South Dakota
SURVEY REPORT

Deer Population Status Update

2021 Biennial Report

Prepared by:
Andrew J. Lindbloom, Senior Big Game Biologist
Lauren M. Wiechmann, Big Game Biologist
Andrew S. Norton, Senior Big Game Biologist
Steven L. Griffin, Big Game Biologist

SOUTH DAKOTA DEPARTMENT OF GAME, FISH AND PARKS
PIERRE, SOUTH DAKOTA

WILDLIFE SURVEY REPORT 2021-05

April 2021

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICIES

INTRODUCTION

South Dakota's diverse landscapes of grassland, cropland, and timbered areas are home to white-tailed deer (*Odocoileus virginianus*) across the entire state and mule deer (*Odocoileus hemionus*) primarily adjacent to and west of the Missouri River breaks. Deer hunting is a popular and much awaited outdoor activity for many sportsmen and women in South Dakota. Within South Dakota, approximately 62,900 residents and 7,600 non-residents hunted deer in 2020, with peak deer hunter participation occurring in 2010 when 81,478 residents and non-residents pursued deer. Hunting remains the number one tool for managing deer populations across South Dakota and harvest strategies are intended to ensure the well-being of the species and its habitat while maintaining populations at levels compatible with human activity and land use.

White-tailed deer and mule deer management units are managed towards objectives to increase, maintain, or decrease populations. All management unit objectives are based on annual collection and evaluation of deer biological data, habitat resources, weather data, private land depredation issues, and substantial input from a wide variety of publics with an interest in deer management in South Dakota. South Dakota Department of Game, Fish, and Parks (SDGFP) will adopt harvest strategies that progressively allow white-tailed deer and mule deer to reach these population objectives.

The current over-riding goal for deer management is to "manage white-tailed deer and mule deer populations and habitats by fostering partnerships and stewardship and applying biological and social sciences" (SDGFP 2017). More specific information on deer population objectives, strategies, and research in South Dakota can be found in the South Dakota White-tailed Deer and Mule Deer Management Plan at https://gfp.sd.gov/UserDocs/nav/deer-mgmnt.pdf.

The following report provides a statewide overview of deer surveys and assessments conducted by the SDGFP and an update on the population status of white-tailed deer and mule deer in South Dakota.

POPULATION SURVEYS AND ASSESSMENTS

Mule deer and white-tailed deer herds are monitored annually across their range in South Dakota. Survey efforts are completed to assess herd status and predict population trends in eight data analysis units (DAUs) for mule deer and 11 DAUs for white-tailed deer. We define a DAU as an aggregate of deer management units that is large enough to produce reliable estimates from population surveys while representing similar habitat, climatic, and demographic characteristics. The final product of an analysis performed by the University of Montana in collaboration with SDGFP resulted in the development of 11 DAUs (Figure 1; SDGFP 2017).

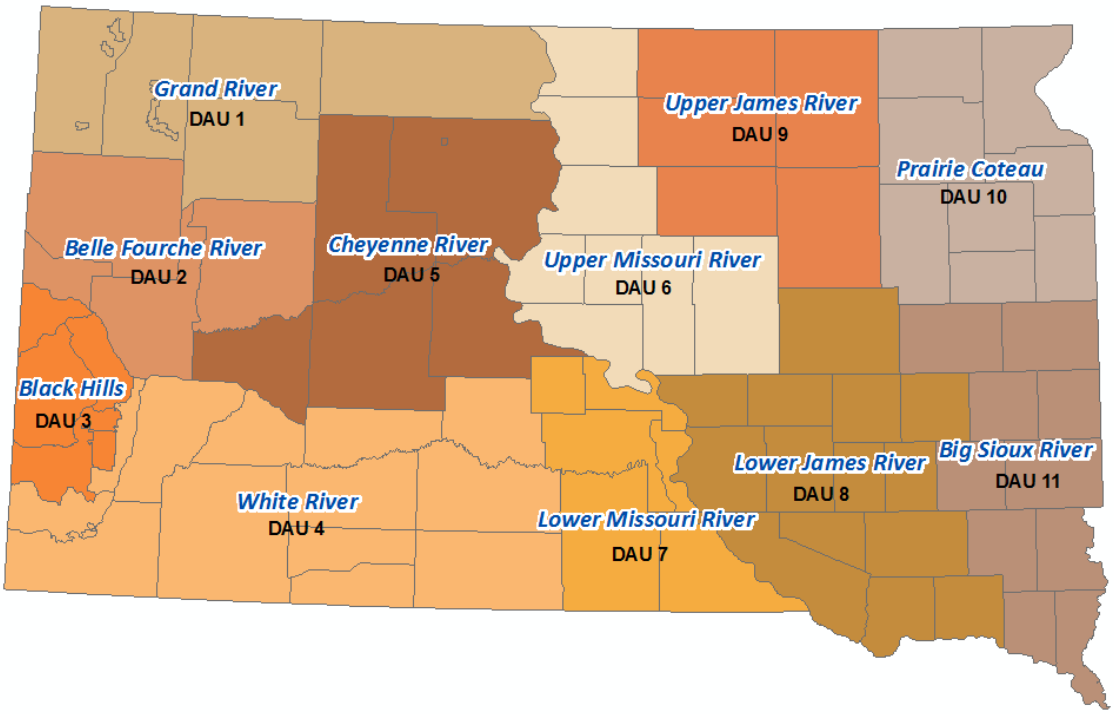


Figure 1. Data Analysis Units (DAUs) for deer management in South Dakota.

Current strategies to manage and evaluate deer populations include establishing population objectives, hunting season evaluations, disease monitoring, herd composition surveys, survival monitoring, calculating winter severity indices, abundance surveys, and population modeling. Survey data are presented at different forums at many geographic scales, but most data are collected and analyzed at the DAU level for purposes of evaluating herd abundance and trends and for determining proper license allocation. The following sections provide a general overview of the surveys and results, but more detailed datasets and descriptions of analyses can be found in Norton et al. (2021).

Population Objectives

Population objective directions (increase, maintain, or decrease) for each firearm deer hunting unit are set every 2 years when season recommendations are brought forward to the SDGFP commission (Figure

2). Deer population objectives for each unit are based on population assessments, habitat conditions, and social considerations.

Within the Black Hills data analysis unit, SDGFP has estimated white-tailed deer abundance for multiple years and therefore was able to define a pre-season abundance objective of 70,000 (65,000-75,000) white-tailed deer. In addition, because hunter satisfaction is strongly correlated with hunter success, SDGFP has established minimum success thresholds for licenses containing "any deer" or "any whitetail" firearm tags (Appendix A). Furthermore, in Limited Access Units, harvest must meet either hunter success or license density thresholds (Appendix A; firearm license densities no greater than 1.5 licenses/square mile for "any deer" licenses and no greater than 2.5 licenses/square mile for "any whitetail" licenses).

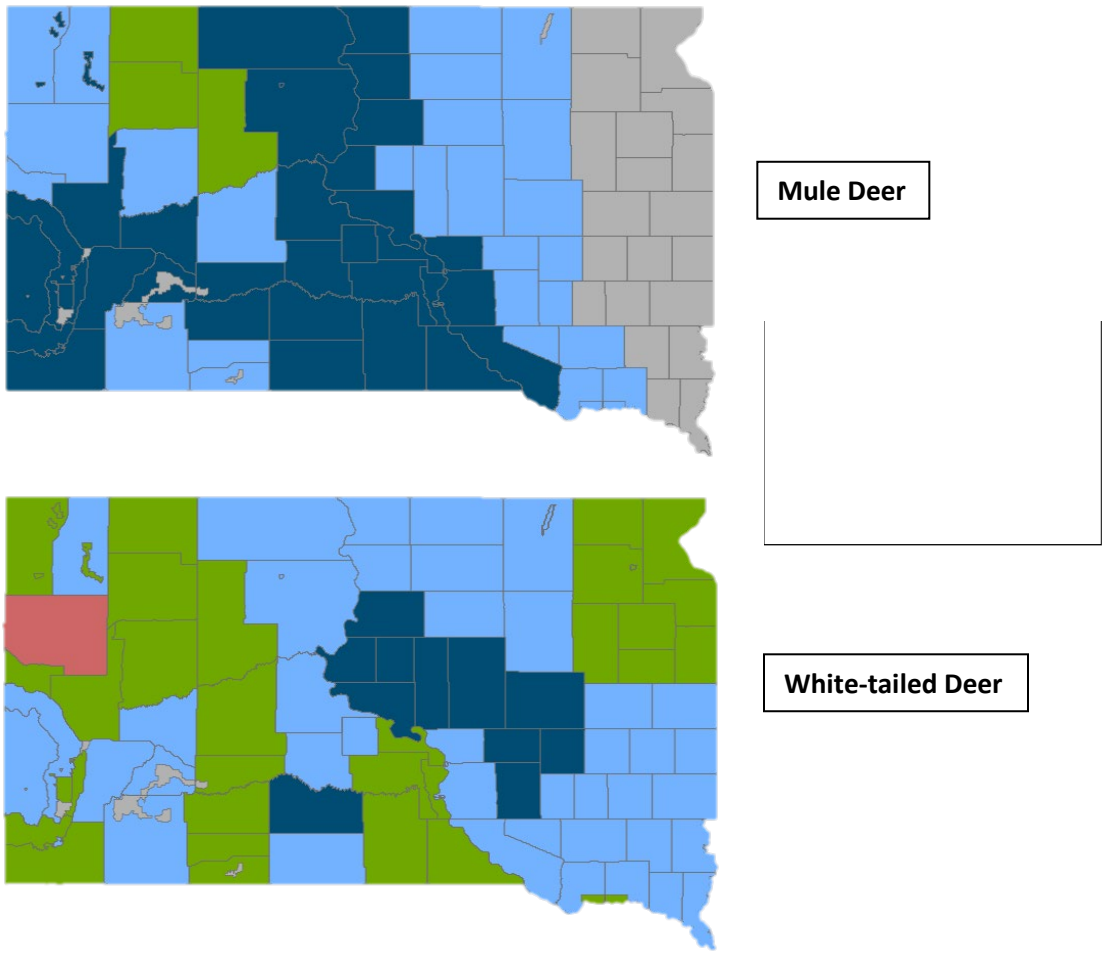


Figure 2. Population objectives for mule deer and white-tailed deer, 2021-22. Areas in gray do not have established objectives.

Hunting Season Evaluations

There are currently a variety of deer hunting opportunities and a number of license types that a hunter can choose from when applying for a deer license. Each deer hunting season has an assortment of

license types available which determines the available tag distribution. License types define the type and number of deer tags available for a respective license. For each license type, SDGFP estimates harvest by species, sex, and age cohorts allowing staff to be able to predict harvest composition based on previous years' success. This provides wildlife managers the ability to reduce or increase harvest pressure on specific species and sex classes of the deer population in order to reach unit population objectives.

Currently all deer hunters are surveyed via email or electronic submission methods. Annual deer hunter surveys are conducted to estimate harvest at each management unit for each species and age/sex cohorts. Statewide harvest for white-tailed deer has slowly increased from a recent low of about 41,200 in 2014 to 51,600 deer in 2020 (Figure 3). SDGFP has maintained a low white-tailed deer doe harvest of about 17,000 for the past several years to allow many herds in the state to increase to more desirable levels while maintaining harvest in other areas that are closer to objectives. Statewide mule deer harvest has slowly increased as well from a low of about 5,400 in 2014 to 7,400 in 2020, mostly due to increased buck harvest since doe harvest has been substantially restricted for the past 7 years (Figure 3). A consistently low mule deer doe harvest of approximately 1,500 has allowed some deer herds of the state to grow to more desirable levels although many areas are still substantially below objective (Figure 2 and Figure 3).

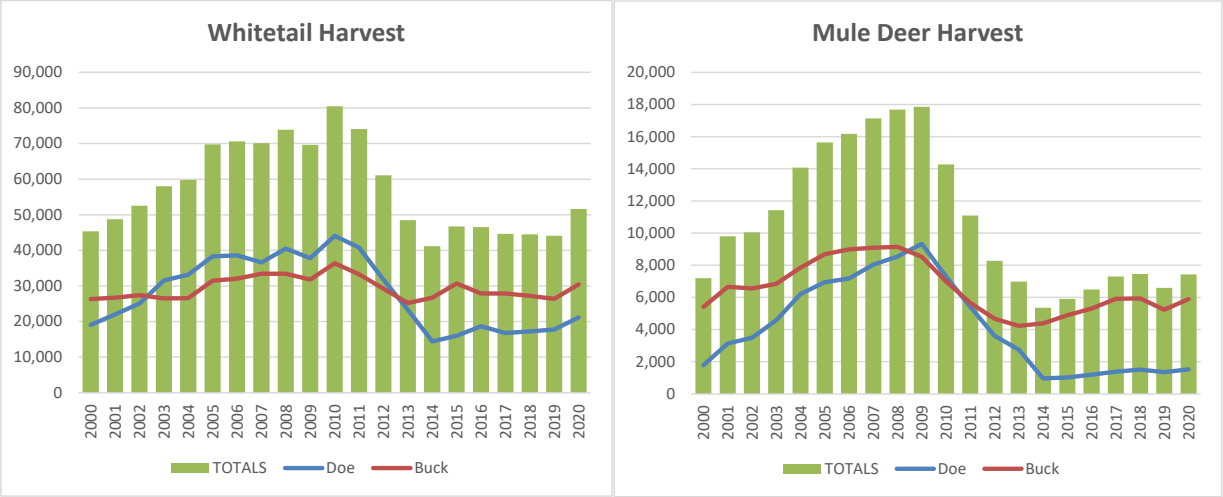


Figure 3. Estimated white-tailed deer and mule deer harvest trends, 2000-2020.

License sales for all deer seasons combined were approximately 106,300 in 2019 and 112,900 in 2020. In 2020, there were about 70,470 unique deer hunters (68,640 in 2019) that overall spent around 602,700 days participating in deer hunting. Harvest by weapon type for all firearm seasons in 2020 was about 47,300 deer, while archery and muzzleloader hunters harvested approximately 10,400 and 1,300 deer respectively (Table 1). License sales and harvest information for each hunting season for 2020 can be found in Appendix B. Harvest data are evaluated at both the firearm unit and DAU level. See Appendices C-M for trend figures of DAU harvest by species and Norton et al. (2021) for more harvest information at the unit level.

Table 1. Deer harvest in 2020 by weapon type in South Dakota.

	White-tailed Deer	Mule Deer	Total
Firearm	41,422	5,866	47,288
Archery	9,061	1,384	10,445
Muzzleloader	1,154	186	1,341
TOTAL	51,637	7,436	59,074

Disease Monitoring

Chronic Wasting Disease

Since 2001, chronic wasting disease (CWD) has been found in 245 elk, 115 mule deer, and 243 white-tailed deer in numerous areas of South Dakota. In the past 2 hunting seasons, SDGFP has detected CWD in 97 white-tailed deer and 24 mule deer (Figure 4). These include 1 white-tailed deer and 1 mule deer from within the boundaries of Wind Cave National Park, 5 white-tailed deer from Custer State Park, 4 white-tailed deer and 1 mule deer from Black Hills Fire firearm units, 64 white-tailed deer and 21 mule deer from west river firearm units, and 1 mule deer from an east river firearm unit. Additionally, 23 white-tailed deer and 1 mule deer were found positive for CWD from city deer removals within the last 2 years. Figure 4 shows the documentation of CWD within South Dakota over the past 2 years. Prior to 2019, CWD had only been documented in 4 counties in the Black Hills area. During the 2019 hunting seasons, CWD was documented in 8 additional counties, and in 2020, CWD was found in 4 more counties (Figure 4).

The South Dakota Chronic Wasting Disease Action Plan was approved by the GFP Commission in June of 2019 (https://gfp.sd.gov/userdocs/docs/Final_SD_CWD_Action_Plan_August_2020.pdf). Communication with all stakeholders within South Dakota is key to a successful CWD Action Plan. This is a working Action Plan with the key points including: investigating regulations regarding interstate and intrastate movement of carcasses, baiting and feeding of wildlife, use of urine based lures, translocation of cervids, game processors, taxidermist, donation of venison, and expansion of surveillance areas to determine current presence of CWD surrounding known endemic areas. The GFP Commission created regulations for the transportation and disposal of deer and elk carcasses from other states and from hunting units within South Dakota's known CWD endemic areas (Figure 4) for the 2020 hunting seasons: https://gfp.sd.gov/2020-cwd-regulations/. New regulations are currently being considered by the SDGFP Commission for the 2021-22 hunting seasons in South Dakota.

Epizootic Hemorrhagic Disease

The State of South Dakota experienced a mortality event of mainly white-tailed deer during July-November 2020 due to Epizootic Hemorrhagic Disease (EHDV) and/or Blue Tongue (BTV). The South Dakota Department of Game, Fish, and Parks (SDGFP) received reports of sick and deceased white-tailed deer, mule deer or pronghorn during the summer and fall of 2020. As in previous years with mortality in the summer months, EHDV was suspected and efforts were made to document the virus through the Diagnostic Lab at South Dakota State University. Through laboratory testing, confirmation was received that the EHDV virus was present in 25 white-tailed deer and 2 mule deer. The SDGFP investigated many sick and dead ungulates that would be associated with EHDV/BTV.

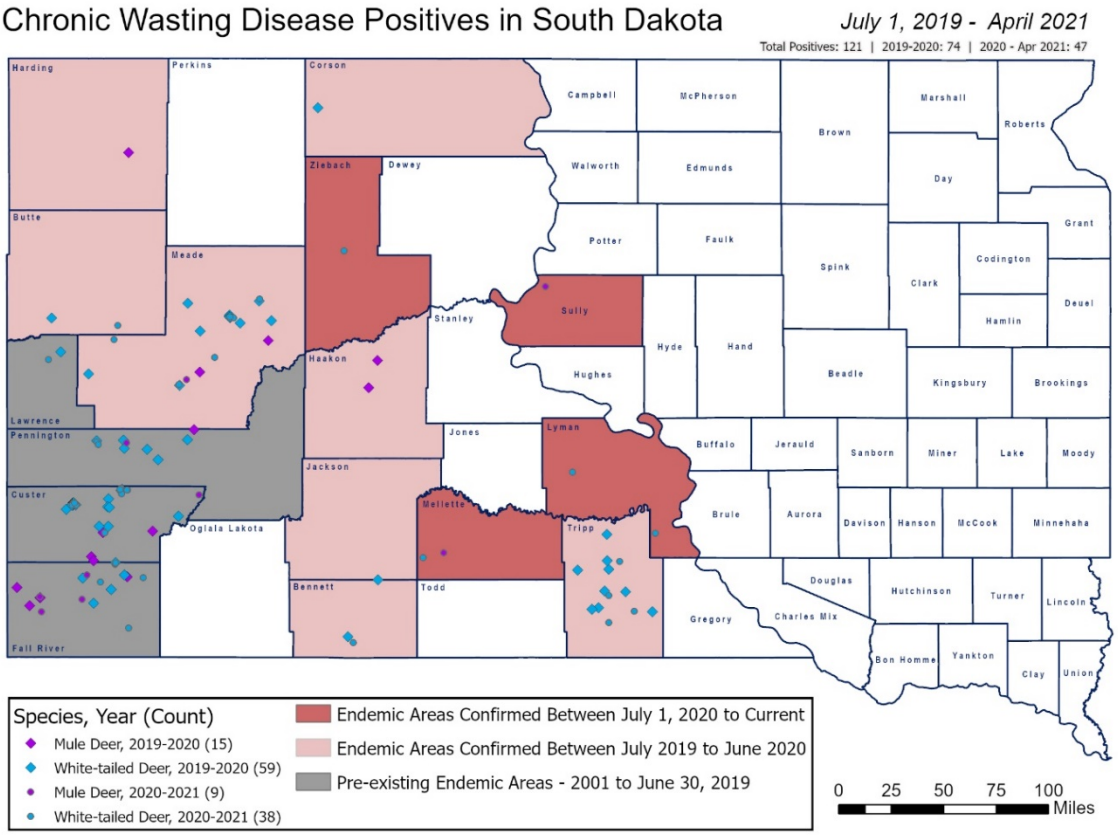


Figure 4. Chronic wasting disease positive wild white-tailed and mule deer in South Dakota, 2019-2021.

Thirty-seven counties from across South Dakota had suspected, reported, or confirmed EHDV or BTV virus in white-tailed deer, mule deer, or pronghorn (Figure 5). Statewide, a total of 665 dead or sick animals were recorded in 2020, which included 663 deer and 2 pronghorn. Only 27 cases of EHDV or BTV was reported in South Dakota in 2019 (Figure 6). Most cases in 2020 were found east of the Missouri River with additional disease found in the NW parts of South Dakota. Reported losses from EHD in 2020 affected unit objectives and 2021-22 license allocations in several hunting units. Preliminary assessments of adult doe survival studies provided further evidence that whitetail survival decreased substantially in many populations where public and staff reported EHD mortalities.

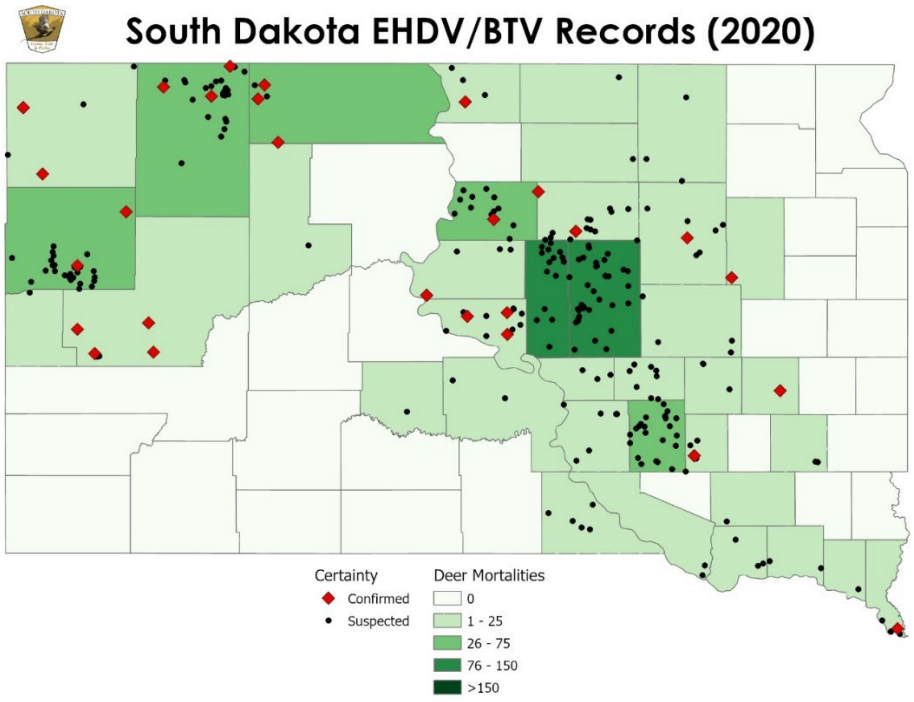


Figure 5. Locations of reported deer, pronghorn, and elk mortalities presumably caused by Hemorrhagic disease in South Dakota, 2020. Red locations indicate positive results from laboratory testing.

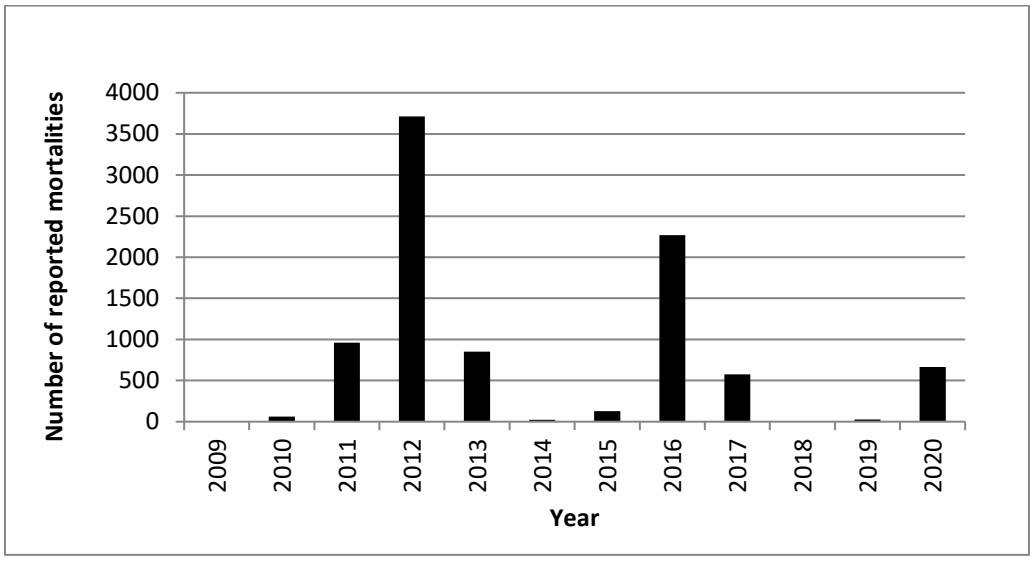


Figure 6. Annual reported hemorrhagic disease mortalities of deer, elk, pronghorn, and bighorn sheep in South Dakota, 2009-2020.

Herd Composition Surveys

Pre-season herd composition surveys of white-tailed deer and mule deer populations have been conducted annually throughout the state of South Dakota since the early 1940s in some areas, but decent records only exist back to the 1970s or 1980s. Current herd composition ground surveys are completed by driving roads or hiking in areas of known deer concentrations in September and October (Appendices C-M). All deer herds that are observed in their entirety are classified to numbers of fawns, does, and bucks. Spatial data are also recorded for each observation in order to reduce double-counting occurrences. A minimum sample size of 200-400 independent group observations per species per DAU is currently obtained to ensure sufficient precision in herd composition estimates. Age ratios are calculated as fawns:100 does and are used as an indicator of fall recruitment into the population. Sex ratios are calculated as bucks:100 does and are an important parameter used in population modeling.

In 2020, SDGFP staff counted and classified 17,086 deer (5,985 mule deer; 11,101 white-tailed deer) to estimate herd composition across the state. Statewide sex ratios were 24 bucks:100 does (95% CI: 23-26) for white-tailed deer and 47 (44-50) for mule deer. Statewide recruitment of white-tailed deer is consistently higher than that observed in mule deer populations (Figure 7). In 2020, mule deer recruitment was 79 fawns:100 does (95% CI: 66-67) statewide but varied from a high of 80 (71-92) in DAU1 to a low of 47 (36-61) in DAU8 (Figure 8). For white-tailed deer, recruitment varied from 60 (51-72) in DAU7 to 97 (85-111) in DAU9 but averaged 79 (76-82) statewide (Figure 9). Quantifying deer recruitment for each DAU is critical to estimate growth rates and determine appropriate license allocation deer herds throughout the variable landscapes of South Dakota.

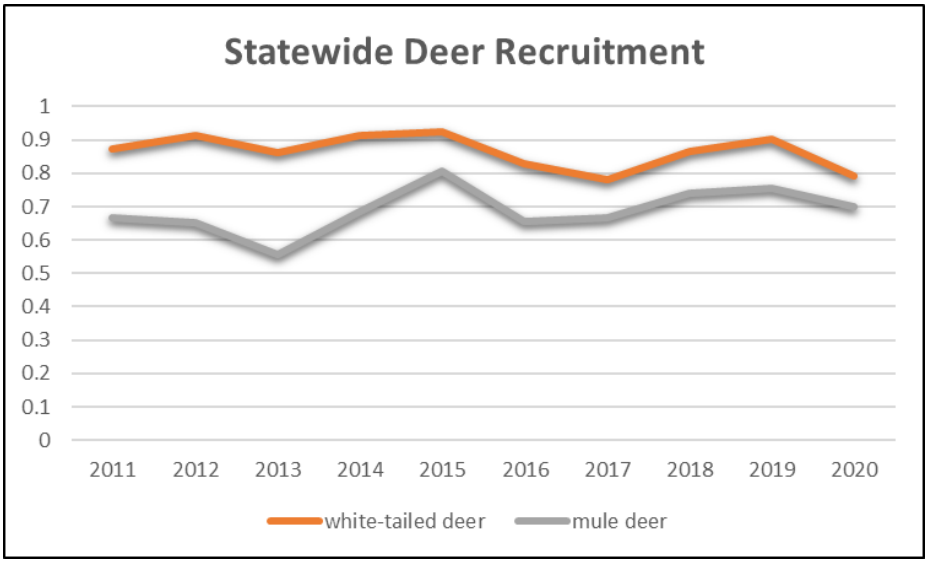


Figure 7. Statewide estimates of recruitment for white-tailed deer and mule deer in South Dakota, 2011 – 2020.

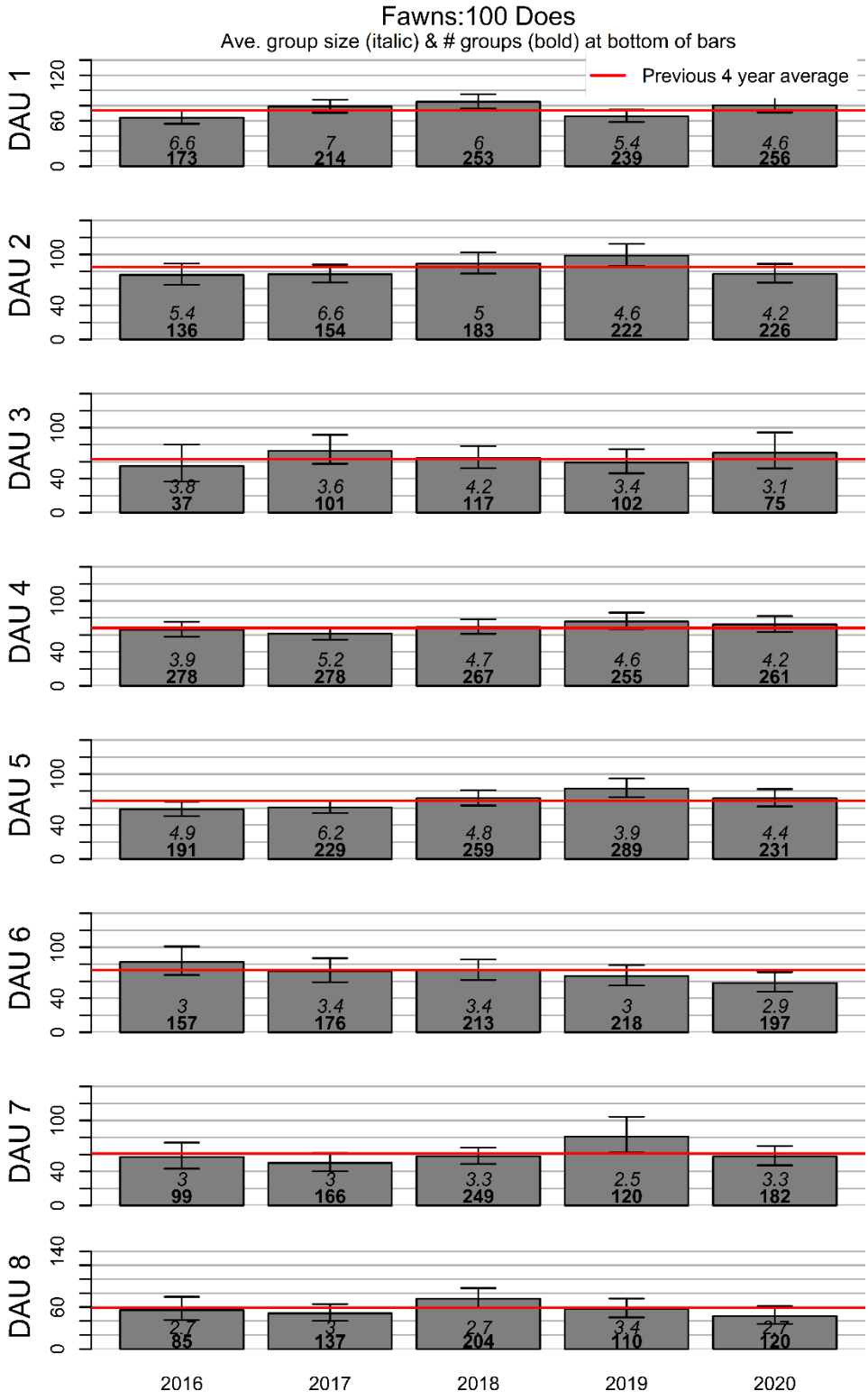


Figure 8. Age ratios from Herd Composition surveys for mule deer, 2016-2020.

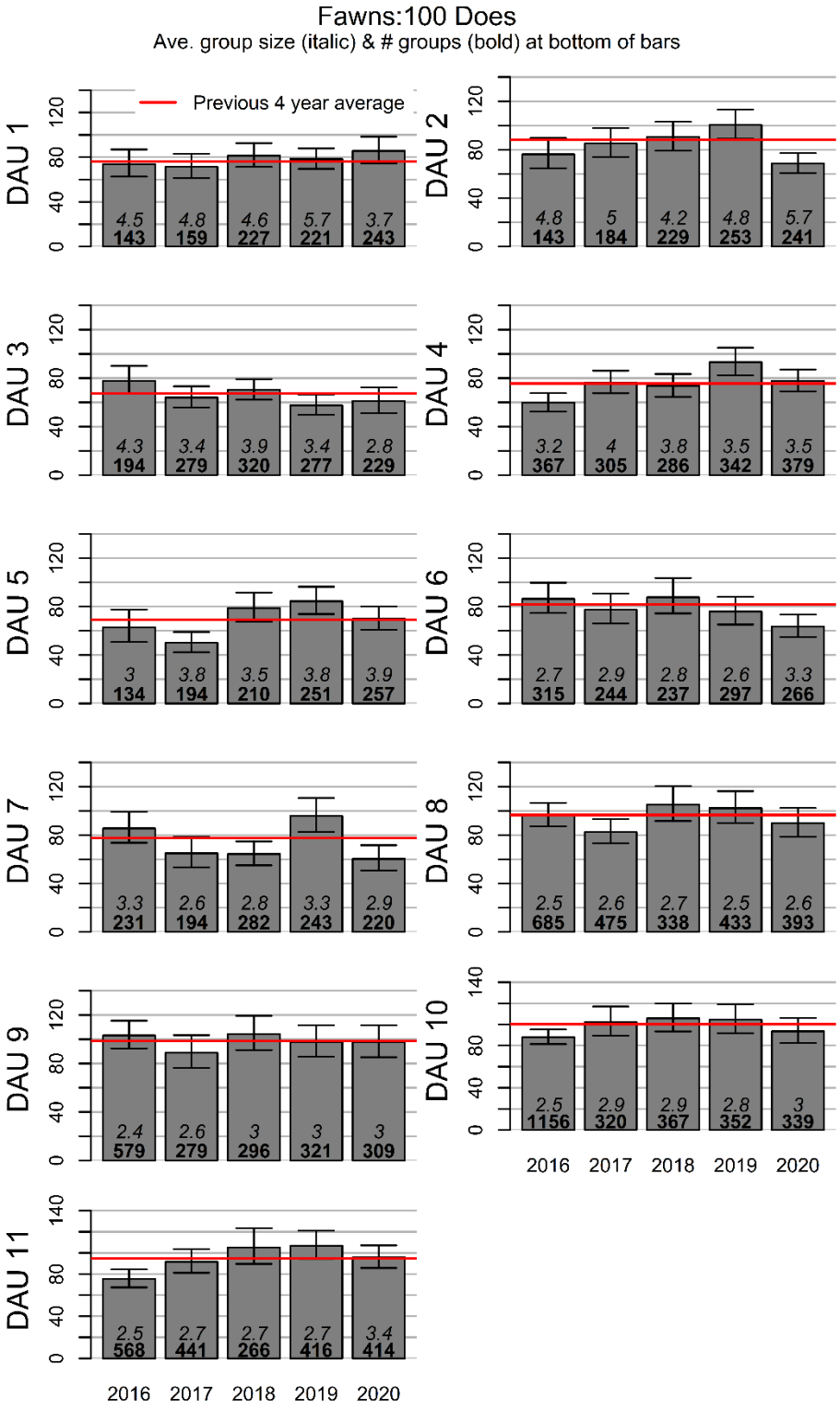


Figure 9. Age ratios from Herd Composition surveys for white-tailed deer, 2016-2020.

Survival Monitoring

Understanding population dynamics of both white-tailed and mule deer and determining annual rates of population change requires knowledge of fawn, juvenile, and adult survival rates. Annual rates of change within a deer population are influenced primarily by adult survival and the number of fawns that reach one year of age. Radio-collared deer have been used to produce survival estimates in South Dakota for over 20 years, and methods continue to evolve to provide more robust estimates (see Norton et al. 2021). Within current active monitoring areas, adult females (17+ months) and juveniles (5-16 months) are primarily captured via helicopter net gun and fitted with a VHF or GPS radio collar. Monitoring occurs one time each month for each collared individual.

Survival rates are used to estimate deer numbers and monitor changes in populations as the result of changes in winter conditions, disease outbreaks, or harvest strategies. Increased efforts to obtain statistically valid survival estimates within a defined data analysis unit have been occurring in recent years, with sample sizes of radio-collared mule deer and white-tailed increased significantly (105 adults and 110 juveniles). Since 2013, over 5,000 deer have been radio-collared to evaluate survival in South Dakota for 2 species, 2 sexes, and 2 age cohorts (Figure 10). Currently, SDGFP is actively capturing and monitoring GPS collared mule and white-tailed deer in DAU1, approximately 105 adults and 110 juveniles of each species. Other areas where survival monitoring is occurring include DAUs 4 and 6 for mule deer, and DAUs 8 and 10 for white-tailed deer.

Preliminary survival estimates are available in 6 DAUs for white-tailed deer and 4 DAUs for mule deer in 2020. White-tailed deer survival for juveniles was 87% (95% CI:80-93), adult bucks 74% (61-89), and adult does varied from 73% (66-81) to 95% (90-99; Table 2). Survival rates for mule deer were 59% (95% CI:48-68) for juveniles while adult does varied from 77% (67-89) to 84% (76-92;Table 3).

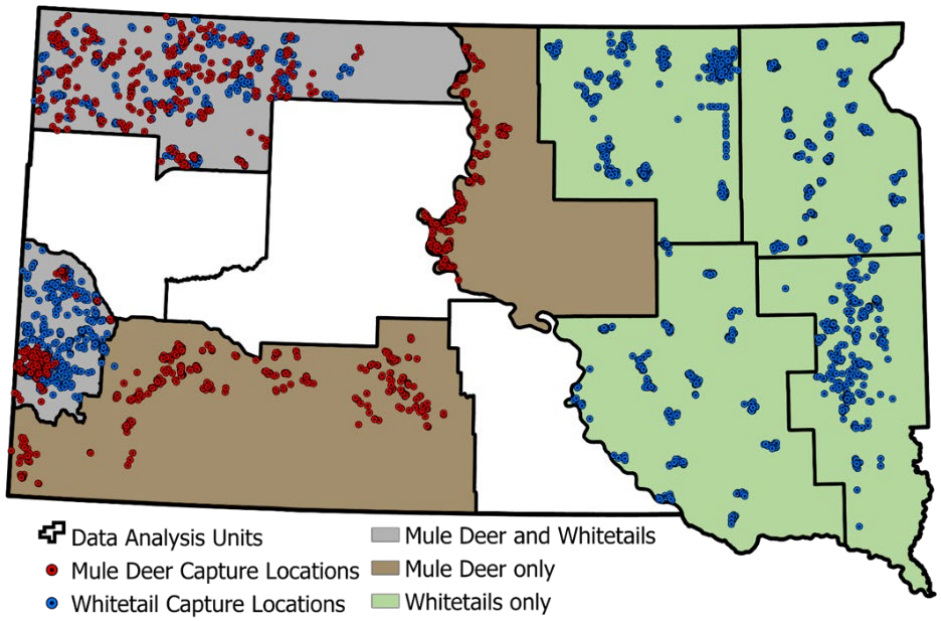


Figure 10. Winter capture and radio-collaring locations of mule deer and white-tailed deer in South Dakota, 2013-2020.

Table 2. Preliminary survival rates of white-tailed deer by DAU in 2020.

Adult Does				
DAU	Annual Survival	Lower 95% CI	Upper 95% CI	n
1	95%	90%	99%	102
3	75%	62%	89%	53
8	73%	66%	81%	148
9	85%	76%	95%	76
10	85%	79%	92%	132
11	85%	76%	95%	71
Juveniles				
DAU	Annual Survival	Lower 95% CI	Upper 95% CI	n
1	87%	80%	93%	105
Adult Bucks				
DAU	Annual Survival	Lower 95% CI	Upper 95% CI	n
3	74%	61%	89%	46

Table 3. Preliminary survival rates of mule deer by DAU in 2020.

Adult Does				
DAU	Annual Survival	Lower 95% CI	Upper 95% CI	n
1	83%	76%	91%	113
3	77%	67%	89%	61
4	84%	76%	92%	95
6	82%	75%	90%	114
Juveniles				
DAU	Annual Survival	Lower 95% CI	Upper 95% CI	n
1	59%	49%	70%	92

Survival studies have been instrumental in providing area specific biological data for SDGFP managers to use in evaluating deer populations and management options. Although these data often provide the only means to estimate population abundance and trends for local deer herds, survival rate data are still lacking in many areas. Future evaluations of spatial and temporal relationships in survival data will be critical in assessing the need for continued survival studies. In addition, a current collaborative research project with University of Montana is further evaluating mule deer and white-tailed deer survival in DAU1 and the relationships between survival, weather, movements, and habitat.

Abundance Surveys

Aerial sightability surveys

Sightability models are used to calculate the detection probability of individual groups and correct for groups missed during surveys by documenting factors affecting animal detection (Samuel et al. 1987). Models are developed by flying over groups of animals that include radio-collared individuals and by

recording covariates for individual groups both observed and undetected by observers (Samuel et al. 1987). A sightability model derived by Robling 2011, is applicable to DAU 9 and DAU 10 with a detection rate of 84.4%, with visibility significantly influenced by group size and canopy cover. In the winter of 2017-2018, the entire DAU 10 was flow during 100% snow cover conditions and 18,383 deer were counted providing an estimate of 19,655 (95% CI = 19,121 – 20,780) white-tailed deer for the entire DAU. In the winter of 2018-2019, the entire DAU 9 was flown during 100% snow cover conditions and 30,210 deer were observed providing an estimate of 33,616 (95% CI = 31,078 – 34,824) white-tailed deer for the entire DAU. No surveys were flown in the past 2 years.

Road transect distance sampling

Beginning in 2016, spotlight road surveys were completed by SDGFP within the boundaries of the Black Hills DAU (i.e., DAU 3), where distance sampling models have recently been developed to estimate white-tailed deer abundance (Cudmore 2017). Sixty transect routes have been selected by General Randomized Tessellation Stratified sampling (Stevens and Olsen 2004), with transect lengths varying from 3.5 km to 16 km (Figure 11). Surveys are conducted during the last two weeks of August, beginning ½ hour after sunset and generally lasting 3-5 hours depending on transect length and the number of deer observed. Spotlights are used to locate deer on both sides of the transect. Each survey has two observers, with the driver serving as one of the observers.

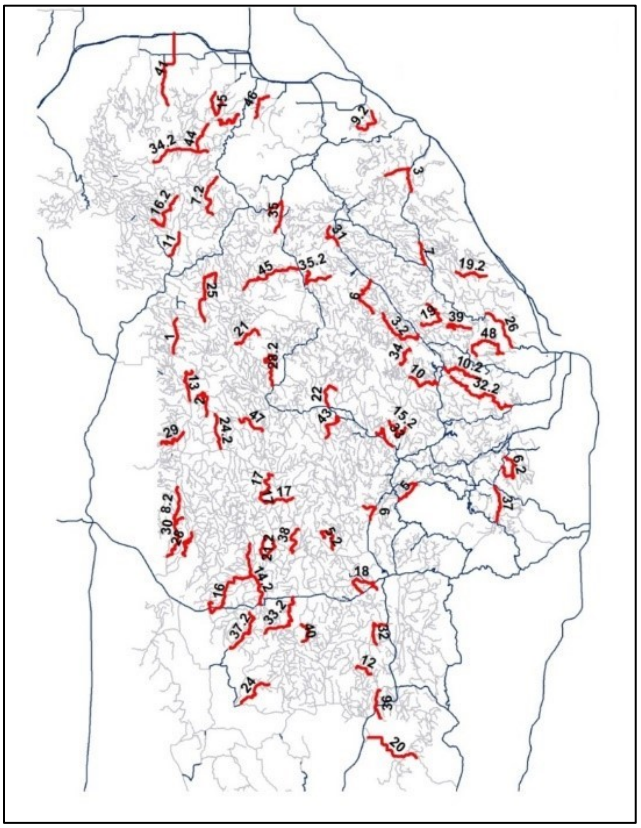


Figure 11. Road transects used for spotlight deer survey in the Black Hills.

Distance sampling surveys over the past 2 years has resulted in a Black Hills white-tailed deer population estimate of approximately 42,700 (+ 5,700 SE) in 2019 and 45,000 (+ 5,000 SE) in 2020, substantially lower than previous years' estimates that were around 60,000 or more deer (Figure 12). Variability and low precision make interpretation of distance sampling surveys challenging, but regardless the results suggest that white-tailed deer are below the 70,000 deer objective established for the Black Hills.

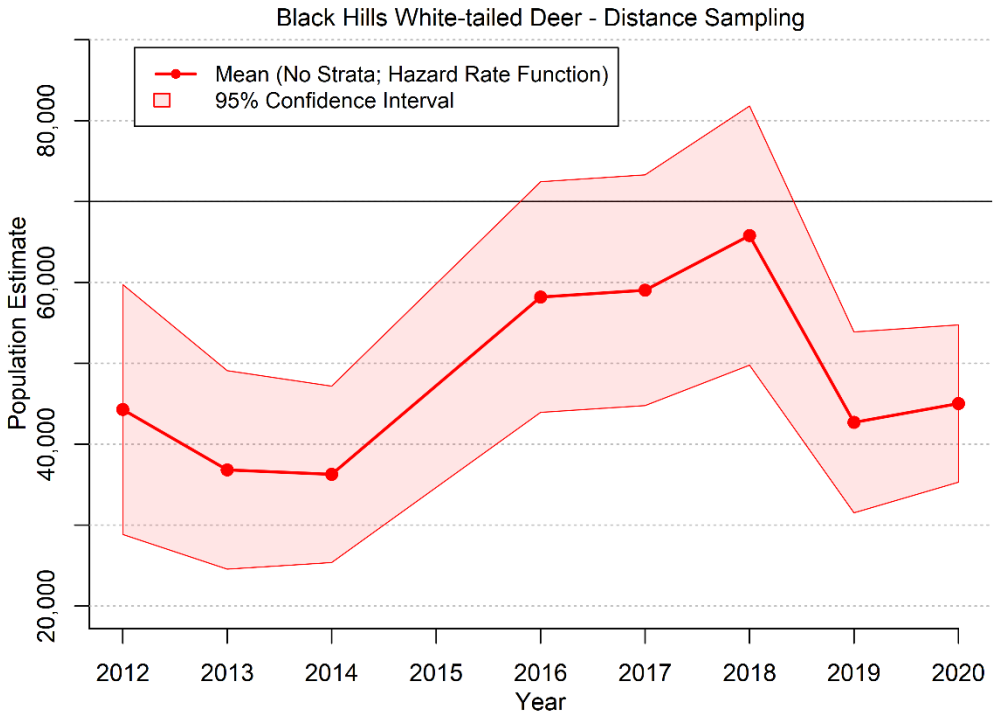


Figure 12. Estimates of white-tailed deer in the Black Hills from distance sampling transects, 2012 – 2020.

Population Modeling

One of the first and most important steps in modeling deer populations is to first define a qualitative population objective (i.e., substantially decrease, slightly decrease, maintain current level, slightly increase, substantially increase). This process involves SDGFP staffs obtaining stakeholder's opinions regarding the status of deer populations within individual firearm deer hunting units throughout the year (SDGFP 2017). Multiple sources of public opinion are used in formulating population objectives and include personal contacts with landowners and hunters, open houses, regional advisory meetings, hunter and landowner opinion surveys, hunter harvest surveys quantifying success and satisfaction ratings, and other submitted comments. Once the data are reviewed and summarized, internal staff meetings are then conducted at the regional level to discuss public input received regarding deer population abundance levels, deer depredation issues, landowner tolerance, hunter comments, and harvest results from the previous season. The end result is a defined qualitative population objective for each firearm management unit.

After a qualitative management unit objective is defined, a numerical value is assigned to that management unit (i.e., substantially decrease = 1, slightly decrease = 2, maintain current level = 3, slightly increase = 4, substantially increase = 5), which is used in defining a population objective at a larger Data Analysis Unit level. The first step in the development of a DAU population objective is to determine how much weight each firearm unit objective contributes to the overall DAU objective. This step incorporates unit harvest proportions within a DAU to weight each unit objective appropriately because not all units within a DAU have equal harvest rates. Unit harvest proportions are calculated by taking the 5-year harvest average of white-tailed deer or mule deer within the defined management unit divided by the total 5-year harvest average for the entire DAU. The management unit objective is then multiplied by the harvest proportion for that unit and the sum of the weighted values for all the units within the DAU then becomes the numerical DAU population objective. The DAU objective is then assigned a lambda rate (i.e., rate of change to population abundance) objective based on pre-determined ranges that are realistic for most deer herds in South Dakota (Table 4). To quantify the objective lambda value, the DAU objective is entered into the following linear regression equation: 0.1456 (DAU Objective) + 0.5631 = Lambda Objective.

Table 4. Categorical objective values based on qualitative objective.

Qualitative Objective	Unit Objective	DAU Objective	Lambda Objective
Substantially decrease	1	1.0 - 1.5	0.7 - 0.8
Slightly decrease	2	1.5 - 2.5	0.8 - 0.9
Maintain	3	2.5 - 3.5	0.9 - 1.1
Slightly increase	4	3.5 - 4.5	1.1 - 1.2
Substantially increase	5	4.5 - 5.0	1.2 - 1.3

Once the lambda objective is defined, integrated population models are used to generate population projections for each DAU (lambda and abundance estimates) based on modeling inputs (e.g., adult female survival, adult male survival, juvenile survival, recruitment). Harvest-based population models are used to reconstruct the previous year pre-hunting season population and project abundance to future years for each DAU while considering various harvest management strategies for each management unit (Norton et al. 2021). The projected (model generated) and objective lambdas are then compared and future antlerless harvest strategies are manipulated to achieve the desired lambda objective rate derived from the DAU population objective. Antlerless harvest is assumed to be additive and the number of antlerless deer added or removed from the population is calculated at the DAU level and then distributed to the unit level in accordance with the defined unit objective. Three-year average harvest success rates are calculated for all previously used license types within the management unit and license combinations needed to achieve unit level antlerless harvest recommendations are selected for future harvest season license recommendations. This process is repeated for all mule deer and white-tailed deer management firearm management units across the state.

Reliable DAU abundance estimates are lacking in most areas of the state, therefore population estimates are most valuable for assessing population trends and license allocations. Before the hunting season in 2020, harvest reconstruction estimates resulted in ~400,000 white-tailed deer and ~80,000 mule deer in South Dakota.

Winter Severity Index

Winter severity is an important metric contributing to survival of free ranging mule deer and white-tailed deer (Verme 1968). Relating how climatic conditions impact deer survival and subsequent recruitment has potential predictive value and can assist managers in determining if severe winter weather impacts population growth rates. Based on a winter severity index (WSI) developed by Baccante and Woods (2010), SDGFP currently utilizes mean monthly temperature and total monthly snowfall data from November through April as covariates for the following linear model that quantifies a WSI:

- Monthly WSI = (Mean monthly temperature * (-0.1) +1) * (Total monthly snowfall)
- Annual WSI Value = Sum [mean monthly WSI values (Nov + Dec + Jan + Feb + Mar +Apr)]

Weather data are obtained through an annual data request via the National Oceanic and Atmospheric Administration (NOAA). Program R, a statistical software package (R Core Team 2015) is used to extrapolate weather data across all deer units using an inverse distance weighted interpolation (IDW) function. The winter of 2018-19 was relatively minor compared with normal 30-year average winter data and little if any deer losses were expected (Figure 13). The winter of 2019-20 was more severe than average in several areas of the state, however, and suspected losses will affect SDGFP license allocations for 2021-22 (Figure 14).

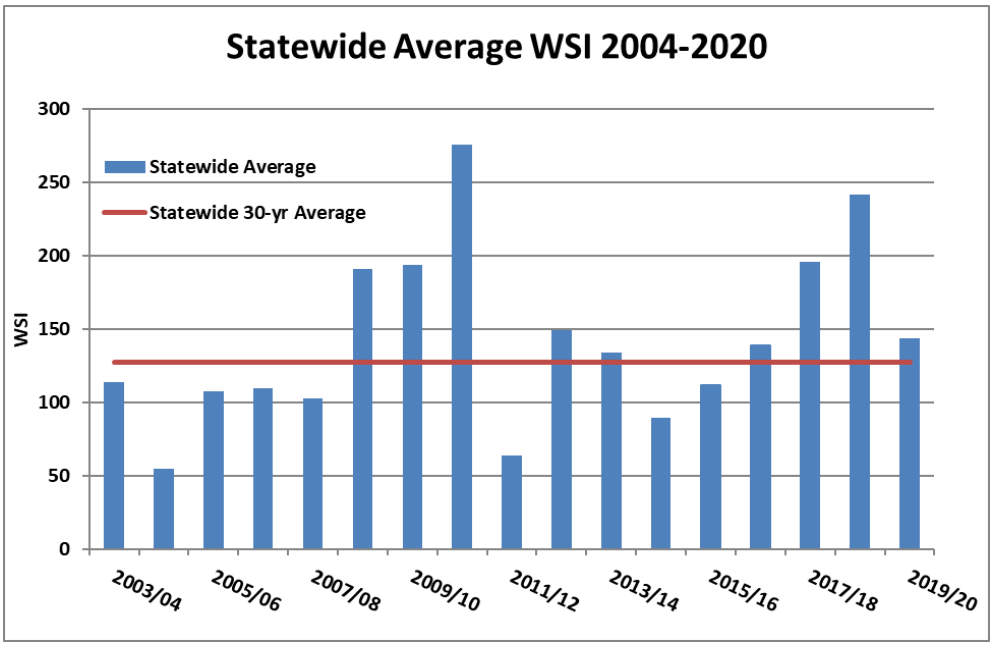


Figure 13. Yearly statewide winter severity indices in South Dakota compared with 30-year average, 2003-04 to 2019-20.

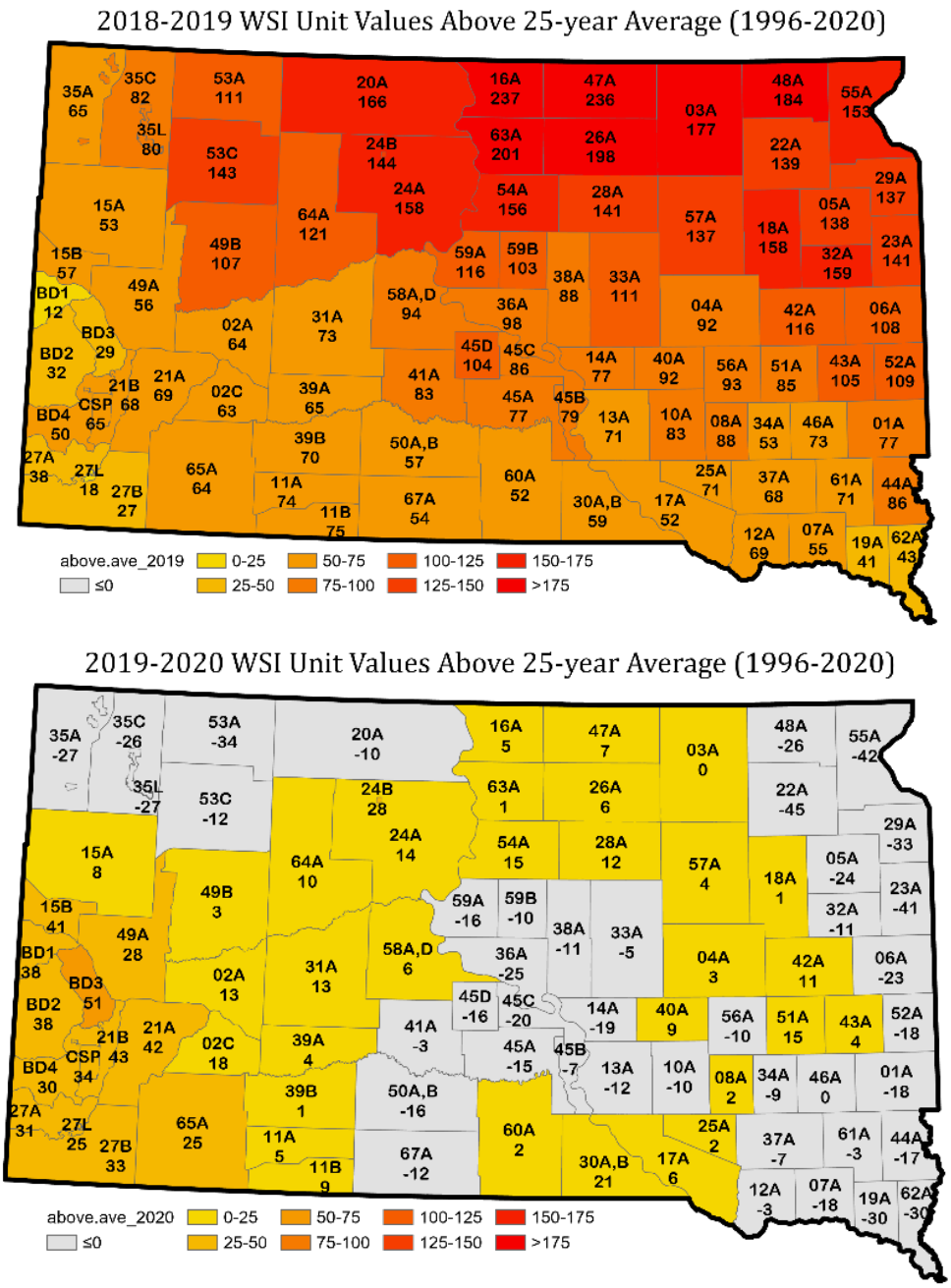


Figure 14 . Winter severity index values compared with 25-30 year normal in South Dakota for the winters of 2018-19 and 2019-20.

Data analyses to evaluate how varying degrees of winter severity values impact deer population performance are on-going. The continued compilation of juvenile and adult survival and recruitment data are necessary to make sound scientific relationships between WSI values and how those values impact mule deer and white-tailed deer population performance spatially and temporally. The occurrence of a severe winter while statistically valid sample sizes are available is vitally important in formulating robust regression equations that can predict survival and potential reproductive rates during years with similar winter severity values.

SUMMARY

Deer are the most abundant and sought-after big game species in South Dakota, with over 70,000 unique deer hunters spending well over one half million days hunting in 2020. The South Dakota Game, Fish, and Parks conducts numerous surveys to obtain important biological data for the management of both mule deer and white-tailed deer populations across the state. Herd composition surveys are conducted every fall and provide important data on age and sex ratios. Over the past 2 years statewide deer recruitment has been near long-term averages, although rates vary between areas. Hunting seasons are managed to align deer densities with unit specific objectives, while also considering established hunter success thresholds. Hunter surveys are conducted annually to estimate harvest, hunter success, and satisfaction. Total deer harvest increased in 2020 to approximately 59,000, with about 51,600 white-tailed deer and 7,400 mule deer harvested. Survival rates are currently monitored in 6 study areas for white-tailed deer, and 4 areas for mule deer. Survival rates for adult does in most areas have been about 80-85%, with adult buck and juvenile rates usually lower and more variable. Aerial deer surveys in the northeast part of the state have not been conducted in the past few years, but distance sampling road transects in the Black Hills were conducted and suggest white-tailed deer densities are below objective. Deer abundance in the remainder of the state is estimated using harvest and harvest rate data, while population trends are estimated using biological data from surveys such as annual survival, recruitment, and harvest. In addition, other important data include diseases and extreme weather. Deer losses to hemorrhagic disease were minimal in 2019 but several areas were negatively impacted in 2020. Winter severity varies by area of the state, but statewide the winter was more severe in 2019 than 2020 and over-winter deer mortalities were observed in several management units. Overall, based on conservative harvests, adequate recruitment and annual survival, minimal disease and winter losses, deer herds across much of the state are increasing. This varies by unit, however, with some areas showing strong growth rates while others very minimal. In general, white-tailed deer herds are growing at a faster rate than mule deer.

LITERATURE CITED

Baccante, D. and R. Woods. 2010. Relationship between winter severity and survival of mule deer fawns in the Peace Region of British Columbia. BC Journal of Ecosystems and Management 10(3):145-153 pp.

Cudmore, Kristopher W. 2017. An evaluation of deer and pronghorn surveys in South Dakota. M.S. Thesis, South Dakota State University, Brookings, USA.

Norton, A. S., A. J. Lindbloom, L. M. Wiechmann, and S. L. Griffin. 2021. Compilation of Deer Survey Methods and Results Reports. South Dakota Game, Fish, and Parks.

Samuel, M. D., E. O. Garton, M. W. Schlegel, and R. G. Carson. 1987. Visibility bias during aerial surveys of elk in northcentral Idaho. Journal of Wildlife Management 51:622-630 pp.

South Dakota Department of Game, Fish and Parks. 2017. South Dakota white-tailed deer and mule deer management plan, 2017-2023. Completion Report 2017-02. South Dakota Department of Game, Fish and Parks, Pierre, South Dakota, USA.

Verme, L. J. 1968. An index of winter weather severity for northern deer. Journal of Wildlife Management 32(3):566-574 pp.

APPENDIX

Appendix A. The 2017 Deer Management Plan objectives to manage white-tailed deer and mule deer populations for both maximum and quality recreational hunting opportunities, considering all social and biological inputs.

Strategy 3E. Manage Limited Access Units (24B, 27L, 35L; see *Quality Deer Management* section) and CSP for a quality hunting experience by using the following established thresholds:

1. Maintain a minimum 1st tag harvest success of 75% (3-year average) for licenses containing "any deer" or "any whitetail" firearm tags; or
2. Maintain firearm license densities no greater than 1.5 licenses/square mile for "any deer" licenses and no greater than 2.5 licenses/square mile for "any whitetail" licenses.

Strategy 3F. Manage for a minimum 1st tag harvest success of 70% (3-year average) for licenses containing "any deer" or "any whitetail" tags in the Black Hills firearm deer season.

Strategy 3G. Manage for a minimum 1st tag harvest success of 60% (3-year average) for licenses containing "any deer" or "any whitetail" tags in each West River firearm deer season unit.

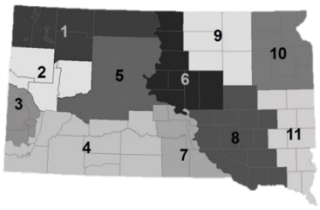
Strategy 3H. Manage for a minimum 1st tag harvest success of 50% (3-year average) for licenses containing "any deer" or "any whitetail" tags in each East River and National Wildlife Refuge firearm deer season unit.

Strategy 3I. Manage for a minimum 1st tag harvest success of 40% (3-year average) for muzzleloader licenses containing "any deer" or "any whitetail" tags in each USFWS Refuge deer hunting unit.

Appendix B. Harvest information for mule deer and white-tailed deer hunting season in 2020 in South Dakota.

			mule deer harvest			white-tailed deer harvest		
Season	**tags sold**	**tag success**	**buck**	**doe**	**total**	**buck**	**doe**	**total**
Archery	34,243	30%	1234	150	1384	6253	2807	9060
Apprentice	4,302	58%	26	372	398	249	1847	2096
Mentored	6,387	57%	21	472	493	371	2773	3144
Muzzleloader	3,707	36%	170	17	187	272	882	1154
LOL Free Antlerless	387	57%	0	0	0	9	212	221
WR Deer	25,888	56%	3042	237	3279	7266	4058	11324
WR Deer LOL	4,463	49%	527	214	741	917	546	1463
WR Special Buck	1,957	74%	465	4	469	964	16	980
ER Deer	29,299	49%	223	23	246	8744	5405	14149
ER Deer LOL	11,537	40%	98	36	134	2807	1655	4462
ER Special Buck	499	55%	18	0	18	250	6	256
Sand Lake NWR	118	34%	0	0	0	35	5	40
Lacreek NWR	19	47%	0	0	0	9	0	9
Waubay NWR	22	23%	0	0	0	5	0	5
Black Hills Deer	5,193	63%	75	7	82	2269	897	3166
Custer State Park	88	65%	3	0	3	28	26	54

Appendix C. DAU 1 – Grand River Study Area



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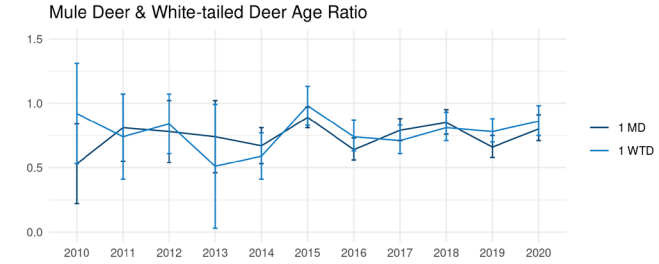

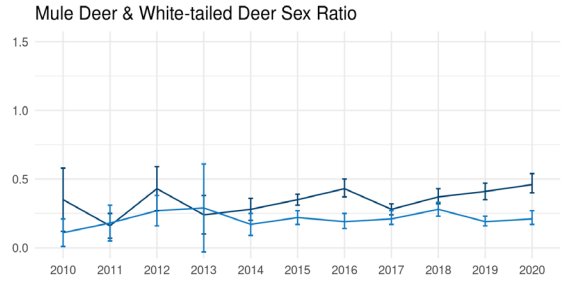

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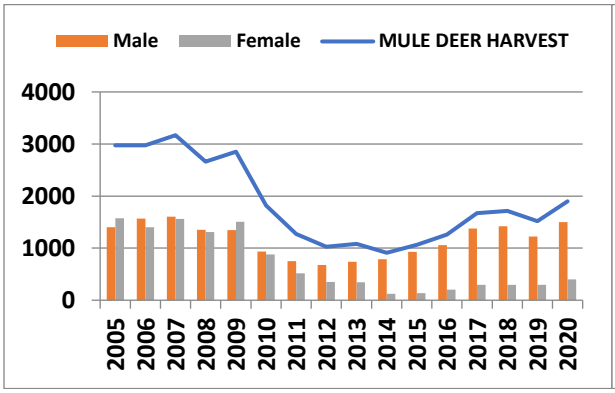

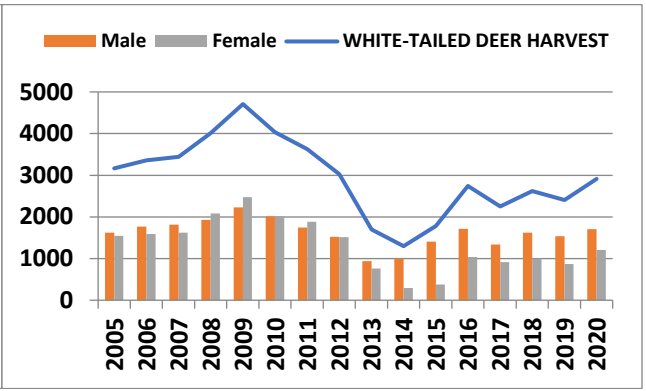

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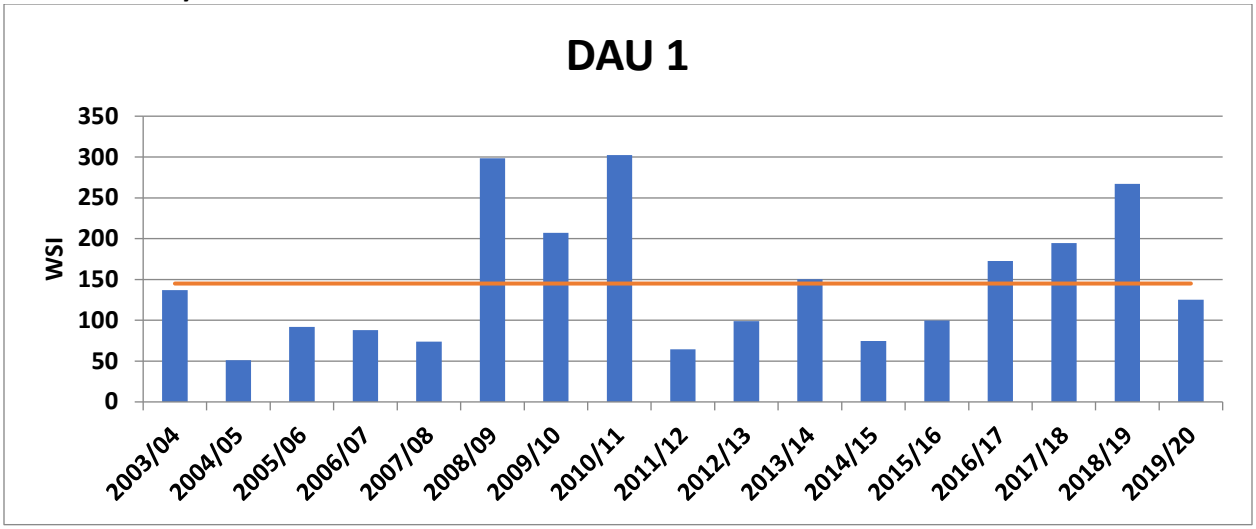

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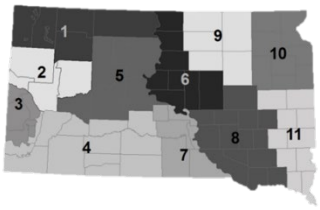

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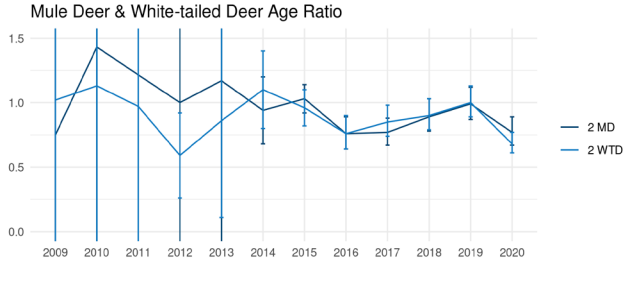

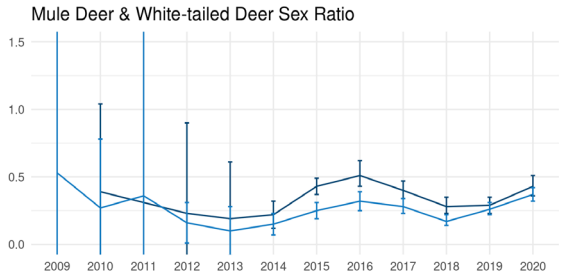

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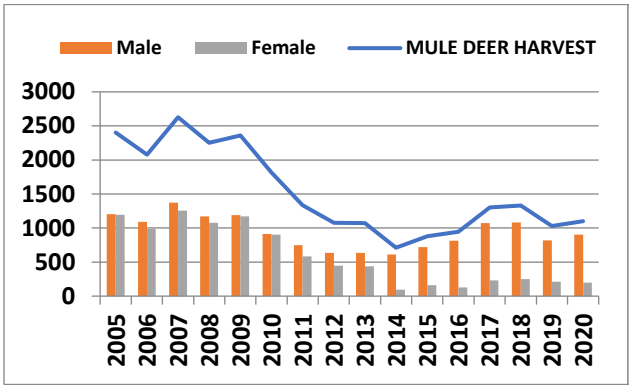

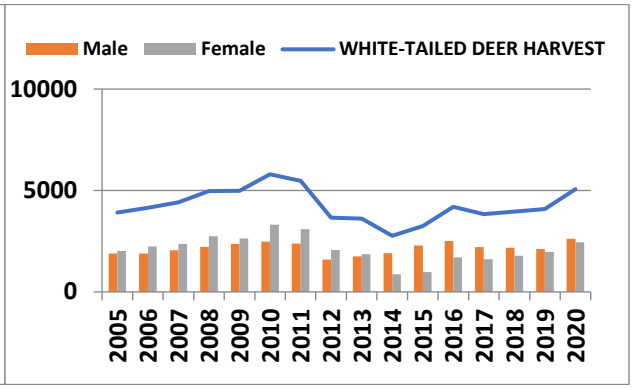

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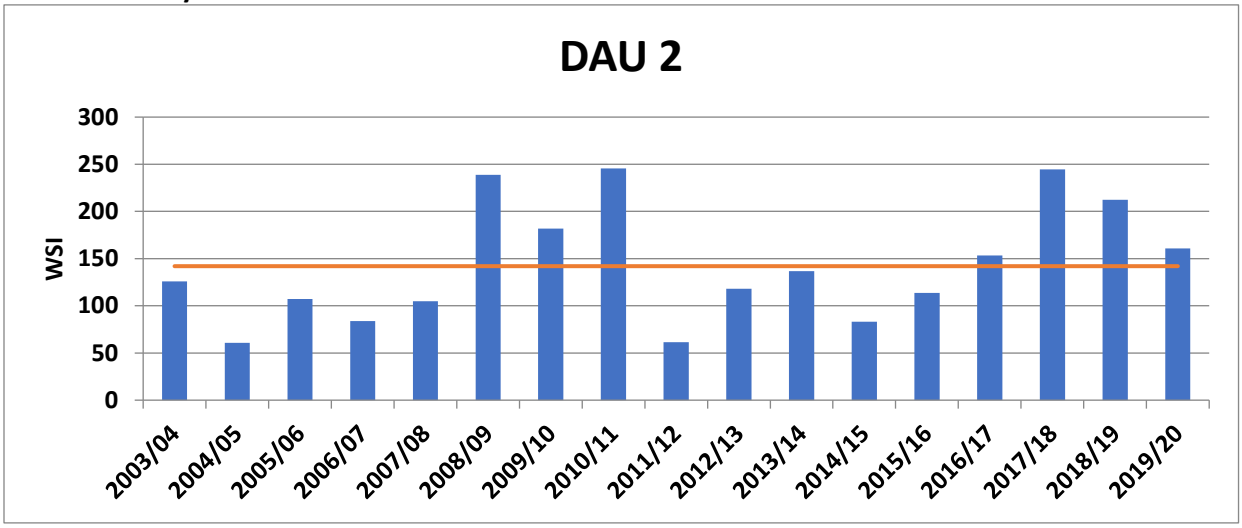

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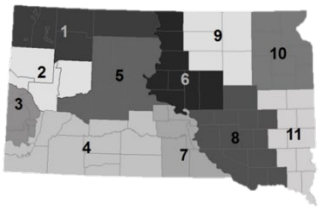

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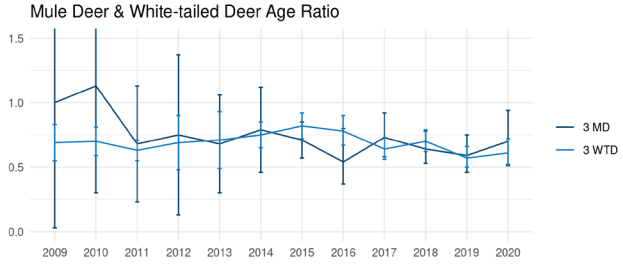

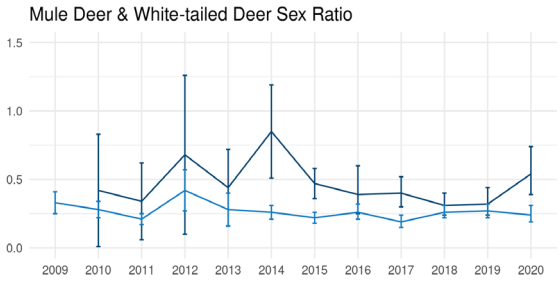

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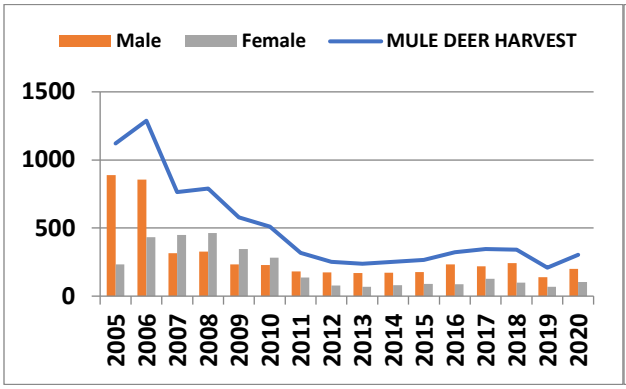

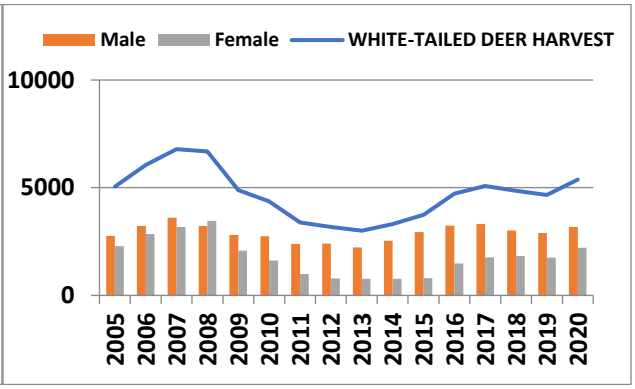

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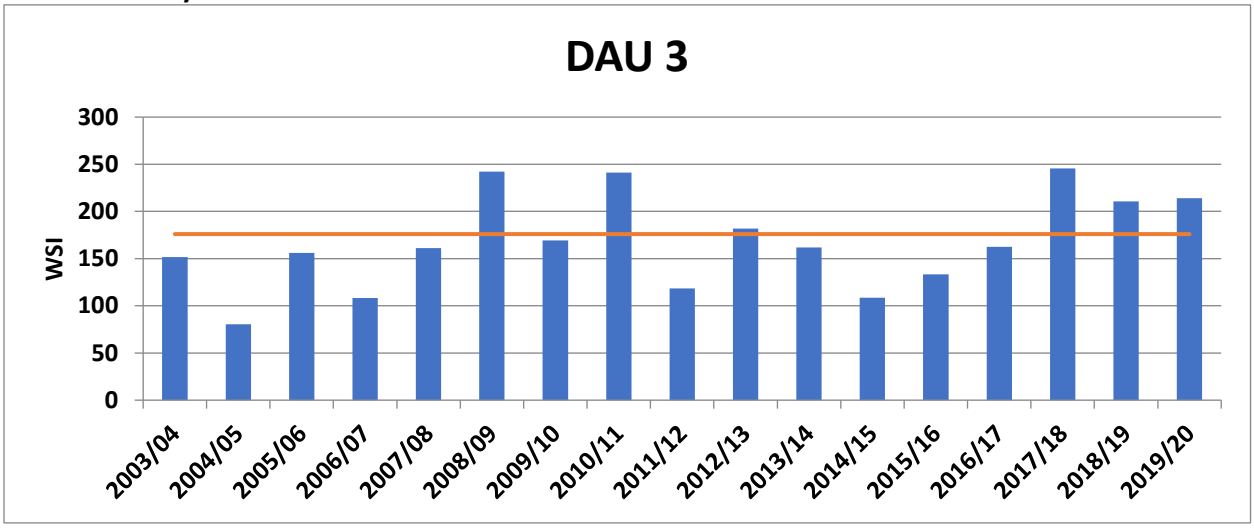

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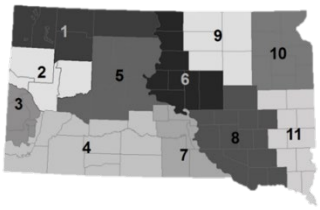

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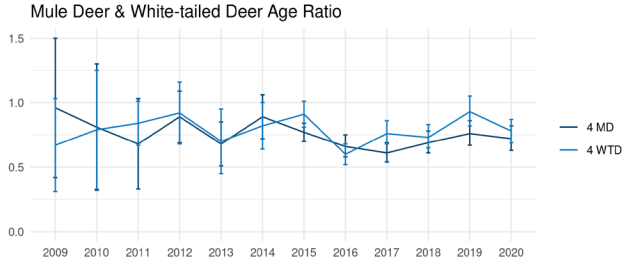

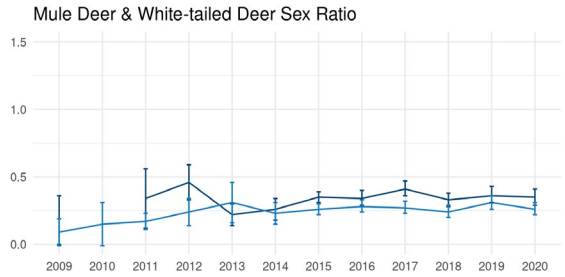

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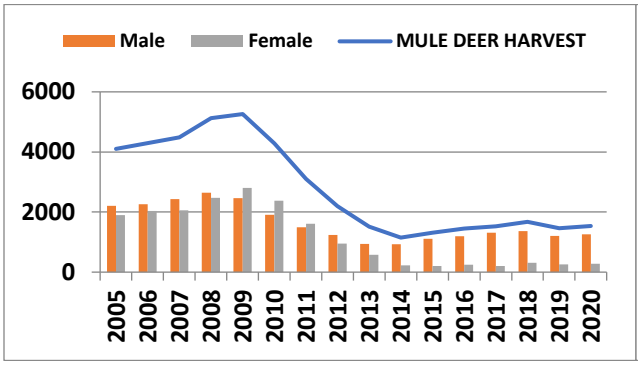

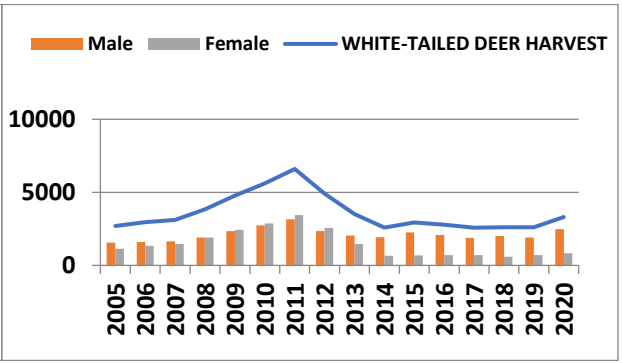

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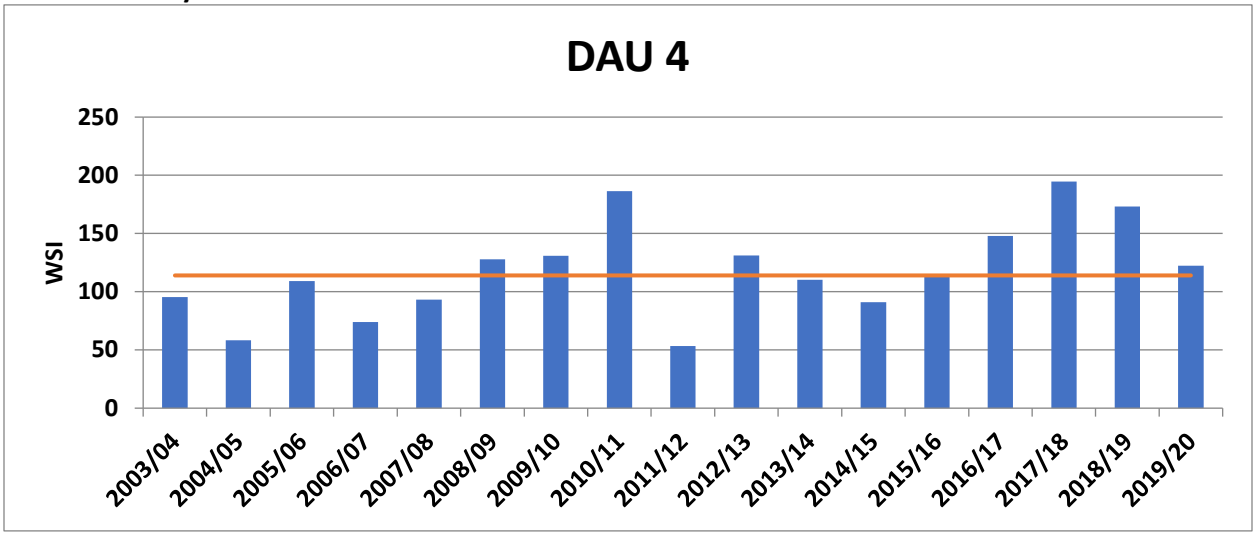
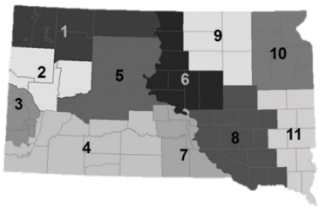


Appendix G. DAU 5 – Cheyenne River Study Area



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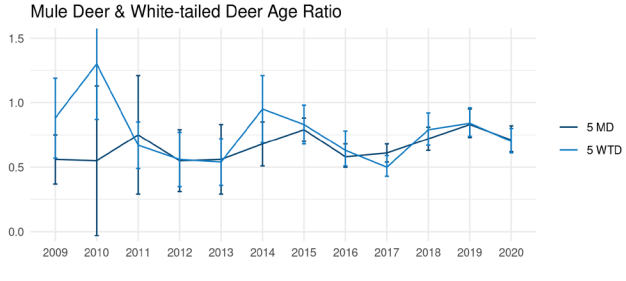

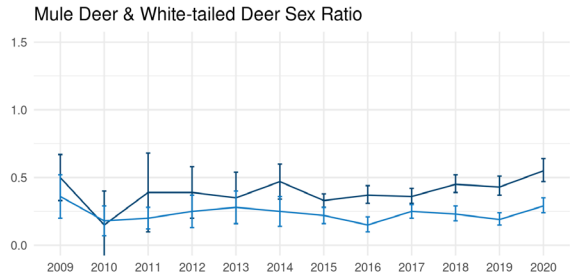

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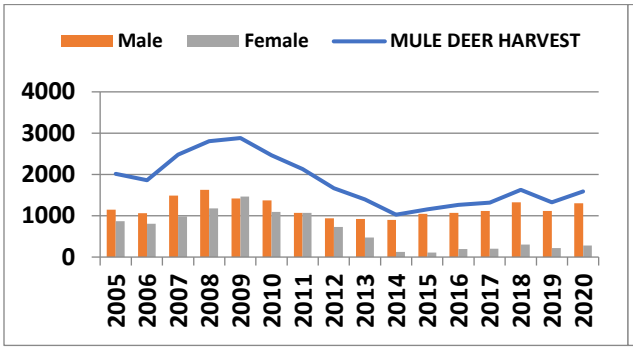

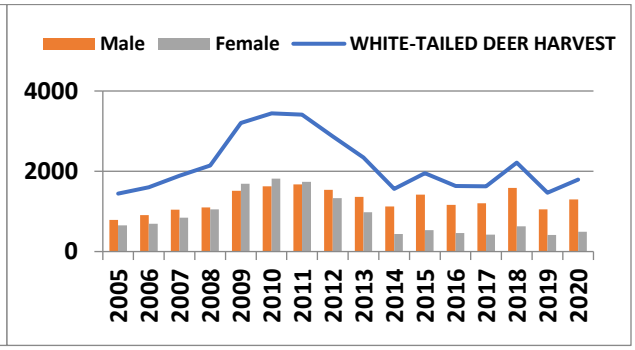

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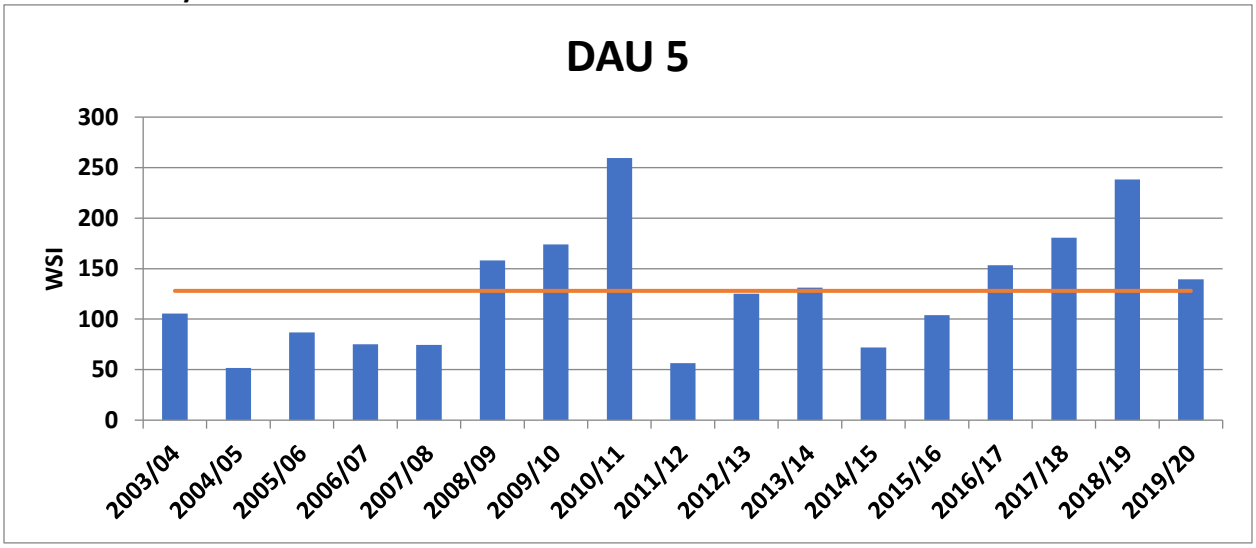
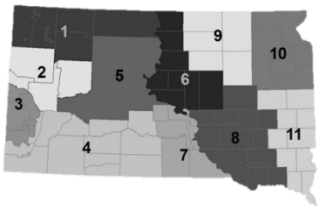


Appendix H. DAU 6 – Upper Missouri River Study Area



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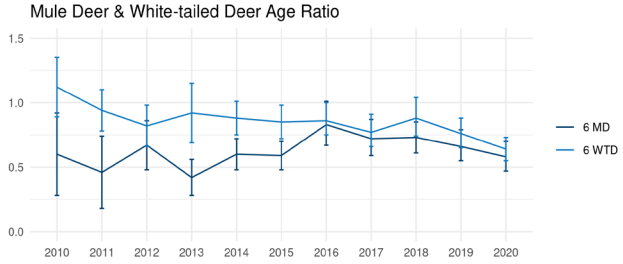

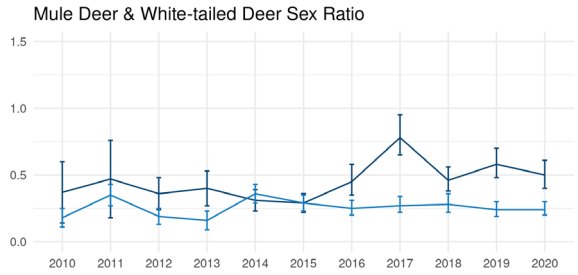

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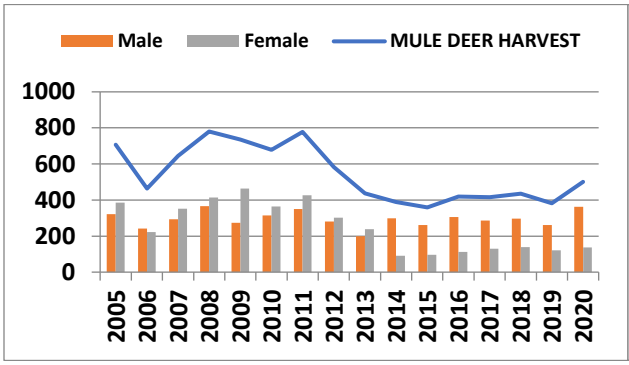

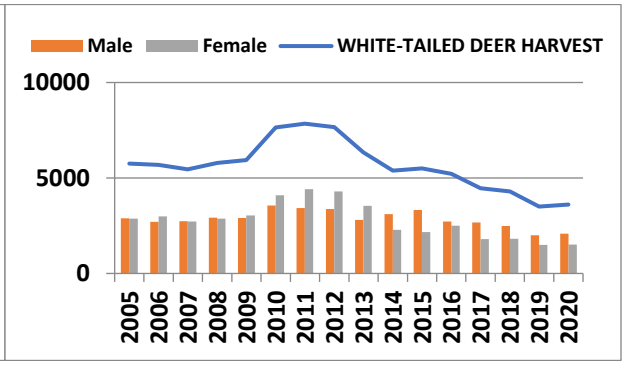

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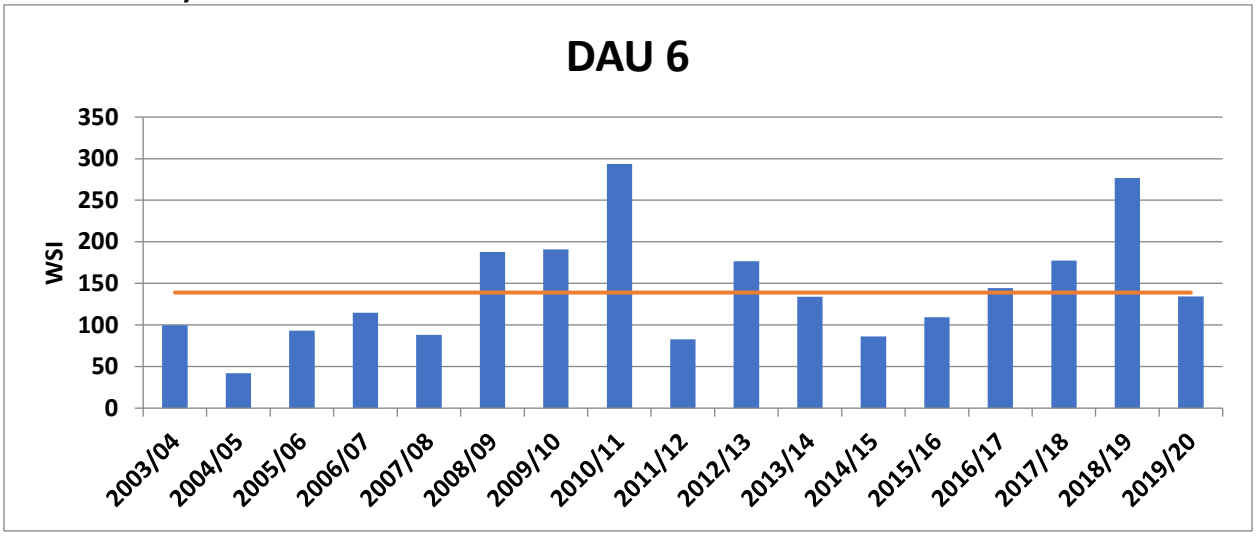
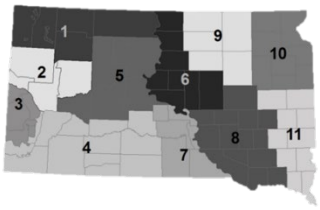


Appendix I. DAU 7 – Lower Missouri River Study Area



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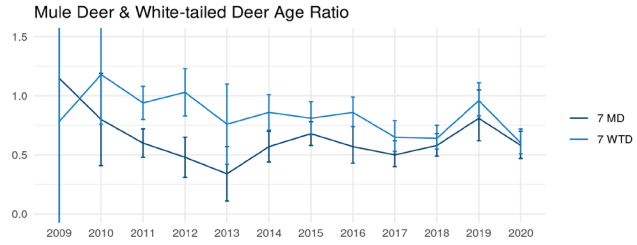

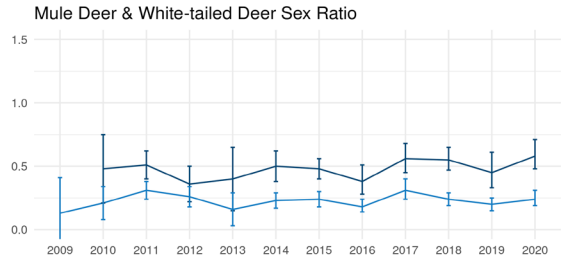

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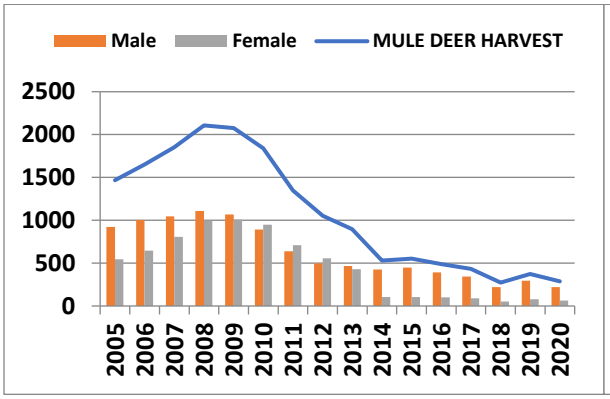

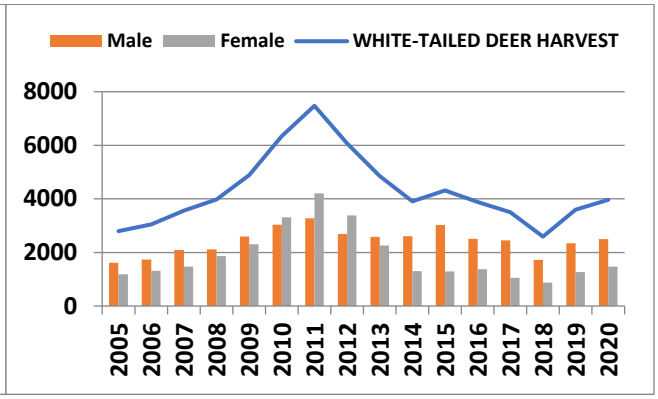

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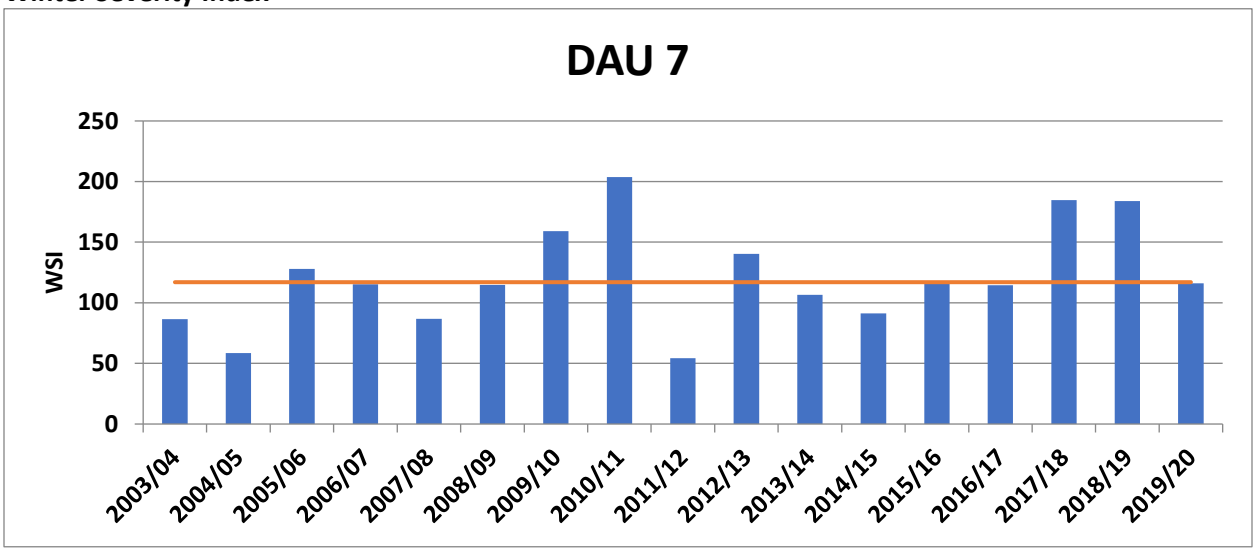
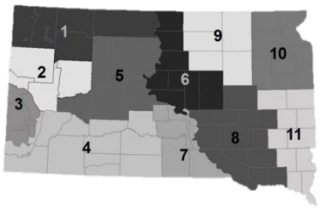


Appendix J. DAU 8 – Lower James River Study Area



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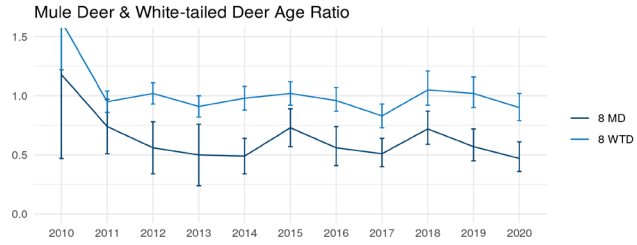

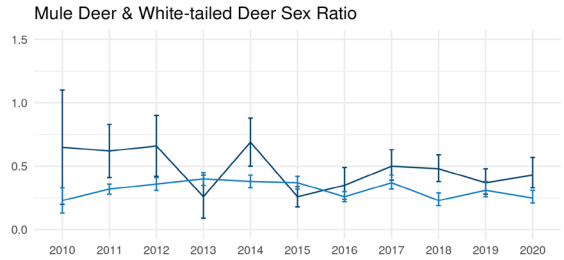

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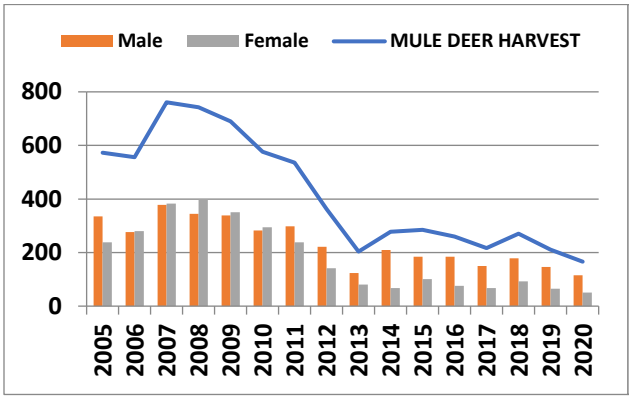
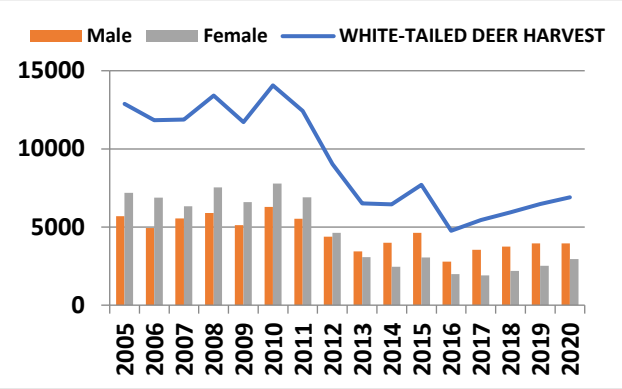
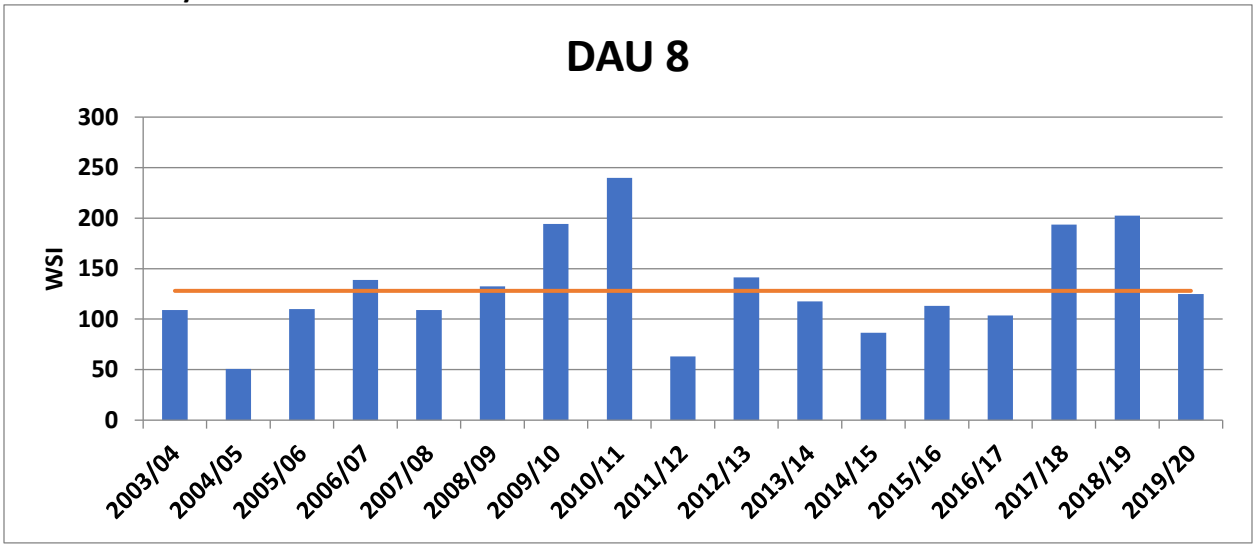
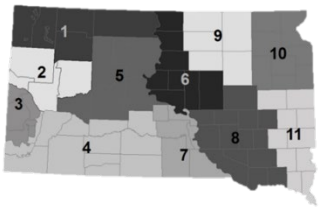




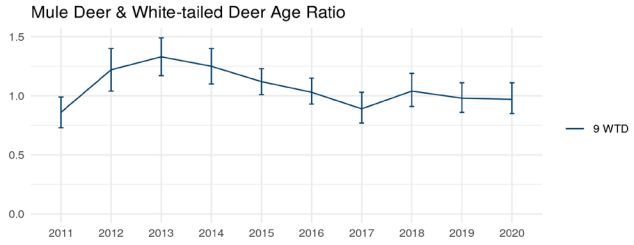
Winter Severity Index

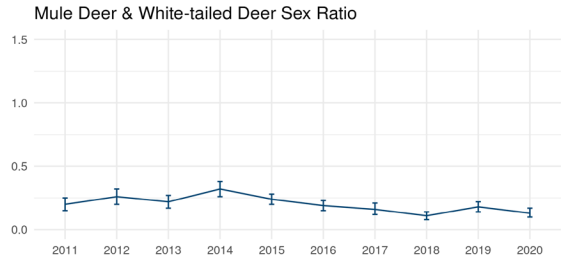


Appendix K. DAU 9 – Upper James River Study Area

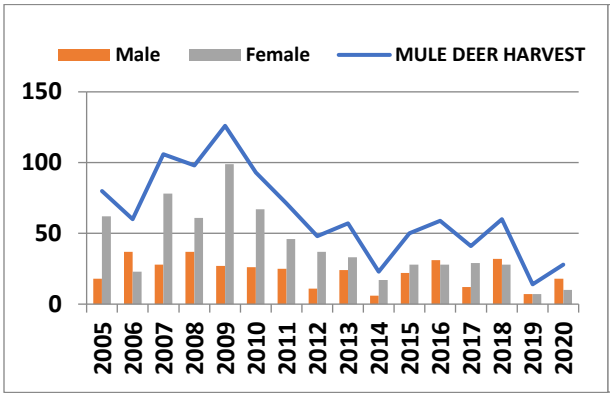


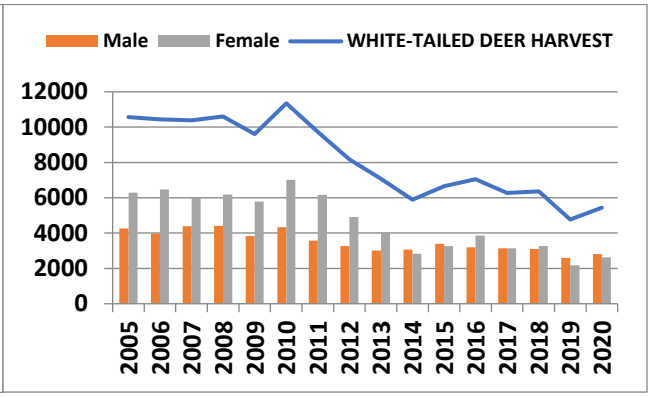
Herd Composition



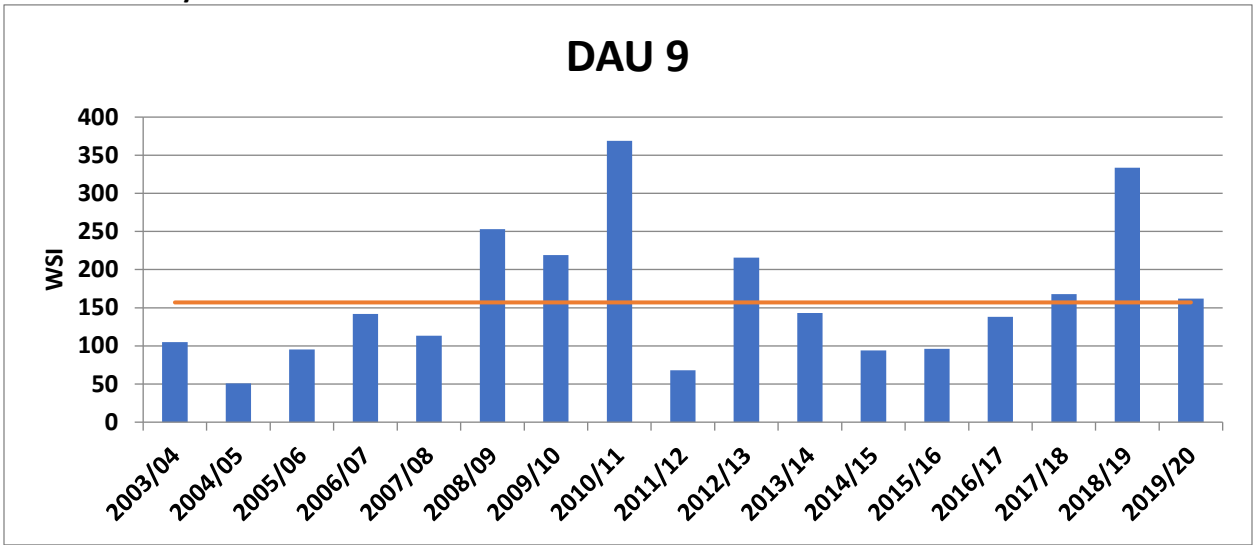


Harvest

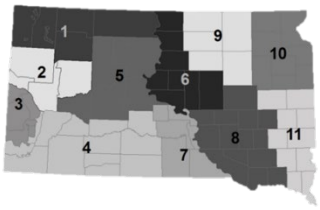




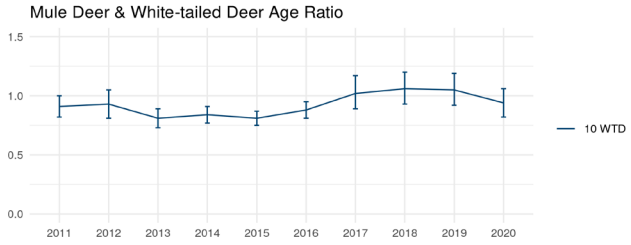
Winter Severity Index

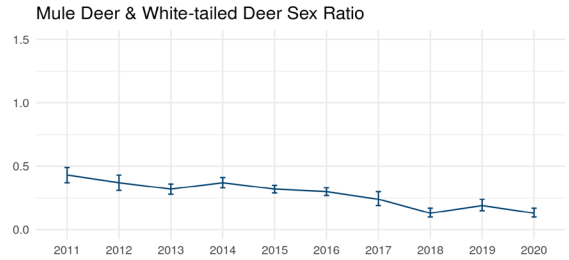


Appendix L. DAU 10 – Prairie Coteau Study Area

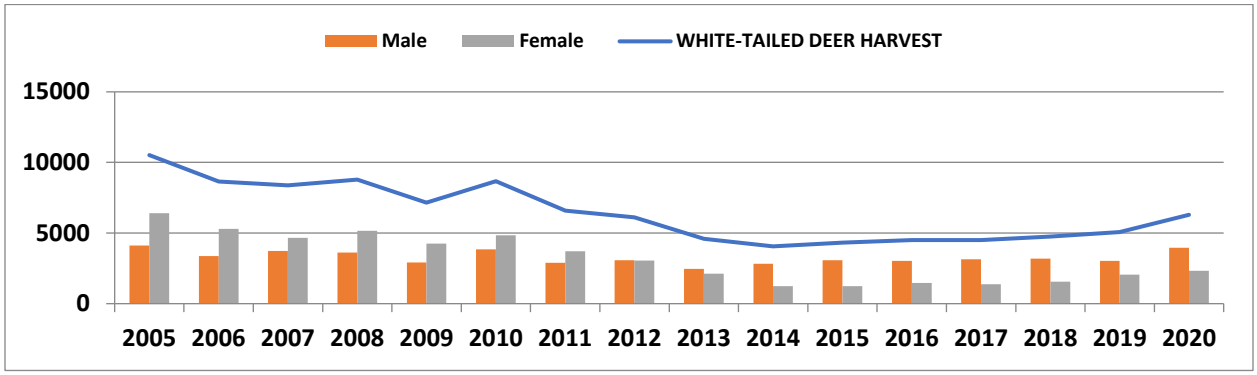


Herd Composition

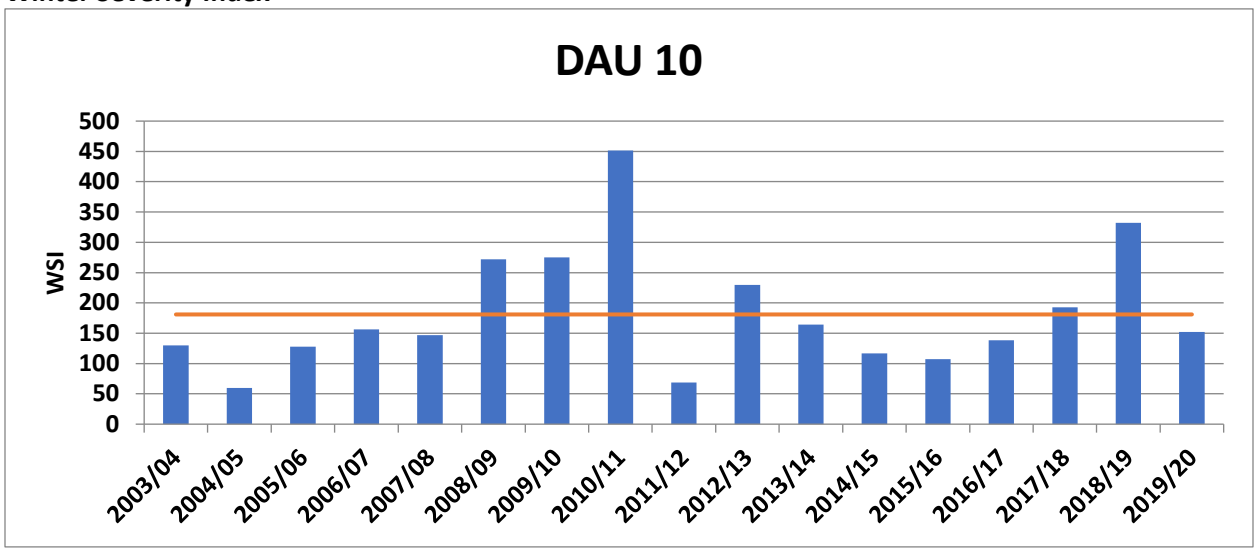




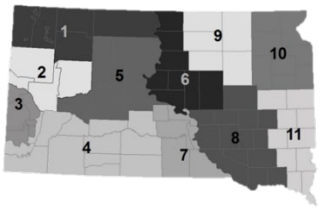
Harvest



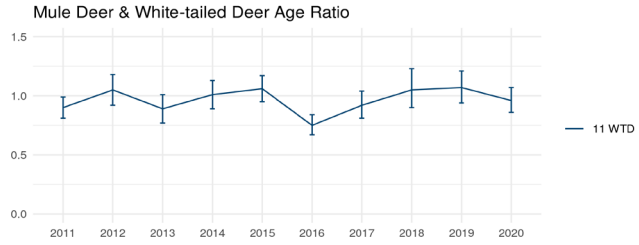
Winter Severity Index

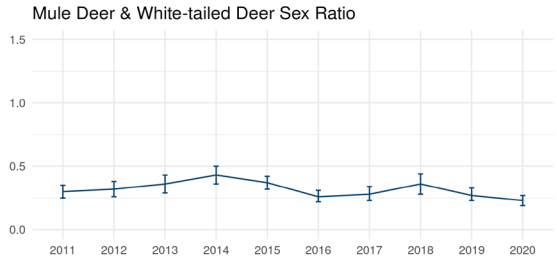


Appendix M. DAU 11 – Big Sioux River Study Area

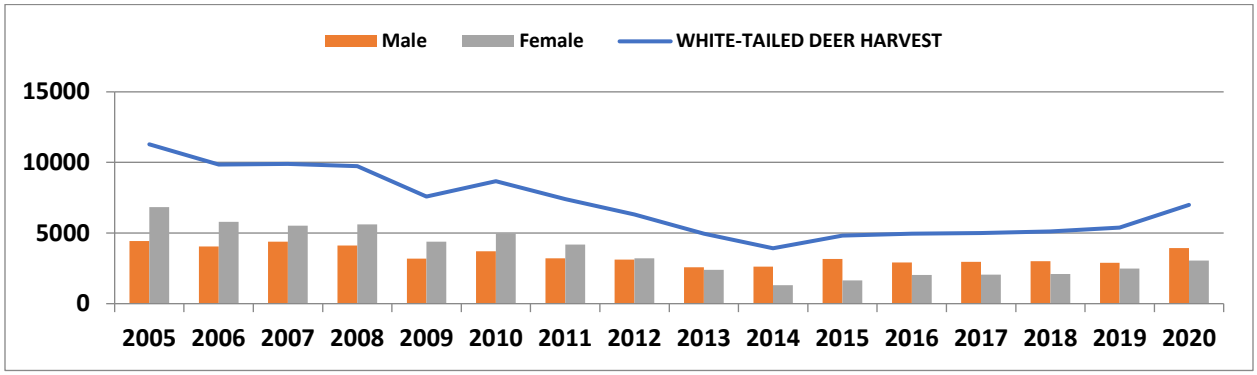


Herd Composition





Harvest



Winter Severity Index