A Baseline Assessment of Furbearers on the Upper Coastal Plain of Virginia

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ABSTRACT
We assessed the status of furbearing mammals on Fort A.P. Hill, Caroline County, Virginia during the 1998-1999 trapping season with the cooperation of local licensed trappers. Our analyses were based on 345 captures representing 10 mammal species, ranging from one bobcat (Lynx rufus) to 157 beavers (Castor canadensis). Mean number of captures per 100 trap nights was 17.0. Captures varied from 11.9 to 17.9 per 100 trap nights for conibear traps and 9.7 to 18.3 per 100 trap nights for leg-hold traps. External measurements of six species were similar to those reported for other populations in the region. We suggest that valuable insights into the ecology and trends of furbearer populations can be obtained from studies conducted on government installations such as Fort A.P. Hill. Management plans that include evaluations of infectious disease reservoirs and transmission and impacts of furbearers on wetlands, other wildlife, and human activities would aid in long-term evaluation of these mammals from ecosystem and health perspectives.

Keywords: beaver, Castor canadensis, Coastal Plain, furbearer, mammals, morphometrics, raccoon, Procyon lotor, trapping, Virginia

INTRODUCTION
Activities of many mammal species are often erroneously considered detrimental to human progress wherever their habits affects human livelihoods. However, most nuisance mammal species are important components of regional ecosystem maintenance, and when properly managed benefit many facets of human activity. For example, beavers (Castor canadensis Kuhl) are directly responsible for creation and maintenance of wetland habitats that support a wide diversity of plants and animals (Naiman et al., 1988, 1994). Castor canadensis ponds are used extensively by waterfowl species such as Wood Ducks (Aix sponsa L.), American Black Ducks (Anas rubripes Brewster), and Mallards (Anas platyrhynchos L.) because of suitable microhabitats provided by these wetlands (Merendino et al., 1995). Similarly, many amphibian and reptile species benefit from beaver activity (Mitchell, 1994, 2000). The majority of mammal species addressed in this survey are members of the order Carnivora and many are instrumental in the control of insect pests, rodents, and non-game fish species.
The majority of the landscape is managed forests and grasslands. Mitchell and Roble (Godin, 1982; Samuel and Nelson, 1982; Toweill and Tabor, 1982). In addition, many of these species are economically important as furbearers.

Our research was conducted on Fort A. P. Hill (APH), Caroline County Virginia, located within the Coastal Plain Physiographic Region (centered approximately at 77° 15' N and 38° 05' W). APH is a 30,329 ha field-training military installation in which the majority of the landscape is managed forests and grasslands. Mitchell and Roble (1998) and Bellows et al. (1999, 2001) described environmental conditions and habitats on the installation. Bellows et al. (2001) provide accounts for all mammal species examined in this paper. Our methods were designed with the cooperation of eight local trappers and the Environmental and Natural Resources Division of APH. Data were collected during the 1998-1999 Virginia trapping season. During this period, trappers provided reports of daily capture success, which included number of each species caught, number of each trap type set, and captures for each trap type. Trap types used fall into two categories, body-gripping (conibear #120, 220, 330) and leg-hold traps (#2 and 3). We recorded species identification, external measurements (total length, tail length, hind foot length, ear length, distance between canines tip-to-tip), demographic data, and body mass for each mammal we processed. Measurements were taken to the nearest mm and mass to the nearest gram.

We calculated total effort, captures per unit effort for each trap type used, and the success of each trap type for each species. Unit of effort = 100 trapnights (TN), and one TN = one trap open for a 24-hr period. We calculated ranges and means (± 1 standard deviation) of external measurements and body mass for each sex of each species. For species with n ≥ 16, we used two-sample t-tests to compare body mass and body length between males and females (α = 0.05; Zar 1996).

We qualitatively assessed habitat characteristics of 13 trapping areas used by four trappers. We recorded dominant tree species, overstory and understory, and shrubs. We also described plant species present at the wetland-upland interface (edge). The presence or absence of four types of evidence of beaver activity (lodge, runways, dams, downed wood) also was recorded.

RESULTS

Captures

Total reported captures was 345 individuals representing 10 mammal species (Table 1). Number of captures for each species ranged from 157 for C. canadensis, representing 46% of reported captures, to one for bobcat (Lynx rufus Rafinesque) (Table 1). Raccoons, Procyon lotor L., (n=65, 12%) and muskrats, Ondatra zibethicus L., (n = 42, 19%) were commonly captured. Captures per 100TNs were based on 288 (1,691TNs) of the 345 captures where trap type was specified. Captures per 100TNs by trap type ranged from 18.3 for #2 leg-hold to 9.7 for #3 leg-hold, and mean captures/100TNs for all trap types was 17.6 (Table 1).
TABLE I. Total captures\(^1\), total captures where trap type was specified\(^2\), total trapnights (TNs), and captures/100TNs by trap type for all species.

<table>
<thead>
<tr>
<th>Order</th>
<th>Species</th>
<th>ConiBear Traps</th>
<th>Leg-hold Traps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>#330 #220 #120</td>
<td>#2 #3 Totals(^2) Totals(^1)</td>
</tr>
<tr>
<td>Marsupialia</td>
<td><em>Didelphis virginiana</em></td>
<td>0 0 4</td>
<td>25 0</td>
</tr>
<tr>
<td>Rodentia</td>
<td><em>Castor canadensis</em></td>
<td>110 10 0</td>
<td>0 3</td>
</tr>
<tr>
<td></td>
<td><em>Ondatra zibethicus</em></td>
<td>21 9 0</td>
<td>2 0</td>
</tr>
<tr>
<td>Carnivora</td>
<td><em>Vulpes vulpes</em></td>
<td>0 0 0</td>
<td>5 0</td>
</tr>
<tr>
<td></td>
<td><em>Urocyon cinereoargenteus</em></td>
<td>0 0 1</td>
<td>17 0</td>
</tr>
<tr>
<td></td>
<td><em>Procyon lotor</em></td>
<td>0 0 23</td>
<td>33 0</td>
</tr>
<tr>
<td></td>
<td><em>Mustela vison</em></td>
<td>1 2 0</td>
<td>1 0</td>
</tr>
<tr>
<td></td>
<td><em>Mephistis mephitis</em></td>
<td>0 0 0</td>
<td>11 0</td>
</tr>
<tr>
<td></td>
<td><em>Lynx rufus</em></td>
<td>7 2 0</td>
<td>0 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 0 0</td>
<td>1 0</td>
</tr>
<tr>
<td></td>
<td><strong>Captures</strong></td>
<td>139 23 28</td>
<td>95 5</td>
</tr>
<tr>
<td></td>
<td><strong>Trapnights</strong></td>
<td>718 194 230</td>
<td>518 31</td>
</tr>
<tr>
<td></td>
<td><strong>Captures/100TNs</strong></td>
<td>17.8 11.9 13.0</td>
<td>18.3 9.7</td>
</tr>
</tbody>
</table>

Habitats

The 13 trapping sites sampled were all riparian habitats surrounded by uplands, deciduous hardwoods dominated most sites. River birch (*Betula nigra* L.) was the only dominant tree species observed that is obligatorily riparian (Reed, 1988). Oaks (*Quercus* L. spp.) were the dominant overstory tree species in 10 of the 13 sites, with white oak (*Q. alba* L.) being the most common. Other common overstory tree species were northern red oak (*Q. rubra* L.), southern red oak (*Q. falcata* Michaux), tulip-tree (*Liriodendron tulipifera* L.), American beech (*Fagus grandifolia* Ehrhart), and red maple (*Acer rubrum* L.). Hickories (*Carya* spp. Nuttall), chestnut oak (*Q. prinus* L.), and river birch were less frequent, but occurred in substantial numbers at one site each. Pines, Virginia pine (*Pinus virginiana* Miller) and loblolly pine (*Pinus taeda* L.), dominated two sites. Common understory tree species, exclusive of sapling overstory trees, were American holly (*Ilex opaca* Aiton), mountain laurel (*Kalmia latifolia* L.), and flowering dogwood (*Cornus florida* L.). Other understory trees frequently observed were sassafras (*Sassafras albidum* Nuttall), ironwood (*Carpinus caroliniana* Walter), and devil’s walking stick (*Aralia spinosa* L.). Two shrubs, blueberries (*Vaccinium* L. spp.) and sweet pepperbush (*Clethra alnifolia* L.), were commonly observed at the edge of most sites. Also present were blackberry (*Rubus* L.), mountain laurel, wax myrtle (*Myrica cerifera* L.), common greenbrier (*Smilax rotundifolia* L.), and deciduous tree saplings. The edges of two sites were relatively open with mature deciduous trees. Downed woody debris (DWD) at most sites were of deciduous trees. Evidence of *C. canadensis* activity varied among the 13 sites, with cuttings of deciduous trees being the most obvious.
Morphometrics

Results of external measurements, demographic information, and body mass were derived from data collected from 111 captures representing six furbearer species (Table 2). The sex of four C. canadensis, and two O. zibethicus was not recorded, and body mass for an additional 14 C. canadensis, 8 females and six males, was not recorded; these 20 individuals are not included in morphometric analyses (Table 2). Analyses were thus based on 91 individuals representing six species. No female mink (Mustela vison Schreber) or red fox (Vulpes vulpes L.) were captured.

There were no significant differences ($t=-0.972$, $P=0.382$) in body mass or mean total length ($t=-0.582$, $P=0.718$) between male and female C. canadensis. There were no significant differences ($t=-0.803$, $P=0.218$) in body mass or mean total length ($t=1.291$, $P=0.109$) between male and female P. lotor.

DISCUSSION

All 10 species represented in this survey are known to occur in this region (Hall 1981; Webster et al., 1985; Whitaker and Hamilton, 1998); however, between 1977 and 1986 fewer than one L. rufus per year was reported taken by trappers in Caroline County (Handley, 1991). Four other mid-sized mammal species that should be common in the region, eastern cottontail (Sylvilagus floridanus Allen), woodchuck (Marmota monax L.), gray squirrel (Sciurus carolinensis Gmelin), and long-tailed weasel (Mustela frenata Lichtenstein), were not captured and are not addressed here. These species are not usually captured with the types of traps used in this study. However, S. floridanus, M. monax, and S. carolinensis are prevalent on the installation and all have been observed in many habitat types (Bellows et al., 2001). No captures of domestic dogs (Canis familiaris L.) or cats (Felis catus L.) were reported.

The use of both conibear and leg-hold traps in a variety of sizes ensured that the widest range of mid-sized mammals was represented. The high mean of captures per 10TNs for all trap types demonstrates their collective effectiveness. Carcasses of two species captured, Virginia opossum (Didelphis virginiana Kerr) and striped skunk (Mephitis mephitis Schreber), were not made available to us by the trappers. Both species appeared frequently in daily capture reports, and the loss of the information associated with these incidental captures represents a loss of valuable data.

Capture location was not available for all captures, making it difficult to compare capture success among trapping areas (habitat types). Comparison of captures/unit effort is a powerful tool for revealing population and habitat preference trends (Chilelli et al., 1996). With such information, fine-scale patterns of habitat use could be established. Without such data, habitat assessments only demonstrate the habitat types most preferred by trappers.

Four species known to live in close association with aquatic habitats (C. canadensis, O. zibethicus, L. canadensis, M. vison) were taken primarily with conibears, which are usually set in or under water. Captures of species with more upland affinities (D. virginiana, M. mephitis, L. rufus, V. vulpes, Urocyon cinereoargenteus Schreber [gray fox]) dominated samples taken by leg-hold traps that are generally set in more upland situations (Darrell Schwartz [trapper], pers. comm.). Castor canadensis was the most frequently captured and measured species. This is not surprising for two reasons. First, #330 conibears are the preferred trap for C. canadensis (Bateman, 1973) and were the most frequently used trap type. Second, all 13 trapping sites we assessed showed evidence of recent C. canadensis activity.

The large number of C. canadensis captured during the 1998-1999 trapping period is a reflection of the large population size that exists on APH. Castor canadensis
TABLE 2. Summary of means for total length (TL), tail length (TV), hind foot length (HF), ear length, body mass, and canines tip-to-tip of six furbearer species captured on Fort A. P. Hill, Caroline County, Virginia. Range and mean ± one standard deviation are provided. No female V. vulpes or M. vison were captured. External measurements are in millimeters, mass was measured in grams.

<table>
<thead>
<tr>
<th>Species</th>
<th>Sex</th>
<th>n</th>
<th>TL</th>
<th>TV</th>
<th>HF</th>
<th>Ear</th>
<th>Body mass</th>
<th>Canine</th>
</tr>
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<tbody>
<tr>
<td>C. canadensis</td>
<td>M</td>
<td>36</td>
<td>653-1151</td>
<td>155-320</td>
<td>130-207</td>
<td>25-36</td>
<td>5,000-25,000</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>22</td>
<td>903 ± 124</td>
<td>238 ± 37</td>
<td>159 ± 16</td>
<td>31 ± 3</td>
<td>11,322 ± 4,264</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>M/F</td>
<td>58</td>
<td>924 ± 155</td>
<td>245 ± 37</td>
<td>160 ± 21</td>
<td>31 ± 3</td>
<td>12,545 ± 5,235</td>
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<td></td>
<td>M</td>
<td>924 ± 124</td>
<td>238-257</td>
<td>81-86</td>
<td>10-17</td>
<td>11,786 ± 4,650</td>
<td>n/a</td>
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<tr>
<td></td>
<td>F</td>
<td>924 ± 155</td>
<td>245 ± 37</td>
<td>82 ± 3</td>
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<td>12,545 ± 5,235</td>
<td>n/a</td>
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<tr>
<td></td>
<td>M/F</td>
<td>924 ± 136</td>
<td>241 ± 37</td>
<td>82 ± 3</td>
<td>15 ± 4</td>
<td>12,545 ± 5,235</td>
<td>n/a</td>
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<tr>
<td>O. zibethicus</td>
<td>M</td>
<td>5</td>
<td>552-611</td>
<td>238-257</td>
<td>81-86</td>
<td>11-17</td>
<td>1,100-1,500</td>
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<tr>
<td></td>
<td>F</td>
<td>4</td>
<td>576 ± 26</td>
<td>246 ± 9</td>
<td>82 ± 3</td>
<td>13 ± 4</td>
<td>1,263 ± 180</td>
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<td>M/F</td>
<td>9</td>
<td>578 ± 45</td>
<td>244 ± 11</td>
<td>82 ± 4</td>
<td>18 ± 3</td>
<td>1,470 ± 130</td>
<td>n/a</td>
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<tr>
<td>V. vulpes*</td>
<td>M</td>
<td>1</td>
<td>970</td>
<td>360</td>
<td>149</td>
<td>79</td>
<td>4,900</td>
<td>18</td>
</tr>
<tr>
<td>P. lotor</td>
<td>M</td>
<td>10</td>
<td>754-890</td>
<td>199-294</td>
<td>104-114</td>
<td>29-64</td>
<td>3,400-6,000</td>
<td>20-25</td>
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<tr>
<td></td>
<td>F</td>
<td>6</td>
<td>819 ± 38</td>
<td>232 ± 29</td>
<td>110 ± 4</td>
<td>50 ± 13</td>
<td>4,815 ± 811</td>
<td>23 ± 2</td>
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<tr>
<td></td>
<td>M/F</td>
<td>16</td>
<td>758 ± 144</td>
<td>241 ± 35</td>
<td>108 ± 7</td>
<td>48 ± 9</td>
<td>4,475 ± 1,015</td>
<td>23 ± 1</td>
</tr>
<tr>
<td>M. vison*</td>
<td>M</td>
<td>1</td>
<td>641</td>
<td>225</td>
<td>68</td>
<td>19</td>
<td>1,800</td>
<td>12</td>
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<td>L. canadensis</td>
<td>M</td>
<td>3</td>
<td>999-1,120</td>
<td>335-423</td>
<td>111-126</td>
<td>12-25</td>
<td>5,750-7,700</td>
<td>18-23</td>
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<td>3</td>
<td>1,080 ± 67</td>
<td>397 ± 54</td>
<td>120 ± 7</td>
<td>20 ± 7</td>
<td>6,833 ± 993</td>
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<td></td>
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<td>6</td>
<td>1,071 ± 104</td>
<td>376 ± 44</td>
<td>116 ± 4</td>
<td>19 ± 5</td>
<td>6,933 ± 2,458</td>
<td>22 ± 1</td>
</tr>
</tbody>
</table>

* Single individual measured
presence on APH is evidenced by the high density of active *C. canadensis* ponds on
the post (ASB and JCM, pers. obs.). High density of these ponds is likely a direct result
of a lack of development on APH. The primary function of APH is to provide the
military with a relatively remote and diverse landscape sufficient for conducting a wide
variety troop field-training activities. Thus, beaver activity is generally only kept in
check when roadways or training facilities are impacted. Collectively, our observations
on APH (1991-2001) indicate that in many respects, *Castor canadensis* functions as a
keystone species. This is evidenced by the qualitative and obvious impacts of its
activities, e.g., tree cutting and damming, on the hydrological and structural attributes
of the wetlands and adjacent habitats. Impacted habitats have undergone shifts in
habitat suitability for local flora and fauna that have resulted in changes of community
composition. Beaver-maintained wetlands often support large populations of amphibians,
reptiles, birds (including waterfowl), fish, and aquatic invertebrates. Many plant
species rely almost exclusively on conditions generated by beaver activity. Our capture
records based on trap type indicate that most of the furbearer species addressed in this
study rely, at least in part, on the habitat created and maintained by *C. canadensis*.

All 13 trapping sites where we qualitatively assessed plant species composition and
*C. canadensis* activity were wetland habitats. Deciduous trees, especially *Quercus* spp.,
dominated the canopies and subcanopies at most sites; however, subcanopy tree species
composition was more heterogeneous among sites than canopy or shrub species
composition. With the exception of impoundments (n = 6), sites were *C. canadensis-
maintained habitats (n = 7). Two sites had active *C. canadensis* lodges; some had
remnants of old lodges. All sites had recent evidence of *C. canadensis* activity—espe-
cially deciduous tree cuttings. Cutting activity and low abundance of pines collectively
explain why DWD was mostly deciduous at many sites. There was no obvious
correlation between plant species composition at the aquatic and terrestrial interfaces
(edges) and frequency of *C. canadensis* cuttings or DWD. We expected to see a
positive, qualitative, relationship here, as frequency of DWD or tree cuttings increase
(i.e., more sunlight), density of shrubs at the edge should also increase—our observa-
tions indicated no patterns among these factors. The most plausible explanation for
these results is that most sites (8) are maintained, or manicured, as recreational or
prop-training areas. Six of the eight sites are impoundments with trails, picnicking and
boating areas, and boat landings. All 13 sites were suitable habitat for the
species trapped therein (Whitaker and Hamilton, 1998; Bellows et al., 2001).

External measurements for five of the six species measured were generally com-
parable to those in the literature (Handley and Patton, 1947; Paradiso, 1969; Webster
et al., 1985; Cothran et al., 1991; Ernst et al., 1997). Measurements for total body
length and tail length for the *O. zibethicus* were slightly higher than specified in Willner
et al. (1980) but comparable to measurements for regional individuals (e.g., Webster
et al., 1985). We found no evidence of sexual dimorphism for body mass or for total
body length in *C. canadensis* and *P. lotor*.

All of these mammals can be vectors of disease such as rabies, canine distemper,
tularemia, and other parasite-borne diseases. Several of these species are well known
to become rapidly overpopulated with consequences of infectious diseases, parasites,
alteration of local biodiversity, and local extinctions (Garrott et al., 1993). These issues
occur at broader scales than at local areas (e.g., military base). Several of the species
captured frequently occupy edge habitats. These species, including *P. lotor*, *V. vulpes,*
*M. mephitis*, and *D. virginiana*, are responsible for much of the mortality of neotropical
migrant bird eggs and nestlings that breed in this region (Wilcove et al., 1986; Meffe
and Carroll, 1997). The first three are major predators of freshwater turtles and their
eggs (Ernst et al., 1994; Mitchell, 1986).
eggs (Ernst et al., 1994; Mitchell, 1994) and also consume a wide variety of human-generated products. The term "subsidized predators" is now commonly used for these species, especially P. lotor (Mitchell and Klemens, 2000). These predators are also implicated in the decline of the Bobwhite Quail (Colinus virginianus L.); however, habitat fragmentation is the primary reason for low population densities for C. virginianus in Virginia (M. Fies, VDGIF, pers. comm.).

The geographic area encompassed by APH provides an excellent arena for examining long-term population trends and habitat availability and use over a large breeding area. Population densities of many animal species fluctuate from year-to-year (Gotelli, 2001) and often track prey species density or mast crops. Therefore, the need for long-term data collection to evaluate such trends is evident. Long-term data collection would also provide additional records for less frequently captured species. Also, the limitation of data collection to the trapping season will reveal only winter patterns of the furbearers.

The furbearer fauna of APH is representative of the upper Coastal Plain of the mid-Atlantic region. Military installations like APH are becoming more ecologically valuable because relatively intact landscapes are quickly disappearing from the region. Such public lands or "refuge-like islands" should be assessed for all taxa. Results of these assessments could be used as yardsticks for determining the effects of landscape-level anthropogenic changes such as deforestation for agriculture and urban and suburban sprawl on regional biota.

ACKNOWLEDGMENTS

The authors collaborated on the design of data collection and analysis. ASB collected morphometrics data and conducted trapping site assessments. We thank all trappers who participated in our data collection, especially Darrell Schwartz. We thank John F. Pagels (Virginia Commonwealth University) for his support of many aspects of this survey and Robert K. Rose (Old Dominion University) for his review of an earlier revision of this manuscript. Funding and administrative support were directed by Jeff Walden and his staff (Conservation Management Institute, Virginia Tech). We thank the Environmental and Natural Resources Division at APH, especially Terry Banks and Heather Mansfield, for support and funding of this project.

LITERATURE CITED


