfaction. Given the potential for recall bias on hunter surveys more

than 2 months after the firearms season, we also used hunter diaries to monitor deer sightings. The diaries were mailed to a sample of hunters prior to the start of firearms seasons. Dairies were mailed to hunters from study WMUs based on Game Take Survey results and a random sample of 1,000 non-respondents to the Game Take Survey from the preceding year. In addition to providing greater detail on daily hunting activities, hunter diaries allow us to compare diary results to survey results to quantitatively evaluate the extent of recall bias.

Antlered Harvest Age Structure

Although we cannot make "before and after" comparisons using marked deer because of small sample sizes prior to the change to a 7-day concurrent season, it may be possible to observe changes in antlered harvest rates using age structure of the harvest from our sex-age-kill data collected during the firearms deer season. We are not able to estimate specific changes in harvest rate; but, we can observe whether any potential change in harvest rates affects the harvest age structure. For example, if antlered harvest rates on yearling bucks increase, we would expect to see a younger age structure in the harvest.

Hunter Densities and Activity

We used results from the annual Game Take Survey to estimate the number of hunter days during the firearms seasons in each study WMU. The Game Take Survey solicits responses from a sample of approximately 18,000 to 20,000 licensed hunters each year. We used standard responses to the Game Take Survey to estimate the number of days spent deer hunting during the firearms season in each study WMU.

RESULTS

Deer Capture, Survival, and Mortality Causes

We captured 724 deer, including 93 recaptures (Table 1). Five hundred twenty-one deer were marked with reward tags, and 104 were marked with radio collars (Table 2). From July 2009-April 2010, 89 radio collared deer were lost to mortality (Table 3). Fifty-three (27 adult males and 26 adult females) of the mortalities occurred due to legal harvest in the 2D, 2G, 3C, and 4B study areas. Other losses included unrecovered harvest (5), poaching (12), road killed (8), and natural causes (3). An additional 8 deer were lost to unknown causes. Eighty-one of the 471 reward tagged deer from 2009 were reported as legal harvests (Table 4). Eighteen of the 724 handled deer in 2010 were lost as a result of capture (Table 5).

Unbiased Population Estimates

Preliminary point estimates of adult deer (i.e., >1 year of age) populations were estimated using mark-recapture techniques (Chapman 1951). Based on harvest rates of marked deer, population estimates of adult deer were 104,310 in WMU 2D, 74,011 in WMU 2G, 58,655 in WMU 3C, and 31,595 in WMU 4B. These results are based on 1 year of data and do not include fawns because no fawns were marked. Additional years of data will improve reliability of these estimates.

Antlerless Harvest Success Rates and Effectiveness of 7-Day Season

Compared to 2007-08 with a 12-day concurrent season, antlerless harvests declined in all 4 experimental WMUs with a 7-day concurrent season. (Table 6). Harvests in the 3 control units remained relatively stable.

Hunter Satisfaction

The second of 3 hunter surveys was mailed to 3,521 hunters in the study WMUs. One-hundred and thirty-eight were undeliverable, and 166 were returned but filled out incorrectly, defaced and rendered unusable, or duplicates. After adjusting for the undeliverables and duplicates, 2,293 of 3,378 surveys were returned by hunters for a 68% response rate. Results from hunter surveys will be reported in the final report of this study.

Deer Hunting Experiences

We sent 2,171 deer hunter diaries to a random sample of deer hunters in study WMUs. Fifty-eight were undeliverable, and 108 were returned but filled out incorrectly with unusable data or the hunters indicated they did not hunt. After adjusting for the undeliverables, 1,105 of 2,113 diaries were returned by hunters for a 52% response rate. Results from hunter diaries will be reported in the final report of this study.

Antlered Harvest Age Structure

In 2007, yearling males (1.5 years of age) made up 39-67% of the antlered harvest in the experimental WMUs and 52-60% of the antlered harvest in the control WMUs. Changes during the 2008 and 2009 seasons have varied by WMU (Table 7).

Hunter Densities and Activity

Hunter days during the firearms season as estimated from the Game Take Survey results (Annual Report 11101) are provided in Table 8.

RECOMMENDATIONS

At the April 2010 meeting of the Board of Commissioners, substantial changes to antlerless allocations were made in experimental units 2D and 2G, and control units 2F and 4A contrary to the study plan. Because allocations and season length have altered, some objectives of the original study plan have been negatively affected and uncertainty regarding interpretation of study results has increased. This project will continue to address those objectives that can be completed under the altered season and allocations.

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Table 1. White-tailed deer captures (including recaptures reported in parentheses) by sex and age class from January - April 2010 in WMUs 2D, 2G, 3C, and 4B, Pennsylvania. An adult is classified as an animal 1.5 years old or older.

	WMU				
Sex/age class	**2D**	**2G**	**3C**	**4B**	**All captures**
Male Adults	18 (1)	16 (0)	36 (5)	21 (1)	91 (7)
Male Fawns	63 (18)	35 (4)	52 (3)	63 (4)	213 (29)
Female Adults	71 (11)	49 (9)	76 (5)	70 (15)	266 (40)
Female Fawns	43 (8)	20 (1)	41 (3)	50 (5)	154 (17)
Total	195 (38)	120 (14)	205 (16)	204 (25)	724 (93)

Table 2. White-tailed deer captures (including recaptures), number of deer marked with reward ear tags and radio collars by WMU, January - April 2010, Pennsylvania. An adult is classified as an animal 1.5 years old or older.

		Reward ear tags			Radio collars		
WMU	**Total captures**[a]	**Juvenile males**	**Adult males**	**Females**	**Juvenile males**	**Adult males**	**Females**
2D	195 (38)	47 (12)	11 (1)	99 (13)	16 (6)	7 (0)	15 (6)
2G	120 (14)	12 (1)	13 (0)	64 (7)	19 (3)	3 (0)	3 (3)
3C	205 (16)	40 (3)	31 (5)	103 (7)	12 (0)	5 (0)	14 (1)
4B	204 (25)[b]	46 (4)	13 (1)	113 (17)	16 (0)	7 (0)	8 (2)
Total	724 (93)	145 (20)	68 (7)	379 (44)	63 (9)	22 (0)	40 (12)

[a] Includes deer neither radio collared nor reward tagged; this total is greater than sum of all sex/age classes.

[b] Includes recapture of a doe ear tagged from a previous study which was neither collared nor tagged with a reward ear tag.

Table 3. Mortality causes for radio collared white-tailed deer in Pennsylvania, July 2009 - May 2010.

	WMU				
Mortality cause	**2D**	**2G**	**3C**	**4B**	**Total**
Legal harvest	12	15	6	20	53
Male adults	8	8	2	9	27
Male fawns	--[a]	--[a]	--[a]	--[a]	--[a]
Female adults	4	7	4	11	26
Female fawns	--[a]	--[a]	--[a]	--[a]	--[a]
Unrecovered harvest	3	1	0	1	5
Male adults	2	1	0	0	3
Male fawns	--[a]	--[a]	--[a]	--[a]	--[a]
Female adults	1	0	0	1	2
Female fawns	--[a]	--[a]	--[a]	--[a]	--[a]
Poaching	4	4	2	2	12
Male adults	3	4	2	1	10
Male fawns	0	0	0	0	0
Female adults	1	0	0	1	2
Female fawns	0	0	0	0	0
Roadkill	3	0	3	2	8
Male adults	1	0	1	1	3
Male fawns	0	0	0	0	0
Female adults	1	0	0	1	2
Female fawns	1	0	2	0	3
Natural Causes	0	2	1	0	3
Male adults	0	1	0	0	1
Male fawns	0	0	1	0	1
Female adults	0	1	0	0	1
Female fawns	0	0	0	0	0
Unknown/Other	3	1	0	4	8
Male adults	0	0	0	2	2
Male fawns	0	0	0	0	0
Female adults	3	1	0	2	6
Female fawns	0	0	0	0	0
Total	25	23	12	29	89
Male adults	14	14	5	13	46
Male fawns	0	0	1	0	1
Female adults	10	9	4	16	39
Female fawns	1	0	2	0	3

[a] Fawns less than 7 months-old are not marked during the hunting seasons.

Table 4. Reported harvests for reward tagged white-tailed deer (471) captured in Pennsylvania, October 2009 - January 2010.

	WMU				
Legal harvest	**2D**	**2G**	**3C**	**4B**	**Total**
Total	32	4	17	28	81
Male adults	18	2	5	16	41
Female adults	14	2	12	12	40

Table 5. Capture related mortalities from 724 handled white-tailed deer in Pennsylvania, January 2010 - April 2010.

	WMU				
Capture related mortalities	**2D**	**2G**	**3C**	**4B**	**Total**
Total	2	8	4	4	18
Male adults	0	0	0	0	0
Male fawns	0	4	4	1	9
Female adults	2	2	0	2	6
Female fawns	0	2	0	1	3

Table 6. Estimated antlerless harvests, number of antlerless licenses sold, and catch-per-unit-effort (CPUE) by WMU, 2007-08 through 2009-10.

	2007-08[a]			**2008-09**[b]			**2009-10**[b]		
WMU	**Harvest**	**Lic. sold**	**CPUE**	**Harvest**	**Lic. sold**	**CPUE**	**Harvest**	**Lic. sold**	**CPUE**
2D	18,100	55,365	0.33	15,600	55,294	0.28	16,000	56,500	0.28
2G	6,600	25,779	0.26	6,500	25,775	0.25	4,200	26,412	0.16
3C	9,600	26,804	0.36	7,300	26,884	0.27	7,100	27,276	0.26
4B	4,500	22,687	0.20	3,800	22,696	0.17	4,100	23,285	0.18
1A	12,500	41,353	0.30	12,600	41,603	0.30	10,700	42,331	0.25
2F	7,100	27,716	0.26	9,100	27,753	0.33	6,600	28,444	0.23
3A	7,800	28,392	0.27	7,500	25,540	0.29	6,000	26,200	0.23
4A	6,700	28,402	0.24	6,900	28,731	0.24	7,400	29,254	0.25

[a] 12-day season in all 8 WMUs.
[b] 7-day season in WMUs 2D, 2G, 3C, and 4B

Table 7. Harvest age structured of antlered deer by WMU, expressed as percentages, 2007-08 through 2009-10 hunting seasons.

	2007-08[a]		2008-09[b]		2009-10[b]	
WMU	**Yearling**	**Adult**	**Yearling**	**Adult**	**Yearling**	**Adult**
2D	0.67	0.33	0.60	0.40	0.56	0.44
2G	0.39	0.61	0.38	0.62	0.28	0.72
3C	0.53	0.47	0.47	0.53	0.38	0.62
4B	0.60	0.40	0.57	0.43	0.58	0.42
1A	0.60	0.40	0.62	0.38	0.59	0.41
2F	0.58	0.42	0.50	0.50	0.53	0.47
3A	0.52	0.48	0.41	0.59	0.47	0.53
4A	0.56	0.44	0.39	0.61	0.39	0.61

[a] 12-day season in all 8 WMUs
[b] 7-day season in WMUs 2D, 2G, 3C, and 4B

Table 8. Estimated hunter effort (days hunted) during the firearms season by WMU, 2007-08 through 2009-10 hunting seasons.

WMU	**2007-08[a]**	**2008-09[b]**	**2009-10[b]**
2D	178,702	171,353	217,350
2G	201,264	212,093	205,440
3C	131,879	128,566	121,712
4B	103,559	101,440	123,336
1A	118,002	91,818	123,517
2F	137,165	127,952	151,215
3A	95,534	73,905	102,765
4A	135,938	120,275	122,885

[a] 12-day season in all 8 WMUs
[b] 7-day season in WMUs 2D, 2G, 3C, and 4B

Appendix 1. 2009-10 Deer hunter diary to determine changes in deer sightings and hunter activity, opinions, and satisfaction.

Pennsylvania Deer Hunter Diary – 2009 Firearms Season (November 30-December 12, 2009)

1. Which of the following licenses and stamps did you purchase for the 2009-10 hunting seasons? (**Circle all that apply**)

   1. GENERAL HUNTING LICENSE **2**. JR or SR COMBINATION HUNTING LICENSE **3**. LANDOWNER LICENSE **4**. ARCHERY STAMP **5**. MUZZLELOADER STAMP

2. How many WMU-specific antlerless licenses did you purchase? _____

3. How many DMAP permits did you purchase? _____

4. How many days did you scout for deer prior to the rifle season? (**Circle one number**)

   1. 0 DAYS
   2. 1-5 DAYS
   3. 6-10 DAYS
   4. MORE THAN 10 DAYS

5. Did you hunt during any of the early deer seasons (i.e., Archery, October muzzleloader, and October rifle)? (**Circle all that apply**)

   1. YES, ARCHERY SEASON
   2. YES, OCTOBER MUZZLELOADER SEASON
   3. YES, OCTOBER RIFLE SEASON FOR JUNIOR, SENIOR, DISABLED PERSON PERMIT HOLDER, AND ACTIVE MILITARY
   4. NO, I DID NOT HUNT DEER DURING ANY EARLY SEASONS

   If YES, did you harvest any deer during these early seasons? **1**. NO **2**. YES, AN ANTLERED DEER **3**. YES, _____ ANTLERLESS DEER
   No. of deer

INSTRUCTIONS FOR COMPLETING HUNTER DIARY:
Each time you hunt deer during the rifle season (November 30-December 12, 2009), please complete a row on the following sheet. You may have more than one entry for a day if you went out for two separate hunts.

- For land ownership, please record whether the land was privately owned, State Game Lands (SGL) or other publicly owned. For example, other publicly owned lands include State Forest Lands, State Parks, and National Forest. If you hunted on multiple land ownerships on a hunt, for example private lands and state game lands, circle both “Private” and “SGL”.

- When hunting, if you cannot identify a deer as antlered or antlerless, please record as “Unk” for unknown.

INSTRUCTIONS FOR RETURNING HUNTER DIARY:

Please return your diary in the self-addressed, postage paid envelope provided by **December 17, 2009**. Your answers will remain confidential.

Pennsylvania Deer Hunter Diary – 2009 Firearms Season (November 30-December 12, 2009)

Date	WMU	Ownership of land hunted (circle all that apply)	Hours Hunted (to the nearest ½ hour)	Antlered deer seen while hunting	Antlerless deer seen while hunting	Unk deer seen	Did you harvest an antlered deer?	If you harvested an antlered deer, how many points did it have?	How many ANTLERLESS deer did you harvest with a WMU antlerless license?	How many ANTLERLESS deer did you harvest with a DMAP permit?	Did you hunt as part of a deer drive?
12/1	3B	Private SGL Other Public	4.5	1	2	1	YES NO	0	1	0	YES NO
		Private SGL Other Public					YES NO				YES NO
		Private SGL Other Public					YES NO				YES NO
		Private SGL Other Public					YES NO				YES NO
		Private SGL Other Public					YES NO				YES NO
		Private SGL Other Public					YES NO				YES NO
		Private SGL Other Public					YES NO				YES NO
		Private SGL Other Public					YES NO				YES NO
		Private SGL Other Public					YES NO				YES NO
		Private SGL Other Public					YES NO				YES NO
		Private SGL Other Public					YES NO				YES NO
		Private SGL Other Public					YES NO				YES NO

IF MORE SPACE IS NEEDED, PLEASE COMPLETE THE SAME INFORMATION AND ATTACH ADDITIONAL SHEET(S) TO THIS FORM

Please complete questions 6 and 7 after the 2009 rifle season

6. How do you rate your satisfaction with your hunting experience during the 2009 rifle season? (**Circle one number**)

1. VERY DISSATISFIED **2**. DISSATISFIED **3**. NEITHER SATISFIED NOR DISSATISFIED **4**. SATISFIED **5**. VERY SATISFIED

7. How do you rate the Pennsylvania Game Commission's deer management program? (**Circle one number**)

1. DON'T KNOW **2**. POOR **3**. FAIR **4**. GOOD **5**. EXCELLENT