

# **Monitoring Population Trends of White-tailed Deer in Minnesota - 2014**

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## **INTRODUCTION**

White-tailed deer (*Odocoileus virginianus*) represent one of the most important big game mammals in Minnesota. Although viewed as being important by both hunters and non-hunters, deer also pose serious socioeconomic and ecological challenges for wildlife managers, such as deer-vehicle collisions, crop depredation, and forest regeneration issues. Thus, monitoring the status of deer populations is critical to determine appropriate harvest levels based on established management goals.

This document 1) describes the structure of and data inputs for the population model used on white-tailed deer in Minnesota, and 2) discusses general trends of deer density and current abundance.

## **METHODS**

I arbitrarily pooled deer permit areas (DPAs) into 12 geographic units to describe population and harvest trends and management issues at a broader scale (Fig. 1). Several management strategies were available in 2013 including: 1) lottery with varying number of antlerless permits, 2) hunter's choice where hunters could hunt either-sex, 3) managed, 4) intensive, and 5) no limit antlerless. The strategy employed during a given year depended upon where the population trend was in relation to the population goal. Some DPAs were not modeled due to light harvest pressure and/or due to having small population sizes which causes stochastic error (Grund and Woolf 2004).

### **Population Modeling**

The population model used to analyze past population trends and test harvest strategies can be best described as an accounting procedure that subtracts losses, adds gains, and keeps a running total of the number of animals alive in various sex-age classes during successive periods of the annual cycle. The deer population was partitioned into 4 sex-age classes (fawns, adults, males, and females). The 12-month annual cycle was divided into 4 periods representing important biological events in the deer's life (hunting season, winter, reproduction, and summer). The primary purposes of the population model were to 1) organize and synthesize data on deer populations, 2) advance the understanding of Minnesota's deer population through population analysis, 3) provide population estimates and simulate vital rates for deer populations, and 4) assist with management efforts through simulations, projections, and predictions of different management prescriptions.

The 3 most important parameters within the model reflect the aforementioned biological events, which include reproduction, harvest, and non-hunting mortality.

Fertility rates were typically estimated at the regional level via fetal surveys conducted each spring (for details, see Dunbar 2005). Fertility rates were then used to estimate population reproductive rates for each deer herd within a particular region. The deer population increased in size after reproduction was simulated. Non-hunting mortality rates occurring during summer months (prior to the hunting season) were estimated from field studies conducted in Minnesota and other agricultural and forested regions. Although summer mortality rates were low, they did represent a reduction in the annual deer population. Previous research suggests virtually all mortality occurring during the year can be attributed to hunter harvests. Annual harvests were simulated in the model by subtracting the numerical harvest (adjusted for crippling and non-registered deer) from the pre-hunt population for each respective sex-age class. Because these modeled deer herds are heavily exploited by deer hunters, the numerical harvest data “drive” the population model by substantially reducing the size of the deer herd (Grund and Woolf 2004). Winter mortality rates were estimated from field studies conducted in Minnesota and other Midwest regions, similar to summer mortality. After winter mortality rates were simulated, the population was at its lowest point during the 12-month period and the annual cycle began again with reproduction.

## **RESULTS**

### **Population Trends and Population Management**

#### Northwest Management Units

*Karlstad Unit* – Deer numbers have moderately declined over the past 5 years in this unit and most populations are near goal (Table 1). Deer populations immediately to the west of PA 101 were well below goal due to prior TB management efforts, but management strategies have been more conservative over the past few years to allow populations to increase.

*Crookston/TRF Unit* – Deer densities have slightly declined in several areas, but population trends are relatively stable throughout the unit. Harvest sex ratios were heavily skewed toward antlerless deer from 2005 through 2011 to bring deer numbers down. However, these ratios have stabilized over the past few years suggesting that deer numbers are stabilizing.

*Mahnomen Unit* – Population trends in most areas are relatively stable, modeling indicates deer numbers have moderately declined in DPA 265 and buck harvest trends declined in a similar fashion. In other DPAs, however, modeling suggests fairly stable deer densities and harvest trends and harvest sex ratios agree with that pattern.

#### Central Management Units

*Morris Unit* – Population trends over the past 5-10 years have been stable, but deer numbers have significantly declined since the mid-90s in many permit areas. Harvest trends over the past 5-10 years are relatively stable as well, indicating the

modeled trends throughout the unit likely reflect the true population dynamics between years in these areas.

*Osakis Unit* – Population trends have been stable in most DPAs over the past 5-10 years, but population trends in DPA 240 suggest a declining population and the harvest trends agree with that assessment. However, harvest sex ratios in the past two years are indicative of population increases, so I would expect trends to increase over the next few years in DPA 240.

*Cambridge Unit* – Modeled trends and harvest trends both indicate deer numbers have been relatively stable over the past 5-10 years in most DPAs. The exception is DPA 223 where modeled trends have increased approximately 45% over the past 5 years and harvest trends have increased 30-35% over the past 5 years, these percentages are indicative of a substantial population increase.

*Hutchinson Unit* – Modeled trends and harvest trends suggest deer populations have been relatively stable in the southern DPAs in this unit, but the same trends suggest increasing deer densities in the northern DPAs over the past 5-10 years. Permit Area 284 was slow to respond to the conservative management strategies around 2005-2007, but trends suggest deer numbers have increase over the past 5 years.

#### Southern Management Units

*Minnesota River Unit* – Modeled trends and harvest trends both indicate that populations in these DPAs have been relatively stable over the past 5-10 years despite using relatively conservative management strategies. The eastern DPAs show slightly better patterns for an increasing deer population, but not significant increases as observed in some DPAs in other units.

*Slayton Unit* – Modeled deer densities are relatively low in southwestern Minnesota due to limited woody cover. Modeled trends and harvest trends are slowly increasing in some areas over the past 5 years, but in other areas those trends are relatively flat indicating a relatively stable deer population. Management strategies have been very conservative over the past 5-7 years, so it is noteworthy that the trends are not increasing at a faster rate.

*Waseca Unit* – Modeled trends and harvest trends suggest deer populations have been stable over the past 5-10 years. Modeled densities are higher to the eastern side of the unit where there is more woody cover available. Trends in those DPAs suggest stable to slightly increasing deer numbers over the past few years.

*Rochester Unit* – Modeled trends suggest relatively stable populations throughout most DPAs in this unit. Harvest trends are difficult to interpret due to the antler-point restriction that has been in effect since 2010. Permit areas 346 and 349 are perhaps the two most concerning DPAs in Minnesota this year. These areas were surveyed last

winter and both DPAs had population estimates where the lower boundary of the confidence interval was nearly 30 deer per square mile.

**Forest Unit** – Deer populations in the forest zone have changed remarkably over the past 10 years. Deer densities and numeric harvests were high from 2004 through 2007 then deer numbers declined in most DPAs from 2007 through 2009. Short-term trends in modeled deer densities and numeric harvest trends indicated that 15 of the 36 modeled DPAs have populations that continued to decline from 2009 through 2014, primarily in more northern DPAs where winter severity indices were relatively extreme during the previous two winters. The more conservative harvest management strategies used throughout the forest zone used in 2012 and 2013 have helped offset the population declines, but winter mortality rates were very high and significantly reduced deer numbers from 2009 through 2014. Some of the most notable DPAs that have declining modeled and harvest trends from 2009 through 2014 include DPAs 110, 111, 122, 126, 177, 178, 180, 181, 197 and 298. Trends in modeled deer densities and numeric harvests were relatively stable from 2009 through 2014 in most southern forest zone DPAs (south of Park Rapids and Duluth). No modeled forest zone DPAs had trends that suggested an increasing deer population from 2009 through 2014.

#### **LITERATURE CITED**

- DUNBAR, E. J. 2005. Fetus survey data result of white-tailed deer in the farmland/transition zone of Minnesota—2005 *in* Dexter, M. H., editor, Status of wildlife populations, fall 2005. Unpublished report, Division of Fish and Wildlife, Minnesota Department of Natural Resources, St. Paul, Minnesota, USA. 270pp.
- GRUND, M. D., and A. WOOLF. 2004. Development and evaluation of an accounting model for estimating deer population sizes. *Ecological Modeling* 180:345-357.



Figure 1. Deer management units in Minnesota, 2014.

Table 1. Pre-fawn deer density (deer/mi<sup>2</sup>) as simulated from population modeling in each permit area in Minnesota, 2009-2014.

| Region           |                         | Pre-fawning Density |      |      |      |      |      |
|------------------|-------------------------|---------------------|------|------|------|------|------|
| Permit Area      | Area (mi <sup>2</sup> ) | 2009                | 2010 | 2011 | 2012 | 2013 | 2014 |
| <b>Karlstad</b>  |                         |                     |      |      |      |      |      |
| 201              | 155                     | 6                   | 6    | 5    | 5    | 5    | 5    |
| 208              | 443                     | 4                   | 4    | 4    | 3    | 3    | 3    |
| 260              | 1249                    | 4                   | 3    | 2    | 2    | 2    | 2    |
| 263              | 512                     | 5                   | 5    | 4    | 4    | 4    | 4    |
| 264              | 669                     | 7                   | 6    | 5    | 6    | 6    | 6    |
| 267              | 472                     | 4                   | 3    | 3    | 3    | 2    | 2    |
| 268              | 230                     | 9                   | 8    | 7    | 7    | 6    | 5    |
| Total            | 3,838                   | 6                   | 5    | 5    | 4    | 4    | 4    |
| <b>Crookston</b> |                         |                     |      |      |      |      |      |
| 209              | 576                     | 9                   | 9    | 9    | 7    | 7    | 7    |
| 210              | 485                     | 12                  | 11   | 11   | 10   | 10   | 10   |
| 256              | 654                     | 6                   | 5    | 5    | 5    | 5    | 5    |
| 257              | 413                     | 8                   | 8    | 6    | 6    | 7    | 7    |
| 261              | 795                     | 2                   | 2    | 2    | 2    | 2    | 2    |
| Total            | 3,053                   | 7                   | 6    | 6    | 6    | 7    | 7    |
| <b>Mahnomen</b>  |                         |                     |      |      |      |      |      |
| 262              | 677                     | 2                   | 2    | 2    | 2    | 2    | 2    |
| 265              | 494                     | 10                  | 10   | 10   | 9    | 8    | 7    |
| 266              | 617                     | 6                   | 5    | 4    | 4    | 4    | 4    |
| 297              | 438                     | 2                   | 3    | 3    | 2    | 3    | 3    |
| Total            | 2,226                   | 5                   | 5    | 5    | 5    | 4    | 4    |

|                  |       |    |    |    |    |    |    |
|------------------|-------|----|----|----|----|----|----|
| <b>Morris</b>    |       |    |    |    |    |    |    |
| 269              | 651   | 2  | 2  | 2  | 2  | 2  | 2  |
| 270              | 749   | 2  | 2  | 2  | 2  | 2  | 2  |
| 271              | 634   | 2  | 3  | 3  | 2  | 3  | 3  |
| 272              | 531   | 2  | 2  | 2  | 2  | 2  | 2  |
| 273              | 575   | 5  | 4  | 4  | 4  | 5  | 5  |
| 274              | 360   | 3  | 4  | 3  | 3  | 3  | 3  |
| 275              | 766   | 4  | 5  | 4  | 3  | 3  | 4  |
| 276              | 544   | 4  | 4  | 4  | 3  | 4  | 4  |
| 282              | 779   | 1  | 1  | 1  | 1  | 2  | 2  |
| Total            | 5,589 | 2  | 3  | 3  | 3  | 3  | 3  |
| <b>Osakis</b>    |       |    |    |    |    |    |    |
| 213              | 1058  | 12 | 13 | 10 | 11 | 12 | 14 |
| 214              | 557   | 19 | 19 | 19 | 19 | 19 | 19 |
| 215              | 702   | 10 | 10 | 10 | 10 | 10 | 10 |
| 239              | 924   | 9  | 10 | 8  | 9  | 9  | 9  |
| 240              | 642   | 17 | 17 | 13 | 14 | 14 | 15 |
| Total            | 3,879 | 14 | 14 | 12 | 13 | 14 | 14 |
| <b>Cambridge</b> |       |    |    |    |    |    |    |
| 221              | 642   | 13 | 13 | 13 | 13 | 13 | 13 |
| 222              | 412   | 16 | 16 | 16 | 16 | 16 | 15 |
| 223              | 376   | 9  | 9  | 10 | 10 | 12 | 13 |
| 225              | 619   | 16 | 16 | 15 | 14 | 15 | 14 |
| 227              | 472   | 13 | 14 | 13 | 13 | 14 | 14 |
| 229              | 287   | 6  | 7  | 6  | 6  | 7  | 8  |
| 236              | 374   | 16 | 15 | 14 | 15 | 15 | 16 |
| Total            | 2,895 | 13 | 13 | 12 | 12 | 13 | 14 |

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|----------------------------|-------|---|---|---|----|----|----|
| <b>Hutchinson</b>          |       |   |   |   |    |    |    |
| 218                        | 813   | 7 | 8 | 8 | 9  | 10 | 11 |
| 219                        | 393   | 8 | 9 | 9 | 10 | 11 | 10 |
| 229                        | 288   | 6 | 7 | 6 | 6  | 7  | 8  |
| 277                        | 885   | 5 | 5 | 5 | 4  | 4  | 5  |
| 283                        | 614   | 3 | 3 | 3 | 3  | 4  | 4  |
| 284                        | 837   | 2 | 3 | 3 | 3  | 4  | 4  |
| 285                        | 550   | 4 | 4 | 4 | 4  | 5  | 6  |
| Total                      | 4,380 | 5 | 6 | 5 | 5  | 6  | 7  |
| <br><b>Minnesota River</b> |       |   |   |   |    |    |    |
| 278                        | 397   | 6 | 7 | 6 | 5  | 6  | 7  |
| 281                        | 575   | 4 | 4 | 4 | 3  | 4  | 5  |
| 290                        | 662   | 3 | 4 | 4 | 4  | 5  | 5  |
| 291                        | 806   | 4 | 5 | 4 | 4  | 5  | 5  |
| Total                      | 2,440 | 4 | 5 | 5 | 5  | 6  | 6  |
| <br><b>Slayton</b>         |       |   |   |   |    |    |    |
| 234                        | 637   | 2 | 3 | 2 | 2  | 2  | 3  |
| 237                        | 729   | 2 | 2 | 3 | 3  | 3  | 3  |
| 250                        | 712   | 2 | 2 | 2 | 3  | 3  | 3  |
| 279                        | 345   | 3 | 3 | 3 | 3  | 4  | 4  |
| 280                        | 675   | 2 | 3 | 2 | 2  | 3  | 3  |
| 286                        | 447   | 3 | 3 | 3 | 3  | 4  | 4  |
| 288                        | 625   | 2 | 2 | 2 | 3  | 3  | 3  |
| 289                        | 816   | 1 | 1 | 1 | 2  | 2  | 2  |
| 294                        | 687   | 2 | 2 | 2 | 2  | 2  | 2  |
| 295                        | 839   | 2 | 2 | 2 | 2  | 2  | 3  |
| 296                        | 666   | 2 | 2 | 2 | 3  | 3  | 3  |
| Total                      | 7,178 | 2 | 2 | 2 | 3  | 3  | 3  |

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| <b>Waseca</b>    |              |           |           |           |           |           |           |
|------------------|--------------|-----------|-----------|-----------|-----------|-----------|-----------|
| 230              | 453          | 3         | 4         | 4         | 4         | 4         | 4         |
| 232              | 377          | 4         | 4         | 4         | 5         | 5         | 5         |
| 233              | 390          | 4         | 4         | 4         | 4         | 4         | 4         |
| 252              | 715          | 2         | 2         | 2         | 3         | 3         | 3         |
| 253              | 974          | 2         | 2         | 2         | 2         | 3         | 3         |
| 254              | 931          | 3         | 3         | 3         | 3         | 3         | 3         |
| 255              | 774          | 3         | 3         | 3         | 3         | 4         | 4         |
| 292              | 481          | 8         | 9         | 8         | 9         | 10        | 10        |
| 293              | 506          | 7         | 8         | 8         | 8         | 8         | 8         |
| 299              | 386          | 4         | 5         | 4         | 4         | 5         | 5         |
| <b>Total</b>     | <b>5,987</b> | <b>4</b>  | <b>4</b>  | <b>4</b>  | <b>4</b>  | <b>5</b>  | <b>5</b>  |
| <b>Rochester</b> |              |           |           |           |           |           |           |
| 338              | 452          | 5         | 5         | 4         | 5         | 4         | 5         |
| 339              | 409          | 5         | 6         | 5         | 5         | 5         | 6         |
| 341              | 596          | 10        | 10        | 10        | 10        | 10        | 11        |
| 342              | 352          | 13        | 14        | 14        | 14        | 14        | 13        |
| 343              | 663          | 11        | 10        | 10        | 10        | 10        | 11        |
| 345              | 326          | 9         | 8         | 8         | 9         | 9         | 9         |
| 346              | 319          | 20        | 23        | 23        | 23        | 27        | 30        |
| 347              | 434          | 8         | 7         | 8         | 8         | 8         | 8         |
| 348              | 332          | 15        | 14        | 14        | 14        | 14        | 13        |
| 349              | 492          | 21        | 22        | 22        | 23        | 25        | 28        |
| <b>Total</b>     | <b>4,564</b> | <b>12</b> | <b>12</b> | <b>11</b> | <b>11</b> | <b>11</b> | <b>13</b> |

| <b>Forest</b> |      |    |    |    |    |    |    |
|---------------|------|----|----|----|----|----|----|
| 103           | 1824 | 5  | 5  | 4  | 4  | 4  | 4  |
| 105           | 932  | 12 | 11 | 9  | 9  | 8  | 7  |
| 108           | 1701 | 6  | 6  | 6  | 7  | 7  | 6  |
| 110           | 530  | 20 | 18 | 15 | 15 | 15 | 13 |
| 111           | 1440 | 4  | 3  | 3  | 3  | 3  | 3  |
| 118           | 1445 | 4  | 4  | 4  | 4  | 5  | 4  |
| 119           | 946  | 4  | 4  | 3  | 4  | 4  | 3  |
| 122           | 622  | 5  | 5  | 5  | 5  | 5  | 4  |
| 126           | 979  | 4  | 4  | 3  | 3  | 3  | 2  |
| 155           | 639  | 12 | 13 | 14 | 14 | 14 | 11 |
| 156           | 834  | 15 | 15 | 15 | 14 | 13 | 10 |
| 157           | 904  | 19 | 19 | 19 | 18 | 17 | 14 |
| 159           | 575  | 16 | 16 | 15 | 14 | 15 | 14 |
| 169           | 1202 | 9  | 9  | 9  | 9  | 9  | 7  |
| 171           | 729  | 9  | 9  | 10 | 10 | 10 | 9  |
| 172           | 786  | 13 | 13 | 13 | 13 | 13 | 12 |
| 173           | 617  | 9  | 9  | 9  | 10 | 10 | 9  |
| 176           | 1150 | 8  | 9  | 8  | 9  | 9  | 7  |
| 177           | 553  | 14 | 15 | 12 | 12 | 13 | 10 |
| 178           | 1325 | 16 | 16 | 14 | 13 | 13 | 10 |
| 179           | 939  | 15 | 15 | 14 | 14 | 13 | 10 |
| 180           | 999  | 8  | 7  | 7  | 6  | 6  | 5  |
| 181           | 746  | 15 | 15 | 12 | 11 | 11 | 9  |
| 183           | 675  | 11 | 11 | 11 | 11 | 12 | 9  |
| 184           | 1318 | 16 | 16 | 16 | 16 | 17 | 15 |
| 197           | 1343 | 7  | 7  | 5  | 5  | 6  | 5  |
| 241           | 1047 | 28 | 27 | 25 | 24 | 24 | 22 |
| 242           | 307  | 22 | 22 | 22 | 21 | 20 | 18 |

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|       |        |    |    |    |    |    |    |
|-------|--------|----|----|----|----|----|----|
| 246   | 860    | 14 | 15 | 15 | 15 | 14 | 13 |
| 247   | 263    | 17 | 18 | 18 | 18 | 18 | 16 |
| 248   | 229    | 23 | 23 | 23 | 22 | 21 | 18 |
| 249   | 729    | 11 | 11 | 11 | 11 | 11 | 10 |
| 258   | 381    | 19 | 19 | 18 | 18 | 19 | 17 |
| 259   | 546    | 23 | 24 | 23 | 21 | 21 | 18 |
| 298   | 677    | 13 | 11 | 8  | 9  | 8  | 8  |
| Total | 32,907 | 11 | 11 | 11 | 10 | 10 | 9  |

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