American Three-toed Woodpecker
(Picoides dorsalis):
A Technical Conservation Assessment

Prepared for the USDA Forest Service,
Rocky Mountain Region,
Species Conservation Project

July 1, 2004

David A. Wiggins, Ph.D.
Strix Ecological Research
1515 Classen Drive
Oklahoma City, OK 73106

Peer Review Administered by
Society for Conservation Biology

**ACKNOWLEDGEMENTS**

I thank Louis Imbeau and Chris Steeger for providing published and unpublished literature on American three-toed woodpecker biology. Gary Patton, Hugh Powell, Bruce Short, and an anonymous reviewer read the entire assessment and provided many useful comments and constructive criticisms that greatly improved the content and presentation of ideas. Jan Burke provided a wealth of knowledge on the spruce-fir ecosystem and the effects of various management techniques on forest structure.

**AUTHOR'S BIOGRAPHY**

David Wiggins developed an early interest in ornithology. During his high school years, he worked as a museum assistant under George Sutton and Gary Schnell at the University of Oklahoma. He later earned degrees from the University of Oklahoma (B.Sc. in Zoology), Brock University (M.Sc. - Parental care in Common Terns, under the supervision of Ralph Morris), and Simon Fraser University (Ph.D. - Evolution of body size in Tree Swallows, under the supervision of Nico Verbeek). This was followed by a National Science Foundation post-doctoral fellowship at Uppsala University in Sweden, where he studied life history evolution in Collared Flycatchers, and later a Fulbright Fellowship working on the reproductive ecology of tits (Paridae) in Namibia and Zimbabwe. He currently splits time between ecological consulting work in Sweden and North America.

**COVER PHOTO CREDIT**

American three-toed woodpecker (*Picoides dorsalis*). Photograph by Jeff J. Jones (jjones@jonestc.com). Use with his permission
**SUMMARY OF KEY COMPONENTS FOR CONSERVATION OF THE AMERICAN THREE-TOED WOODPECKER**

American three-toed woodpeckers (*Picoides dorsalis*) are not federally listed under any conservation category in the United States or Canada. The limited population trend data available from Breeding Bird Surveys and Christmas Bird Counts suggest no clear pattern of decline or increase. However, because of the species’ low abundance and retiring habits, it is not well sampled with such range-wide population sampling efforts. Consequently, data on which to assess population trends of American three-toed woodpeckers are currently lacking at the regional and range-wide scales.

American three-toed woodpeckers are widely considered barometers of the health of old-growth conifer forests in North America. This relationship is largely the result of the species’ apparent dependence on mature and old-growth conifer forests. However, areas of disturbed forests (e.g., recent burns, beetle infestations) have also been widely cited as important habitat. Unfortunately, there is little information available on how these two habitat elements may interact in regulating local populations of woodpeckers. In addition, the extent to which American three-toed woodpeckers utilize habitats (either for foraging or nesting) other than spruce-fir and lodgepole pine in the southern Rocky Mountains remains poorly known.

Given the uncertainties regarding American three-toed woodpecker population trends and habitat requirements in Region 2 of the USDA Forest Service, there are inherent difficulties in assessing which factors represent the biggest threats to the species’ viability in the Region. However, a multitude of published studies from outside the Region suggest that the most likely threats are salvage logging, suppression of bark beetle outbreaks, and logging of old-growth forests. While these threats may be important at the local level, where woodpeckers occur at low densities, they appear to be less important at the regional level where existing old-growth conifer forests appear to be providing suitable conditions for viable populations. There is a lack of information on how habitat configuration (e.g., patch size, patch distribution) affects American three-toed woodpecker populations, and this represents a critical information need for land managers. In addition, the manner in which suitable habitat is created and maintained (e.g., through disturbances, or by successional processes) and how these habitat types differ in supporting healthy populations is not well understood. When logging is carried out within spruce-fir forests, attempts to avoid even-aged stand structure (e.g., by leaving patches of mature/old growth trees) would benefit populations of this woodpecker. Uneven-aged stands would allow for better retention of snags and old-growth trees as foraging and nesting habitat and may also hinder the spread and intensity of spruce beetle attacks. A strong link between conservation elements and management implications can best be achieved by gathering more data on American three-toed woodpecker ecology in the southern Rocky Mountain region.
# Table of Contents

ACKNOWLEDGEMENTS .............................................................................................................. 2  
AUTHOR’S BIOGRAPHY ................................................................................................................. 2  
COVER PHOTO CREDIT .................................................................................................................... 2  
SUMMARY OF KEY COMPONENTS FOR CONSERVATION OF THE AMERICAN THREE-TOED WOODPECKER .................................................................................................................. 3  
LIST OF TABLES AND FIGURES ........................................................................................................ 6  
INTRODUCTION ................................................................................................................................. 7  
  - Goal of Assessment .......................................................................................................................... 8  
  - Scope and Limitations of Assessment .............................................................................................. 8  
  - Treatment of Uncertainty .................................................................................................................. 8  
  - Publication of Assessment on the World Wide Web ......................................................................... 8  
  - Peer Review .................................................................................................................................... 9  
MANAGEMENT STATUS AND NATURAL HISTORY ................................................................. 9  
  - Management Status ......................................................................................................................... 9  
  - Existing Regulatory Mechanisms, Management Plans, and Conservation Strategies ....................... 9  
BILOGY AND ECOLOGY .................................................................................................................. 10  
  - Systematics ..................................................................................................................................... 10  
  - Distribution and abundance ............................................................................................................. 10  
    - Regional distribution and abundance ............................................................................................ 11  
    - Regional discontinuities in distribution and degree of isolation ...................................................... 12  
  - Population trend ............................................................................................................................... 13  
    - Range-wide .................................................................................................................................. 13  
    - Regional ..................................................................................................................................... 13  
  - Activity pattern and movements ...................................................................................................... 13  
  - Habitat .......................................................................................................................................... 14  
    - Foraging habitat ............................................................................................................................... 14  
    - Nesting habitat ............................................................................................................................... 15  
    - General habitat associations .......................................................................................................... 16  
  - Food habits ....................................................................................................................................... 16  
    - Foraging behavior ........................................................................................................................... 17  
    - Natural history of bark and wood-boring beetles ............................................................................ 17  
  - Breeding biology ............................................................................................................................ 18  
    - Phenology ..................................................................................................................................... 18  
    - Nest sites and site fidelity .................................................................................................................. 18  
    - Clutch/brood size ............................................................................................................................. 18  
    - Parental care .................................................................................................................................. 19  
  - Demography .................................................................................................................................... 19  
    - Genetic characteristics and concerns ............................................................................................. 19  
    - Life history characteristics ............................................................................................................. 19  
    - Territoriality and home ranges ......................................................................................................... 20  
    - Factors limiting population growth ............................................................................................... 20  
  - Community ecology ......................................................................................................................... 21  
    - Predators and competitors ............................................................................................................... 21  
    - Parasites and disease ....................................................................................................................... 22  
CONSERVATION ............................................................................................................................. 22  
  - Threats .......................................................................................................................................... 22  
  - Conservation Status of the American Three-toed Woodpecker in Region 2 .................................... 26  
  - Management of the American Three-toed Woodpecker in Region 2 ............................................. 27  
    - Implications and potential conservation elements ........................................................................... 27  
    - Tools and practices ......................................................................................................................... 28  
      - Inventory and monitoring of populations and habitat .................................................................... 28  
      - Population or habitat management approaches ........................................................................... 30
Information Needs.................................................................................................................................................... 32
REFERENCES ............................................................................................................................................................. 35

EDITOR: Gary Patton, USDA Forest Service, Rocky Mountain Region
LIST OF TABLES AND FIGURES

Tables:

Table 1. Conservation status of American three-toed woodpeckers within Region 2 state Natural Heritage Programs. .......................................................... .......................................................... 9

Table 2. Management status of American three-toed woodpeckers within Partners in Flight state Bird Conservation Plans. .......................................................... ...................................................... 10

Table 3. Population densities of American three-toed woodpeckers in North America. .......................................................... .......................................................... 12

Table 4. Summary of population trends for American three-toed woodpeckers during annual Christmas Bird Count. .......................................................... .......................................................... 12


Table 6. Characteristics of foraging trees used by American three-toed woodpeckers. .......................................................... .......................................................... 15

Table 7. Life history characteristics for three primary bark beetle species and wood-boring beetles in general. .......................................................... .......................................................... 18

Table 8. Characteristics of American three-toed woodpecker nest sites in western North America. .......................................................... .......................................................... 19

Table 9. A summary of published management recommendations for American three-toed woodpeckers within Partners in Flight state Bird Conservation Plans. .......................................................... .......................................................... 29

Table 10. Region-wide species inventory and local population monitoring recommendations for American three-toed woodpeckers. .......................................................... .......................................................... 30

Figures:

Figure 1. Map of USDA Forest Service Region 2, with national forests and grasslands outlined in green. .......................................................... .......................................................... 7

Figure 2. A map of the distribution of American three-toed woodpeckers in North America. .......................................................... .......................................................... 11

Figure 3. Changes in the total number of forest fires and total acres burned by decade. .......................................................... .......................................................... 21

Figure 4. Enviromogram representing the web of linkages between American three-toed woodpeckers and the ecosystem in which they occur. .......................................................... .......................................................... 23

Figure 5. The total number of acres of spruce-fir and lodgepole pine forest logged from 1992 to 2000 in Region 2. .......................................................... .......................................................... 25

Figure 6. Decay classifications for conifer and deciduous trees, as presented in surveying techniques for woodpeckers in British Columbia. .......................................................... .......................................................... 31
**INTRODUCTION**

This assessment is one of many being produced to support the Species Conservation Project for the Rocky Mountain Region (Region 2) of the, USDA Forest Service (USFS). The American three-toed woodpecker (*Picoides dorsalis*) is the focus of an assessment because it is a management indicator species (MIS) on multiple National Forests in Region 2 (see Figure 1 for a map of Region 2), as well as a sensitive species at the Regional level. As a barometer for species viability at the Forest level, a MIS has two functions: 1) to estimate the effects of planning alternatives on fish and wildlife populations [36 CFR 219.19 (a)(1)]; and 2) to monitor the effects of management activities on species via changes in population trends [36 CFR 219.19 (a)(6)]. In the National Forest System a sensitive species is a plant or animal whose population viability is identified as a concern by a Regional Forester because of significant current or predicted downward trends in abundance or in habitat capability that would reduce its distribution [FSM 2670.5 (19)]. A sensitive species may require special management, so knowledge of its biology and ecology is critical.

This assessment addresses the biology and conservation status of the American three-toed woodpecker throughout its range, but with an emphasis on Region 2. The information is then used to link threats and conservation elements to management implications. This introduction defines the goal of the assessment, outlines its scope, and describes the process used in its production.

**Figure 1.** Map of USDA Forest Service Region 2, with National Forests and Grasslands outlined in green.
Goal of Assessment

Species conservation assessments produced as part of the Species Conservation Project are designed to provide forest managers, research biologists, and the public a thorough discussion of the biology, ecology, conservation, and conservation/management considerations of certain species based on available scientific knowledge. The assessment goals limit the scope of the work to critical summaries of scientific knowledge, discussion of broad implications of that knowledge, and outlines of information needs. The assessment does not seek to develop specific management recommendations but provides the ecological background and conservation context upon which management must be based. However, it does focus on the consequences of changes in the environment that result from management (i.e. management implications). Furthermore, it cites management recommendations proposed elsewhere and, when management recommendations have been implemented, the assessment examines their success.

Scope and Limitations of Assessment

The American three-toed woodpecker assessment examines the biology, ecology, conservation, and management of this species with specific reference to the geographic and ecological characteristics of the Rocky Mountain Region. Although some of the literature on the species originates from field investigations outside the region, this document places that literature in the ecological and social context of the south-central Rockies. Similarly, this assessment is concerned with reproductive behavior, population dynamics, and other characteristics of American three-toed woodpeckers in the context of the current environment rather than under historical conditions. The evolutionary environment of the species is, however, considered in conducting the synthesis, but placed in current context.

In producing the assessment, I reviewed refereed literature, non-refereed publications, research reports, and data accumulated by resource management agencies. Not all publications on American three-toed woodpeckers are referenced in the assessment, nor was all published material considered equally reliable. The assessment emphasizes refereed literature because this is the accepted standard in science. Non-refereed publications or reports were regarded with greater skepticism. Nonetheless, I chose to use some non-refereed literature in the assessments when information was otherwise unavailable.

Although American three-toed woodpeckers are widely considered to be barometers of forest health, they have received relatively little attention from researchers. This likely stems from their low abundance, habitat choice (dense, mature conifer forest), and generally quiet, unobtrusive behavior. As a consequence, writing this assessment required reliance on a relatively small set of publications, and firm conclusions were typically difficult to formulate.

Treatment of Uncertainty

Science represents a rigorous, systematic approach to obtaining knowledge. Competing ideas regarding how the world works are measured against observations. However, because our descriptions of the world are always incomplete and our observations are limited, science focuses on approaches for dealing with uncertainty. A commonly accepted approach to science is based on a progression of critical experiments to develop strong inference (Platt 1964). However, it is difficult to conduct experiments that produce clean results in the ecological sciences. Often, we must rely on observations, inference, good thinking, and models to guide our understanding of ecological relations. In this assessment, we note the strength of evidence for particular ideas, and we describe alternative explanations where appropriate.

In this assessment, the primary source of uncertainty stemmed from a lack of basic information on American three-toed woodpecker population dynamics. Several of the assessment goals (e.g., life-cycle diagrams, demographic matrices) were not achieved due to the uncertainty surrounding the basic life history parameters (e.g., survival and reproduction). This in turn limited the extent to which a link could be established between regional forest management strategies and the conservation implications for American three-toed woodpeckers.

Publication of Assessment on the World Wide Web

To facilitate the use, species conservation assessments are being published on the Region 2 web site. Placing the documents on the web makes them available to agency biologists and managers, other agencies and organizations, and the public more rapidly than publishing them as reports. More important, it facilitates their revision, which will be accomplished based on guidelines established by Region 2.
Peer Review

Assessments developed for the Species Conservation Project have been peer reviewed prior to release on the Web. This report was reviewed through a process administered by the Society for Conservation Biology, employing two recognized experts on this or related taxa. Peer review was designed to improve the quality of communication and to increase the rigor of the assessment.

MANAGEMENT STATUS AND NATURAL HISTORY

Management Status

The American three-toed woodpecker receives protection from “take” in the United States under the federal Migratory Bird Treaty Act (16 U.S.C. 703-711), which implements the provisions of several International treaties for the conservation of migratory birds. The species is not listed as threatened in Canada (COSEWIC 2004). It is classified as a sensitive species within Region 2 and as a management indicator species within the Arapaho-Roosevelt, Bighorn, Black Hills, and Pike-San Isabel National Forests. American three-toed woodpecker is also considered Imperiled or Vulnerable by Natural Heritage Programs of two states in Region 2 (Table 1), and it is a Priority Species or Focal Species within several Partners in Flight (PIF) state programs (Table 2). Thus, although not threatened on a range-wide scale, there is considerable regional concern given the species’ low abundance and apparent dependence on old-growth forests and natural forest disturbances.

Existing Regulatory Mechanisms, Management Plans, and Conservation Strategies

As noted above, American three-toed woodpecker is a focal species within several PIF state landbird conservation plans within and near Region 2 (Table 2). In Wyoming, American three-toed woodpecker is listed as a Level II priority species, requiring population monitoring. The species is not listed in the Colorado state plan, and no plans have yet been published for South Dakota, Nebraska, or Kansas. The American three-toed woodpecker is listed as a priority species in Arizona, Nevada, Utah, Idaho, and Montana (Table 2).

Existing PIF management plans for American three-toed woodpecker are largely meant as guidelines for land managers and conservation efforts within each state. These plans suggest that natural fires within high-elevation, spruce-fir forests should (at least occasionally) be allowed to burn and that beetle infestations be allowed to run their course. In addition, retention of old, diseased, and decaying trees is also suggested. Existing federal regulations (e.g., 1995 Federal Wildland Fire Management Policy) appear to contrast with such suggestions. Forest Service policy regarding salvage logging in areas of beetle infestation may be detrimental to American three-toed woodpecker and should be considered in updated Forest Plans. However, as noted elsewhere in this assessment, the effects of beetle infestations (from small- to large-scale) on American three-toed woodpecker population dynamics have not been closely studied. Thus, any forest management plans developed for American three-toed woodpecker habitat would ideally be preceded by

---

Table 1. Conservation status of American three-toed woodpeckers within Region 2 state Natural Heritage Programs.

<table>
<thead>
<tr>
<th>State</th>
<th>State Status*</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wyoming</td>
<td>S3</td>
<td>Fertig and Beauvais 1999</td>
</tr>
<tr>
<td>South Dakota</td>
<td>S2</td>
<td><a href="http://www.state.sd.us/gfp/Diversity/RareAnimal.htm#KEY">http://www.state.sd.us/gfp/Diversity/RareAnimal.htm#KEY</a></td>
</tr>
<tr>
<td>Nebraska</td>
<td>Not listed</td>
<td><a href="http://www.natureserve.org/nhp/us/ne/birds.html">http://www.natureserve.org/nhp/us/ne/birds.html</a></td>
</tr>
<tr>
<td>Kansas</td>
<td>Not listed</td>
<td><a href="http://www.kbs.ukans.edu/">http://www.kbs.ukans.edu/</a></td>
</tr>
</tbody>
</table>

xx * S2 = Imperiled because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.
S3 = Vulnerable through its range or found locally in a restricted range (21 to 100 occurrences).
Table 2. Management status of American three-toed woodpeckers within Partners in Flight state Bird Conservation Plans. Region 2 states are in bold.

<table>
<thead>
<tr>
<th>State</th>
<th>Status</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado</td>
<td>Not a Priority Species</td>
<td>Beidleman 2000</td>
</tr>
<tr>
<td>Kansas</td>
<td>State PIF plan not published</td>
<td></td>
</tr>
<tr>
<td>Wyoming</td>
<td>“Priority Level II” (Monitoring Species)</td>
<td>Nicholoff 2003</td>
</tr>
<tr>
<td>Nebraska</td>
<td>State PIF plan not published</td>
<td></td>
</tr>
<tr>
<td>South Dakota</td>
<td>State PIF plan not published</td>
<td><a href="http://www.kbs.ukans.edu/">http://www.kbs.ukans.edu/</a></td>
</tr>
<tr>
<td>Montana</td>
<td>“Priority Level II” (Monitoring Species)</td>
<td>Casey 2000</td>
</tr>
<tr>
<td>New Mexico</td>
<td>Not a Priority Species</td>
<td>Rustay 2001</td>
</tr>
<tr>
<td>Utah</td>
<td>Priority Species</td>
<td>Parrish et al. 2002</td>
</tr>
<tr>
<td>Idaho</td>
<td>“Moderate Priority Species”</td>
<td>Ritter 2000</td>
</tr>
<tr>
<td>Nevada</td>
<td>“Priority focus” species</td>
<td>Neel 1999</td>
</tr>
<tr>
<td>Arizona</td>
<td>“Spruce-Fir Priority Species”</td>
<td>Latta et al. 1999</td>
</tr>
<tr>
<td>Alaska</td>
<td>Not a Priority Species</td>
<td>Andres 1999</td>
</tr>
<tr>
<td>Oregon/Washington</td>
<td>Not a Priority Species</td>
<td><a href="http://community.gorge.net/natres/pif/">http://community.gorge.net/natres/pif/</a></td>
</tr>
</tbody>
</table>

more focused studies of the relationship between fire (or other sources of disturbance), beetle outbreaks, and woodpecker population dynamics (see Information Needs section for further details).

Biology and Ecology

Systematics

American three-toed woodpeckers were formerly considered conspecific with *Picoides tridactylus* of Eurasia. However, they were recently split from that form by the American Ornithologists’ Union (Banks et al. 2003) based upon evidence of differences in mtDNA and in vocalizations. The species is closely related and similar to black-backed woodpecker (*P. arcticus*; Bock and Bock 1974). The American three-toed woodpecker is a relatively specialized species, feeding primarily on beetles within decaying and dead trees and occurring in low densities throughout their range. Populations may increase significantly in areas where fires have recently burned, or where other natural disturbances have caused widespread die-off within conifer stands. These disturbances typically lead to, or are preceded by, infestations of beetles, and woodpeckers may remain in these areas for up to three years.

Recent mtDNA evidence (Zink et al. 2002) suggests that there is very little genetic structuring among populations within North America. However, it should be noted that samples taken for analysis were restricted to the relatively contiguous boreal forest areas, and populations at the southern end of the range (e.g., the southern Rocky Mountains), where distribution is relatively patchy, were not sampled. Thus, the extent to which relatively isolated populations (e.g., Black Hills, Great Basin National Park) have genetically diversified from the main populations is unknown.

Distribution and abundance

American three-toed woodpecker have a wide distribution throughout the boreal forests of North America (Figure 2), closely matching the distribution of spruce species (Bock and Bock 1974). The distribution becomes patchy further south in the western United States, and the species reaches its southern limits in northern Arizona (San Francisco and White Mountains; Monson and Phillips 1981) and central New Mexico (Mogollon Plateau and Sacramento Mountains; Bailey 1928, Hubbard 1978). As American three-toed woodpecker typically occur at low population densities and are unobtrusive, typical survey methods may not provide an accurate assessment of population densities or even presence/absence (Gunn and Hagan 2000). Consequently, any changes in abundance must be interpreted cautiously. Although Breeding Bird Survey (BBS; Sauer et al. 2004) data from North America show relatively strong decreases in abundance in some areas (e.g., Colorado, southern Rockies), the trends are based on extremely small sample sizes and are not statistically significant (see Population Trend section).

Over most of its North American range, American three-toed woodpeckers occur in sympathy with black-backed woodpeckers, a close relative and competitor. However, from southern Wyoming southward, American three-toed woodpeckers occur in the absence of black-
backed woodpeckers. The lack of competition may have resulted in changes in habitat use and foraging behavior, as well as differences in demography. However, to date there are no data available with which to assess such potential effects.

Regional distribution and abundance

The status of American three-toed woodpecker within Region 2 states is as follows:

South Dakota – Rare permanent resident, restricted to high elevation conifer (primarily spruce) forests in the Black Hills, where breeding has been regularly documented (South Dakota Ornithologists’ Union 1991, Tallman et al. 2002).

Nebraska – Non-breeding straggler (fewer than 5 records) to extreme northwest Nebraska (Pine Ridge area; Sharpe et al. 2001).
**Wyoming** – Uncommon permanent resident, apparently widely distributed in the state (with the possible exception of the northeast [Knight 1902, Oakleaf et al. 1992, Leonard 2001]), but restricted to high elevation conifer forests (Dorn and Dorn 1999).

**Colorado** – Recent breeding bird atlas work (1987-1995) recorded breeding in all high elevation mountain ranges throughout the state, with low abundance scores throughout (Versaw 1998).

**Kansas** – No records for the state (Thompson and Ely 1989).

As is the case in other parts of the species’ range, the abundance of American three-toed woodpecker in Region 2 is difficult to measure. Koplin (1969) found a density of 0.25/ha in unburned coniferous forest in northern Colorado, increasing to 1.20/ha two years after the same area burned. These density estimates are significantly higher than those found in other parts of the American three-toed woodpecker range (Table 3).

However, long-term data from Christmas Bird Counts (CBC) suggest that densities in Colorado (0.07 birds per 100 party hours) are low, relative to the average across the species’ range (0.16 birds per 100 party hours; Table 4).

**Regional discontinuities in distribution and degree of isolation**

American three-toed woodpecker are largely restricted to high elevation conifer forests and are therefore distributed in a mosaic pattern (mirroring the pattern of high elevation mountains) throughout Region 2. A geographically isolated population occurs in the Black Hills of South Dakota. However, the degree to which the Black Hills population is demographically and genetically isolated is not known. Given the relatively small amount of suitable habitat in the Black Hills, genetic and demographic studies there may be relatively productive since individuals could be more easily tracked over time.

---

**Table 3.** Population densities of American three-toed woodpeckers in North America. Region 2 state is in bold.

<table>
<thead>
<tr>
<th>Study Area</th>
<th>Period of Study</th>
<th>Estimate in Burned Forest?</th>
<th>Density (birds/ha)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado</td>
<td>Summer</td>
<td>No</td>
<td>0.25</td>
<td>Koplin 1969</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Montana</td>
<td>Summer</td>
<td>Yes</td>
<td>0.25</td>
<td>Blackford 1955</td>
</tr>
<tr>
<td>Washington</td>
<td>Winter</td>
<td>No</td>
<td>0</td>
<td>Kreisel and Stein 1999</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>0.03</td>
<td>Steeger and Dulisse 1997b</td>
</tr>
<tr>
<td>British Columbia</td>
<td>Winter</td>
<td>No</td>
<td>&lt;0.01</td>
<td>Murphy and Lehmhausen 1988</td>
</tr>
<tr>
<td>Alaska</td>
<td>Winter</td>
<td>No</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes</td>
<td>0.08</td>
<td>Hagan et al. 1997</td>
</tr>
<tr>
<td>Maine</td>
<td>Summer</td>
<td>No</td>
<td>0.03</td>
<td>Imbeau et al. 1999</td>
</tr>
<tr>
<td>Quebec</td>
<td>Summer</td>
<td>No</td>
<td>0.06</td>
<td></td>
</tr>
</tbody>
</table>

---

**Table 4.** Summary of population trends for American three-toed woodpeckers during annual Christmas Bird Counts (Sauer et al. 1996). Trends are for the period 1960 to 1988 and represent the percentage change in the number of birds seen per year. The abundance measure is the mean number of birds seen per 100 party hours.

<table>
<thead>
<tr>
<th>Region</th>
<th>N</th>
<th>Trend</th>
<th>Significance</th>
<th>Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado</td>
<td>14</td>
<td>0.0</td>
<td>n.s.</td>
<td>0.07</td>
</tr>
<tr>
<td>British Columbia</td>
<td>14</td>
<td>-1.7</td>
<td>&lt;0.05</td>
<td>0.46</td>
</tr>
<tr>
<td>Ontario</td>
<td>41</td>
<td>0.7</td>
<td>n.s.</td>
<td>0.13</td>
</tr>
<tr>
<td>Entire survey region</td>
<td>162</td>
<td>0.5</td>
<td>n.s.</td>
<td>0.16</td>
</tr>
</tbody>
</table>
Population trend

Range-wide

Evidence from BBS’s (Sauer et al. 2004) throughout the species’ range in North America suggests a decline of 3 percent per year from 1980 to 2003 (Table 5). However, regional trends fluctuated widely, from an 11 percent decrease in the southern Rocky Mountains, to an 8 percent increase in the northern Rocky Mountains. It is important to note that none of the trends listed in Table 5 are statistically significant. American three-toed woodpecker are difficult to survey adequately due to features of their preferred habitat (high elevation and dense conifer forest), as well as their generally quiet, unobtrusive behavior. As a consequence, the reliability of BBS data for American three-toed woodpecker appears to be suspect. There are also limited, long-term (1959-1988) data available from CBC’s (Table 4) that suggest a small, but statistically significant decline in British Columbia (a result that conflicts with BBS data; Table 5). In Colorado, no significant change in abundance on CBC routes has been identified during the period. However, as with BBS data, data from CBC’s should be interpreted cautiously as sample sizes from high elevation conifer forests are relatively small. In summary, the two main tools typically used in assessing long-term population trends for birds (BBS and CBC surveys) do not adequately sample for American three-toed woodpecker and are thus of little apparent value in assessing American three-toed woodpecker population trends.

Regional

There are no apparent discontinuities in abundance, with low population levels throughout Colorado (Versaw 1998). Furthermore, the abundance of American three-toed woodpecker, at least in Colorado, does not appear to have changed significantly in the past century (Cooke 1897; Versaw 1998). This latter point is somewhat surprising, given wide-spread fire suppression on National Forest System lands over the past half-century (see Threats section). Nonetheless, any conclusions regarding regional variation in abundance are difficult to draw, given the species’ low abundance and the difficulty of conducting surveys.

Activity pattern and movements

American three-toed woodpecker show relatively little variation in activity patterns throughout the day. In northern Colorado, Koplan (1969) found no significant diurnal variation in the activity patterns of American three-toed woodpecker, at least during the late summer and fall. American three-toed woodpecker typically stay on or near their home ranges throughout the year, with only occasional movements to lower elevations during winter (Leonard 2001). In addition, individuals congregate around abundant food sources (e.g., recent burns, beetle infested stands), especially in winter. However, the extent to which such food-rich areas are exploited during the breeding season remains unclear (Koplan 1969).

Table 5. American three-toed woodpecker trend results from North American Breeding Bird Surveys from 1980 to 2003 (Sauer et al. 2004). The trend indicates the percentage change per year. Note the lack of statistical significance, despite strong trends in some areas. This likely results from low densities of woodpeckers and from a relatively low number of survey routes. Region 2 states are in bold.

<table>
<thead>
<tr>
<th>Region</th>
<th>N</th>
<th>Trend</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado</td>
<td>7</td>
<td>-12.6</td>
<td>0.71</td>
</tr>
<tr>
<td>Wyoming</td>
<td>3</td>
<td>+4.7</td>
<td>0.49</td>
</tr>
<tr>
<td>Alaska</td>
<td>16</td>
<td>+6.5</td>
<td>0.33</td>
</tr>
<tr>
<td>Yukon Territory</td>
<td>7</td>
<td>+8.2</td>
<td>0.63</td>
</tr>
<tr>
<td>British Columbia</td>
<td>9</td>
<td>+3.5</td>
<td>0.72</td>
</tr>
<tr>
<td>Northern Rockies</td>
<td>7</td>
<td>+8.1</td>
<td>0.64</td>
</tr>
<tr>
<td>Central Rockies</td>
<td>10</td>
<td>-0.2</td>
<td>0.94</td>
</tr>
<tr>
<td>Southern Rockies</td>
<td>9</td>
<td>-11.4</td>
<td>0.71</td>
</tr>
<tr>
<td>U.S. Fish and Wildlife Service Region 2</td>
<td>3</td>
<td>+6.7</td>
<td>0.78</td>
</tr>
<tr>
<td>U.S. Fish and Wildlife Service Region 6</td>
<td>14</td>
<td>-14.7</td>
<td>0.45</td>
</tr>
<tr>
<td>Survey-wide</td>
<td>31</td>
<td>-3.1</td>
<td>0.64</td>
</tr>
</tbody>
</table>
Aside from the seasonal altitudinal shifts noted above, no migration has been documented (Leonard 2001). The sexes may segregate during winter, with males sometimes concentrating on burned sites and females in unburned areas (see Habitat: Foraging habitat section). In Canada and the eastern United States, individuals only rarely move south of the normal range in boreal forest (Yunick 1985, Leonard 2001) although in some years small-scale “irruptions” into areas outside the normal range do occur. Thus, American three-toed woodpecker are typified by relatively little daily, seasonal, or annual variation in their activity patterns.

Habitat

In Region 2, the core habitats for American three-toed woodpecker appear to be old growth spruce-fir as well as lodgepole pine (Pinus contorta) forest (Versaw 1998, Dorn and Dorn 1999), with birds also exploiting recently burned (or otherwise damaged) forests that provide a rich supply of food (Koplin 1969, Crockett and Hansley 1978). Within Region 2, American three-toed woodpecker typically breed at altitudes above 2700 m (Versaw 1998). Foraging habitat may vary according to season and local environmental conditions but is generally in the same areas used for nesting. The primary tree species used for both nesting and foraging include Engelmann spruce (Picea engelmanni), white spruce (Picea glauca), Douglas-fir (Pseudotsuga menziesii), subalpine fir (Abies lasiocarpa), and lodgepole pine. It should be emphasized that although some general patterns of habitat use are known, detailed studies of habitat use have not been carried out in Region 2. For example, the extent to which birds move between adjacent forest types (either for breeding or for short-term foraging) is poorly understood. This particularly applies to disturbed (e.g., fire, beetle infestation) areas where woodpecker densities appear to be high.

Foraging habitat

Table 6 summarizes studies of American three-toed woodpecker foraging habitat across the species’ range. Within Region 2, winter studies of foraging behavior have been carried out in subalpine conifer forests (Baldwin 1960, 1968; Koplin 1969), where there was an apparent preference for Engelmann spruce as foraging substrate (Table 6). In central Oregon, 63 percent of foraging observations were of birds feeding on lodgepole pine, and 25 percent were on Engelmann spruce (Goggans et al. 1988). In Alaska, observations within a fire-damaged spruce forest indicated that males preferred lightly burned (and avoided heavily charred) white spruce, while females appeared to avoid this burned habitat and foraged in nearby unburned areas (also on white spruce; Murphy and Lehnhausen 1988). In Idaho and Montana, foraging observations were well distributed among Douglas-fir, lodgepole pine, ponderosa pine, and subalpine fir. In British Columbia, 79 percent of observations (n = 275) of foraging woodpeckers were on lodgepole pine (Steeger and Dulisse 1997a), with additional observations on Douglas-fir, western larch (Larix occidentalis), western white pine (Pinus monticola), and western hemlock (Tsuga heterophylla). Another study in British Columbia (Klenner and Huggard 1997) found American three-toed woodpecker foraging mainly on recently dead subalpine fir and spruce, with no apparent differences in foraging patch choice between summer and winter, nor between males and females. In Idaho and Montana, Hutto and Young (1999) found the highest proportion of American three-toed woodpecker in post-fire conifer forests, followed by spruce-fir forests. In Québec, American three-toed woodpecker foraging in black spruce (Picea mariana) forests used snags in proportion to their availability in the habitat (Imbeau and Desrochers 2002).

A problem with all of the studies cited above (with the exception of Imbeau and Desrochers 2002) is that the choice of foraging tree species was not analyzed in relation to the abundance of different species within the local habitat. Thus, rather than showing a “preference” for certain tree species, American three-toed woodpecker may have simply been choosing trees in proportion to their local abundance. While foraging habitat choice can be inferred indirectly from the nest-site/foraging locations of American three-toed woodpecker, much stronger conclusions regarding foraging habitat choice could be inferred from studies showing statistically significant deviations in the percentage of tree species used for foraging, relative to the percentage available in the local habitat.

Several studies have suggested that habitat choice by foraging American three-toed woodpecker is most strongly affected by the proportion of the local trees that are damaged or dead, rather than the tree species per se. Thus, the bird’s attraction to recently burned, submerged, and other forms of damaged forests is largely a result of the high proportion of damaged trees, and thus greater bark and wood-boring beetle abundance. In central Oregon (Goggans et al. 1988), 88 percent of all the foraging woodpeckers were observed on snags, and 77 percent of these snags were recently dead. Similarly, in Idaho and Montana, 94 percent of foraging observations were on snags (Hejl and McFadzen unpublished data, cited in Leonard 2001),
while in southern British Columbia, most foraging trees were experiencing “moderate” levels of decay (Steeger and Dulisse 1997a). In Québec, American three-toed woodpecker showed a clear preference ($P < 0.001$) for foraging on standing snags, with approximately 80 percent of all observations on standing or fallen snags (Imbeau and Desrochers 2002). The general pattern from these studies is that American three-toed woodpecker focus their foraging efforts on trees that are susceptible to (or damaged as a result of) beetle infestation (i.e., dead trees that are undergoing some form of decay, or trees that have been damaged by fire, wind, or some other form of stress).

The value of disturbed forests as American three-toed woodpecker foraging habitat declines over time. In Alaska, Lehnhausen and Murphy (1998) found that recently burned white spruce forest represented good foraging habitat for up to three years post-fire. In Alberta, Hoyt and Hannon (2002) showed a decrease in American three-toed woodpecker occupancy in burned conifer forests from three to eight years post-disturbance. The temporal value of disturbed sites likely depends on the severity of the disturbance as well as the local habitat. A similar study of post-disturbance site occupancy in disturbed habitats in Region 2 would provide valuable information for land managers (see Information Needs section).

In summary, American three-toed woodpecker choice of foraging habitat is most likely dictated by the abundance and distribution of bark beetles and wood-boring beetles in the local environment. Thus, choice of foraging trees may be seen more as a result of which species of beetles are most abundant locally, rather than as a choice of foraging tree species per se.

### Nesting habitat

In the western half of its North American range, American three-toed woodpecker prefers mature, unlogged conifer forests as well as conifer forests that have undergone some form of disturbance (e.g., burn, flood, windthrow). In northern Idaho and Montana, 84 percent of nests were located in unlogged stands (Leonard 2001). Similar results were found in southern

<table>
<thead>
<tr>
<th>Study area</th>
<th>Period of Study</th>
<th>Foraging Tree Species</th>
<th>% use</th>
<th>Primary food</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>northern Colorado</td>
<td>June-December</td>
<td>Engelmann spruce, lodgepole pine, subalpine fir</td>
<td>81, 12, 7</td>
<td>scolytids</td>
<td>Koplin 1969</td>
</tr>
<tr>
<td>central Oregon</td>
<td>April-September</td>
<td>mixed conifer stands, mixed conifers, mostly lodgepole pine, pure lodgepole pine stands</td>
<td>55, 20, 14</td>
<td>—</td>
<td>Goggans et al. 1988</td>
</tr>
<tr>
<td>British Columbia</td>
<td>winter</td>
<td>lodgepole pine, Douglas fir, hybrid spruce, western larch, white pine, western hemlock</td>
<td>79, 11, 5, 4, 0.7, 0.3</td>
<td>scolytids</td>
<td>Steeger and Dulisse 1997a</td>
</tr>
<tr>
<td>Alaska</td>
<td></td>
<td>white spruce (males), white spruce (females)</td>
<td>91 (males), 100 (females)</td>
<td>scolytids and cerambycids</td>
<td>Murphy and Lehnhausen 1988</td>
</tr>
<tr>
<td>Quebec</td>
<td>summer and winter</td>
<td>black spruce, jack pine, white birch, balsam fir</td>
<td>92, 6, 0.7, 0.3</td>
<td>scolytids</td>
<td>Imbeau and Desrochers 2002</td>
</tr>
</tbody>
</table>
Idaho and northeastern Wyoming, where nests were located primarily in mature/old growth lodgepole pine stands, and also in wet areas close to standing water (Hoffman 1997). In eastern North America, American three-toed woodpecker prefer old growth, mixed conifer forests, and especially those close to bogs and flooded areas (Short 1974). Thus, throughout North American range, the preferred nesting habitat appears to be unlogged, old growth conifer forests, as well as conifer forests that have undergone some form of disturbance. Sources of disturbance may include fire (Blackford 1955, Koplin 1969, Hutto 1995, Murphy and Lehnhausen 1998), flooding (Yeager 1955, Short 1974), disease (Yunick 1985), and windthrows (Baldwin 1968). Such disturbances create the necessary conditions (weakened and dying trees) for outbreaks of wood-boring beetles that are the preferred food of American three-toed woodpecker (see Food Habits section). However, although it is known that American three-toed woodpecker nest near areas of disturbed forest, the extent to which such areas are preferred (relative to undisturbed old-growth) is not known.

In Colorado, breeding bird atlas data showed that American three-toed woodpecker had a clear preference for spruce-fir habitats (Versaw 1998). Nonetheless, there were a handful of records in other habitats including three nests in ponderosa pine (Pinus ponderosa) and two in aspen (Populus tremuloides). Such observations raise the possibility that American three-toed woodpecker will opportunistically shift habitats to exploit short-term abundances of insects. As mentioned in the Information Needs section at the end of this assessment, establishing to what extent such flexibility in nesting habitat choice is typical is a critical information need, as it will have important consequences for habitat management in Region 2.

General habitat associations

Old-growth spruce-fir and lodgepole pine forests appear to represent the core habitat for the American three-toed woodpecker in most areas of Region 2 (cf. Versaw 1998, Dorn and Dorn 1999). In addition, areas of disturbed forest including recent burns, drought-affected forest, and areas affected by windthrow or avalanches provide optimal conditions for wood-boring beetles (primarily) and some species of bark beetles (secondarily) and thus, at least temporarily, good foraging habitat for American three-toed woodpecker. It appears that at the landscape level, a suitable habitat matrix for American three-toed woodpecker is comprised of a patchwork of old-growth conifer forests as well as recently disturbed habitats. Although some aspects of the value of disturbed habitats are in need of further study (see Information Needs section), it is clear that American three-toed woodpecker densities can increase dramatically at disturbed sites and that such sites represent a key component of suitable landscapes for American three-toed woodpecker.

Food habits

American three-toed woodpecker feed primarily on beetles of the families Scolytidae (bark beetles) and Cerambycidae and Buprestidae (wood-boring beetles). Beal (1911) found that these families comprised over 75 percent of the diet of American three-toed woodpecker, with the majority of the diet composed of wood-boring beetles. In Alaska, American three-toed woodpecker showed a preference for bark beetles (Scolytidae) over cerambycids, which were preferred by black-backed woodpeckers (Murphy and Lehnhausen 1998). Thus, diet appears to vary according to which species of beetles are most accessible. There is some indication that American three-toed woodpecker occasionally feed on sap, but most observations of such behavior are anecdotal in nature and further study is needed to determine if sap forms a regular part of the diet (Bent 1939, Villard 1994, Imbeau and Desrochers 2002).

In northern Colorado, in an area where American three-toed woodpecker were relatively abundant and feeding on burned Engelmann spruce, Koplan (1969) found Ips piliifrons (Scolytidae) the most abundant beetle in trunks and large branches, and Pityophthorous spp. the most abundant in smaller branches and twigs. In southern British Columbia, American three-toed woodpecker fed on mountain pine beetles (Scolytidae: Dendroctonus ponderosae) within dead and dying lodgepole pines (Steeger and Dulisse 1997b). In Alaska, stomachs of 11 male American three-toed woodpecker contained largely spruce beetle (Scolytidae; D. rufipennis) and first-instar cerambycid larvae, while stomachs of seven females contained mostly Phloeostenus pini (Scolytidae) and first-instar cerambycids. The stomachs of three woodpeckers in California contained 89 percent buprestid beetles. In a study presumably based in Colorado and Wyoming (although not evident from the description given), Stallcup (1962) analyzed the contents of 103 American three-toed woodpecker stomachs and found that Ips spp. (Scolytidae) were the most abundant, with smaller numbers of cerambycids, buprestids, and pythids. Together with observations of American three-toed woodpecker foraging habitat choice, these results suggest that American three-toed
woodpecker show flexibility in their foraging habits, cueing in on local outbreaks of various species of beetles, depending on their abundance in the local area.

Foraging behavior

American three-toed woodpecker forage primarily on conifer trunks, removing bark with lateral blows that expose the inner bark and cambium (Murphy and Lehnhausen 1998). They typically remain on the same tree for long periods, with frequent pauses and quiescent periods (Short 1974). American three-toed woodpecker show a clear preference for foraging on conifer trunks while largely avoiding branches (Koplin 1969, Villard 1994). In Québec, over 90 percent of all observations of foraging woodpeckers were on trunks (Imbeau and Desrochers 2002). There is conflicting evidence as to whether the sexes utilize different foraging behavior (Leonard 2001). For example, Short (1974) and Bull et al. (1986) reported no difference in the average foraging height of males and females, whereas Imbeau and Desrochers (2002) found that in Québec, females fed at higher locations on trees. Studies in Alaska (Murphy and Lehnhausen 1998) and Manitoba (Villard 1994) have suggested that females forage on trees with larger trunk diameters, while no such difference was observed in Oregon (Bull et al. 1986). Murphy and Lehnhausen (1998) also reported that, within a study area composed of burned and unburned plots, females tended to forage in unburned areas and males in burned sites. There are no data on how foraging behavior and diet vary with American three-toed woodpecker age.

Natural history of bark and wood-boring beetles

Bark and wood-boring beetles are natural components of western forests and may be found in dead, diseased/damaged, or healthy trees. Different species of beetles have varying numbers of hosts, although most are restricted to one or a few hosts. Bark (Scolytidae) and wood-boring (Cerambycidae and Buprestidae) beetles have different life histories. In general, bark beetles are small, short-lived, periodically reach epidemic population levels, and may attack either healthy, living trees or dead, decaying trees. Wood-boring beetles are relatively large, tend to be long-lived (more than one year in the larval stage), and typically occur in highest densities in dead or dying trees just after some form of forest disturbance (e.g., fire).

Factors affecting local outbreaks of bark beetles include: 1) stand conditions such as tree age and size, stand density, and tree species composition; 2) weather conditions (e.g., drought); and 3) disturbances such as fire, wind damage, landslides/avalanches. In general, beetle infestations are more common within older, dense stands with low species heterogeneity. In Region 2, the primary climatic factor that affects beetle outbreaks is drought. Drought induces water stress and lowers the ability of trees to fend off attacks of beetles and disease. While fire is the primary disturbance leading to increased bark beetle populations in western forests, wind and avalanche-induced tree falls may be more important factors in high elevation spruce-fir forests.

Scolytid beetles feed at or just below the bark level on phloem tissue of living, dying, and dead conifers. The beetles, which range from <1mm to 5mm in length, also introduce a fungus that may block water movement from the roots to the top of the tree and thus weaken the tree’s use of sap as a response to beetle attack. The action of the larvae, together with the fungal colonization of the tree, typically kills the infested tree. Populations of these beetles typically occur at relatively low levels and are concentrated on dead or dying trees.

Three species of Dendroctonus beetles affect habitats utilized by American three-toed woodpecker in the southern Rocky Mountains. Mountain pine beetles (D. ponderosae) attack dead or dying trees but are commonly found on live, healthy trees as well. In the Rocky Mountains, mountain pine beetles can be a significant source of mortality for lodgepole pine, with up to 100 trees killed per acre over a three to four year outbreak (Samman and Logan 2000). Spruce (D. rufipennis) and Douglas-fir (D. pseudotsugae) beetles affect a range of the tree species in the spruce-fir belt that forms the primary nesting habitat for American three-toed woodpecker in many areas. Life history summaries of these three Dendroctonus species, as well as wood-boring cerambycids are in Table 7.

Forest management practices also play a key role in regulating bark beetle infestations. For example, selective logging within lodgepole pine forests may increase the abundance and alter the reproductive characteristics of scolytid beetles. Hindmarch and Reid (2001a, b) compared the abundance, diversity, and reproductive tactics of bark beetles within thinned and unthinned stands of lodgepole pine and found that thinned stands supported a greater abundance of beetles for at least three years after thinning. In addition, in thinned stands, male beetles attracted more females, and females laid more eggs. The authors suggested that both of these results were due (in part) to increased wind and temperature within thinned stands. However, other studies have shown conflicting results for different species of pine beetles with different life histories.
For a thorough assessment of bark beetle outbreaks in the Rocky Mountains, see Samman and Logan (2000).

Breeding biology

Phenology

The phenology of American three-toed woodpecker breeding events is poorly known. Pair-formation has not been studied. Although Grinnell (1900) reported that drumming began in March in Alaska, it is not clear whether drumming is related to mate attraction (Short 1974, 1982) or to territorial defense (Winkler and Short 1978). The available data suggest that a new nest is excavated each year (Leonard 2001). Data on egg-laying dates in North America suggest that nest building likely occurs from mid-March to early May. In western North America, where the species tends to breed at higher altitudes, egg dates range from late May until early July, and fledging dates from 15 June to after 27 July (Steeger and Machmer 1996, Leonard 2001). In British Columbia, dates for 12 clutches ranged from 8 May to 13 July, while 79 broods were found in nests between 28 May and 22 July, with 51 percent of those broods recorded between 18 and 30 June (Campbell et al. 1990). Thus, primary dates for censusing would be: drumming/nest building (March to May), incubation (May to June), chick-provisioning (June to late July).

Table 7. Life history characteristics for three primary bark beetle species and wood-boring beetles in general. Secondary bark beetle species (e.g., Ips spp.) typically live on dead trees and have faster generation times (for further information see http://www.barkbeetles.org/ips/Westips.html).

<table>
<thead>
<tr>
<th>Factor</th>
<th>Mountain Pine Beetle</th>
<th>Spruce Beetle</th>
<th>Douglas Fir Beetle</th>
<th>Wood-boring Beetles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Dendroctonus</em></td>
<td><em>Dendroctonus</em></td>
<td><em>Dendroctonus</em></td>
<td>Carambycidae/</td>
</tr>
<tr>
<td></td>
<td>ponderosae</td>
<td>rufipennis</td>
<td>pseudotsugae</td>
<td>Buprestidae</td>
</tr>
<tr>
<td>Main host tree species</td>
<td>Lodgepole pine</td>
<td>Engelmann, white, and sitka spruce</td>
<td>Douglas fir</td>
<td>Variable</td>
</tr>
<tr>
<td>Main adult flight</td>
<td>June-September</td>
<td>May through August</td>
<td>April through August</td>
<td>late spring to mid summer</td>
</tr>
<tr>
<td>Host preference</td>
<td>living trees</td>
<td>living trees or windfall/slash</td>
<td>living trees or windfall/slash</td>
<td>dead trees</td>
</tr>
<tr>
<td>Normal Length of life cyclea</td>
<td>1 year</td>
<td>2 years</td>
<td>3-12 months</td>
<td>&lt;1 to 5 years</td>
</tr>
<tr>
<td>Overwintering stage</td>
<td>larvae</td>
<td>larvae and adultb</td>
<td>larvae and adult</td>
<td>larvae and adult</td>
</tr>
</tbody>
</table>

= The length of primary bark beetle life cycles is highly dependent on the ambient temperature. In warm summers, low elevations or southern latitudes, spruce beetles can complete their cycles in 1 year or less.

= Spruce beetles must overwinter as adults before emerging to attack new host trees. In the normal cycle of 2 years, spruce beetles overwinter as larvae in the first year and as adults in the second year.

Data on nest site characteristics are summarized in Table 8. American three-toed woodpecker may select healthy, dying, or dead trees for nest sites, but appear to prefer snags and stubs, especially those with heartrot (Lester 1980, Goggans et al. 1988, Leonard 2001). Within Region 2, the few data available suggest that cavity heights are relatively low (5 to 13 feet above ground; Table 8). In contrast, 25 cavities in southeastern British Columbia were located at a mean of 7.9 m above ground (Steeger and Dulisse 2001), while 20 nest cavities in Oregon averaged 7.7 m above ground (Goggans et al. 1988). This difference in average nest heights may simply reflect the fact that concerted efforts were made to locate nests in Oregon and British Columbia, whereas most nests in Region 2 were found fortuitously. Thus, it is likely that the height of American three-toed woodpecker nest cavities in Region 2 is higher than the scant available data suggest.

As very few American three-toed woodpecker have been banded, there is no information available on breeding site fidelity.

Clutch/brood size

Clutch size varies from three to seven eggs (Bent 1939). In southern British Columbia, Steeger and Dulisse (1997a) reported a mean clutch size of 3.4 (s.d. = 0.6, n = 7, range = 2-4), whereas clutches from
Montana and Idaho averaged 3.6 eggs (s.d. = 0.2; Hejl and McFadzen cited in Leonard 2001). Koenig (1987) reported an average clutch size of 3.9 (s.d. = 0.6) from 15 clutches across North America. There is very little information on hatching success or loss of nestlings (see Demography: Life history characteristics section). Brood sizes (n = 17) from throughout British Columbia averaged 2.47 young (Campbell et al. 1990), but this number is difficult to interpret given that brood sizes were checked at varying (random) dates during the nesting cycle.

**Parental care**

The egg-laying interval is apparently 24 hours (Leonard 2001), with one 4-egg clutch laid over a period of five days (Steeger and Machmer 1996). Both parents develop brood patches before the nest cavity is completed (Bendire 1895) and incubate (Short 1974, Leonard 2001). Males typically incubate the clutch at night, with both sexes taking shifts during the day. Both sexes feed the young, but females decrease their feeding frequency in the late nestling stage (Leonard 2001). After fledging, the young remain in the vicinity of the nest (for at least a few days), and the parents apparently divide the brood.

**Demography**

**Genetic characteristics and concerns**

Aside from the mtDNA work of Zink et al. (2002), there has been no genetic work focused on American three-toed woodpecker. As this species is relatively sedentary and occurs in a naturally fragmented habitat in the southern Rocky Mountains, a geographic mosaic pattern of genetic diversity might be expected (due to restricted gene flow). However, Zink et al. (2002) found no such pattern within their (limited) samples from North America (see the discussion in the Biology and Ecology: Systematics section). On the regional scale, it would be interesting to know if the relatively isolated population in the Black Hills has diverged from those in the southern Rocky Mountains, and whether the small population size (or a founder event) in the Black Hills has led to decreased genetic diversity there.

**Life history characteristics**

There is no information available on age-related differences in survival or reproduction in American three-toed woodpecker. They are assumed to begin reproducing in their second year (Leonard 2001). The

---

**Table 8. Characteristics of American three-toed woodpecker nest sites in western North America.**

<table>
<thead>
<tr>
<th>Region</th>
<th>N</th>
<th>Nest tree characteristics</th>
<th>Height (m)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Columbia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Okanagan Valley</td>
<td>6</td>
<td>live aspen, western larch dead stubs (birch, Engelmann spruce,</td>
<td>0.7 - 12.3 (mean = 4.7)</td>
<td>Cannings et al. 1987</td>
</tr>
<tr>
<td></td>
<td></td>
<td>western larch)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>British Columbia</td>
<td>25</td>
<td>dying or decayed trees; lodgepole pine, western larch, Douglas-fir,</td>
<td>7.9</td>
<td>Steeger and Dulisse 1997a, Steeger and Dulisse 2001</td>
</tr>
<tr>
<td>Southeast</td>
<td></td>
<td>western red cedar, and trembling aspen.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southeast</td>
<td>12</td>
<td>recently dead (10) or older snags (2); subalpine fir</td>
<td>—</td>
<td>Klenner and Huggard 1997</td>
</tr>
<tr>
<td>Washington</td>
<td>2</td>
<td>old stub, live larch</td>
<td>7.6</td>
<td>Jewett et al. 1953</td>
</tr>
<tr>
<td>Idaho</td>
<td>2</td>
<td>fir stubs</td>
<td>2.7</td>
<td>Burleigh 1971</td>
</tr>
<tr>
<td>Oregon</td>
<td></td>
<td></td>
<td>23.1</td>
<td>Goggans et al. 1988</td>
</tr>
<tr>
<td>South Dakota</td>
<td>1</td>
<td>dead part of a live spruce</td>
<td>3.9</td>
<td>Pettingill and Whitney 1965</td>
</tr>
<tr>
<td>Black Hills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colorado</td>
<td>4</td>
<td>aspen stub, Engelmann spruce, lodgepole pine, dead Engelmann spruce</td>
<td>1.5 - 2.7 (mean = 2.1)</td>
<td>Bailey and Niedrach 1965</td>
</tr>
<tr>
<td>Colorado</td>
<td>1</td>
<td>dead aspen</td>
<td>1.5</td>
<td>Aiken and Warren 1914</td>
</tr>
<tr>
<td>New Mexico</td>
<td>2</td>
<td>spruce, yellow pine</td>
<td>6.8</td>
<td>Bailey 1928</td>
</tr>
</tbody>
</table>

---

**Table 8. Characteristics of American three-toed woodpecker nest sites in western North America.**

<table>
<thead>
<tr>
<th>Region</th>
<th>N</th>
<th>Nest tree characteristics</th>
<th>Height (m)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Columbia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Okanagan Valley</td>
<td>6</td>
<td>live aspen, western larch dead stubs (birch, Engelmann spruce,</td>
<td>0.7 - 12.3 (mean = 4.7)</td>
<td>Cannings et al. 1987</td>
</tr>
<tr>
<td></td>
<td></td>
<td>western larch)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>British Columbia</td>
<td>25</td>
<td>dying or decayed trees; lodgepole pine, western larch, Douglas-fir,</td>
<td>7.9</td>
<td>Steeger and Dulisse 1997a, Steeger and Dulisse 2001</td>
</tr>
<tr>
<td>Southeast</td>
<td></td>
<td>western red cedar, and trembling aspen.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southeast</td>
<td>12</td>
<td>recently dead (10) or older snags (2); subalpine fir</td>
<td>—</td>
<td>Klenner and Huggard 1997</td>
</tr>
<tr>
<td>Washington</td>
<td>2</td>
<td>old stub, live larch</td>
<td>7.6</td>
<td>Jewett et al. 1953</td>
</tr>
<tr>
<td>Idaho</td>
<td>2</td>
<td>fir stubs</td>
<td>2.7</td>
<td>Burleigh 1971</td>
</tr>
<tr>
<td>Oregon</td>
<td></td>
<td></td>
<td>23.1</td>
<td>Goggans et al. 1988</td>
</tr>
<tr>
<td>South Dakota</td>
<td>1</td>
<td>dead part of a live spruce</td>
<td>3.9</td>
<td>Pettingill and Whitney 1965</td>
</tr>
<tr>
<td>Black Hills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colorado</td>
<td>4</td>
<td>aspen stub, Engelmann spruce, lodgepole pine, dead Engelmann spruce</td>
<td>1.5 - 2.7 (mean = 2.1)</td>
<td>Bailey and Niedrach 1965</td>
</tr>
<tr>
<td>Colorado</td>
<td>1</td>
<td>dead aspen</td>
<td>1.5</td>
<td>Aiken and Warren 1914</td>
</tr>
<tr>
<td>New Mexico</td>
<td>2</td>
<td>spruce, yellow pine</td>
<td>6.8</td>
<td>Bailey 1928</td>
</tr>
</tbody>
</table>
only information available on philopatry is of a first time breeder found nesting 250 m from its natal site (Steeger and Dulisse 1997b). Information on immigration and emigration from breeding areas is scant. Among closely related *Picoides tridactylus* in Europe, a six-year study showed that individuals typically bred at sites 300 to 500 m from the previous year’s site (Leonard 2001). Thus, from the limited information available, it appears that natal and adult philopatry is relatively strong. If so, then gene flow among isolated populations is probably relatively low. There is also no information available on the existence or percentage of non-breeding floaters in the population.

Given the paucity of data on life-history characteristics for American three-toed woodpecker, analyses of life cycle diagrams and associated demographic matrices (Caswell 1989, McDonald and Caswell 1993) were not carried out in this review. While such analyses can provide valuable insights into which life-history stages may be most critical to population growth, constructing models based on incomplete and/or poor data is not warranted (Reed et al. 2002). Not surprisingly, no Population Viability Analyses have been published for American three-toed woodpecker.

In British Columbia, Steeger and Dulisse (1997a) reported 75 percent hatching success of all eggs laid (n = 7 clutches), but only 13 percent fledging success at nests (n = 6) with known outcomes. The poor fledging success was attributed to relatively cold, wet weather during the nestling period, and/or to intensive logging of lodgepole pine (the primary foraging substrate) in the immediate vicinity of nesting trees. Goggans et al. (1988) reported a 53 percent success rate (young at or near fledging) for nests in Oregon. Again, poor success was attributed to nearby logging and consequent effects on the food supply; all nests (n = 15) that failed during incubation were located in logged areas.

**Territoriality and home ranges**

There is little information on territoriality by American three-toed woodpecker during the breeding and wintering seasons. Gibbon (1966) noted American three-toed woodpecker defending the immediate area around nests from other woodpecker species. In Norway, closely related *Picoides tridactylus* breeding pairs used (minimum) areas of 11, 17, and 19 ha, but whether these areas were actively defended or not was not reported (Hogstad 1977). Several studies have documented a partitioning of the breeding territory by males and females (Leonard 2001). In keeping with the species’ low abundance, territories are often non-abutting. However, Bent (1939) noted that nests may be found in close proximity within disturbed forest stands with abundant food resources.

Data on home ranges are also scant. Goggans et al. (1988) followed three American three-toed woodpecker and found summer home ranges of 304, 142, and 53 ha. However, these were considered to be minimum estimates, as home range size continued to increase with increasing data collection. Steeger and Dulisse (1997b) tracked one female American three-toed woodpecker during winter and found a home range of 31.2 ha. Klenner and Huggard (1997) radio-tagged four breeding American three-toed woodpecker in British Columbia and found that birds generally foraged within an area of 1 km$^2$ around their nests sites but that they sometimes flew several kilometers away to feed in nearby areas. As in many other species of birds, variation in American three-toed woodpecker home range size is likely significantly affected by food resources, with smaller home ranges in areas with plentiful food. Clearly, more data need to be collected on home range size in American three-toed woodpecker.

**Factors limiting population growth**

Breeding habitat availability is likely the primary factor limiting population growth in American three-toed woodpecker. Breeding habitat in Region 2 is fragmented because of natural (e.g., variation in elevation) and human-induced (e.g., logging) causes. In addition, fire suppression over the past century (see Threats: Fire suppression section) has reduced the extent of wildfires (Figure 3) and thereby may have limited population growth in American three-toed woodpecker by reducing the number and size of beetle outbreaks. Fire suppression would most strongly affect wood-boring beetles and those species of bark beetles that depend on dead or dying trees. Fire suppression may also limit dispersal of young and adults by eliminating potential “corridor” habitats between breeding areas. Reproductive success appears to depend on abundant local food resources, and active logging in the vicinity of American three-toed woodpecker nests has been shown to reduce reproductive success (see Demography: Life history characteristics section).

There is considerable evidence that the diet specialization of American three-toed woodpecker has a profound impact on their population densities. In areas of scolytid outbreaks, local significant increases in American three-toed woodpecker populations have been noted (Bent 1939, Yeager 1955, Koplin 1969, Bull et al. 1986). These increases are particularly
dramatic during the winter months, but they may also occur during the breeding season, typically in areas where large fires have killed and/or damaged extensive areas of forest (for a summary of density studies, see Table 2 in Leonard 2001). As mentioned elsewhere in this assessment, there remains a need for data on the population density and success of breeding woodpeckers at disturbed sites. Such data will allow for a better understanding of the role of old-growth and disturbed habitats in determining American three-toed woodpecker population viability.

Community ecology

Predators and competitors

Leonard (2001) summarized the scant data available on predators of American three-toed woodpecker. Both young and adult American three-toed woodpecker are likely taken by Northern goshawks (Accipiter gentilis; Squires 2000). Bailey (1928) reported a black bear (Ursus americanus) attempting to claw into a low nest in a lodgepole pine, but such predation is likely rare. As with other hole-nesting birds, American three-toed woodpecker may be susceptible to mammalian (e.g., squirrel, marten) predation of the nest contents (i.e., eggs and young) (Alerstam and Högstedt 1981, Greenwood 1985).

American three-toed woodpecker react aggressively towards (dominant) black-backed woodpeckers during the breeding season (Short 1974), but the extent to which they may directly compete for nest sites, territories, and food resources is unknown. Gibbon (1966) reported interspecific aggression with other woodpecker species near American three-toed woodpecker nests in New Brunswick. However, in Oregon, Goggans et al. (1988) observed no aggressive
interactions between foraging American three-toed woodpecker and a number of other woodpecker species. Thus, the limited available evidence suggests that aggressive interspecific interactions with other woodpecker species are limited to areas in the immediate vicinity of the nest site and do not normally occur over food resources.

Parasites and disease

There have been no systematic studies of parasites or disease among American three-toed woodpecker, and thus few data are available. Haas and Wilson (1984) report two species of fleas (Ornithophaga anomala and Ceratophyllus adustus) from American three-toed woodpecker nests in Alaska. Bent (1939) reported a nest in Arizona that contained “maggots” on the nest floor – an observation that suggests the possibility of blow flies (Protocalliphora), which are common parasites of hole-nesting birds.

Interactions between American three-toed woodpecker, their competitors, and their environment are summarized in Figure 4. The primary nesting and foraging habitat for American three-toed woodpecker in Region 2 is old-growth spruce-fir and lodgepole pine (Versaw 1998, Dorn and Dorn 1999). The primary resource in such forests is large dead and dying conifers, which provide suitable substrates for various forms of beetles (e.g., scolytids, cerambycids, buprestids). Dead and dying trees also provide the principal substrate for American three-toed woodpecker nests, although live trees are also commonly used. Natural disturbances produce conditions that are conducive to beetle outbreaks. For example, drought stress may weaken the ability of trees to defend against attacks by bark beetles, thus leading to beetle population outbreaks and significant tree mortality. Such mortality can lead to fuel build-up and increased chances of forest fires. Fire and windthrow leave dead and dying trees that harbor large numbers of wood-boring beetles. Areas with bark and wood-boring beetle outbreaks are typically exploited by American three-toed woodpecker, either for foraging in fall and winter, or for breeding.

As mentioned earlier, American three-toed woodpecker may react aggressively towards black-backed woodpeckers, especially near nest sites (Short 1974). Observations in Oregon provided no evidence of aggression among foraging American three-toed woodpecker, black-backed woodpeckers, hairy woodpeckers (Picoides villosus), Northern flickers (Colaptes auritus), or sapsuckers (Sphyrapicus spp.; Goggans et al. 1988). Northern goshawks are likely the most important predator of American three-toed woodpecker, as there is considerable habitat overlap between the two species in Region 2.

CONSERVATION

Threats

With a relatively large home range and a close association with old-growth conifer forests, American three-toed woodpeckers are sensitive to forest harvesting and fragmentation (Leonard 2001). The harvesting of old-growth coniferous forests in North America has likely contributed to local American three-toed woodpecker population declines (Hunter 1992, Hagan et al. 1997, Imbeau et al. 1999). Recent modeling work by Imbeau et al. (2001) indicated that of all the birds breeding in the boreal forests of eastern Canada, American three-toed and black-backed woodpeckers faced the most threats from current forestry practices. These threats included direct loss of and fragmentation of old-growth forest, limitation of natural tree death and decay, and logging of recently burned stands. American three-toed woodpeckers are susceptible as they are tightly linked to areas of old-growth forest, which are preferred for logging, they prefer to forage on dead and dying trees, which are often cut in active logging areas; and they show a strong, albeit short-term, attraction to recently burned stands, which have become increasingly rare due to fire suppression policy.

In Region 2, a significant proportion of American three-toed woodpecker habitat is on federal land, and management decisions within the USDA Forest Service will likely play a key role in determining American three-toed woodpecker population viability. Isolated populations, such as those in the Black Hills, would benefit from close monitoring, as extirpation of such populations may be difficult to reverse given the sedentary nature of the species.

The principal threats to the species in Region 2 (and elsewhere) are:

1) Logging of old-growth forest – Populations in other areas of the species’ range have undergone drastic reductions or even local extinction due to excessive (e.g., 300,000 hectares per year in Quebec; Imbeau et al. 2001) harvesting of old-growth forest. Such logging eliminates and/or fragments the primary foraging/breeding habitat of American three-toed woodpecker. The
Figure 4. Envirogram representing the web of linkages between American three-toed woodpeckers and the ecosystem in which they occur. The linkages were derived from a synthesis of the published studies reported in this assessment.
extent to which logging of old growth forests currently presents a problem (both locally and regionally) for American three-toed woodpecker in Region 2 is unclear, but recent data (Figure 5) suggest a decline in the total number of logged (in some form) acres of spruce-fir and lodgepole pine in Region 2 National Forests. In fact, only a few of the forest units within Region 2 performed any logging of spruce-fir forests during the 1991-2000 period (Region 2 SILVA unpublished. data). Mapping and linking spatial variation in logging activity with American three-toed woodpecker range and abundance would allow for an assessment of whether (and how) logging activities may be impacting American three-toed woodpecker. For example, limited data from both British Columbia and Oregon suggest that American three-toed woodpecker breeding success is negatively affected by local logging activities (Steeger and Dulisse 1997a, Goggans et al. 1988). Although some broad-scale data are currently available on American three-toed woodpecker distribution in Colorado (Versaw 1998), data collection within a more restricted area (e.g., within a single National Forest unit) would allow for a better understanding of the effects of logging activities on American three-toed woodpecker.

Old-growth spruce-fir habitat appears to represent the core breeding and feeding area for the species, and although they sometimes will wander to neighboring areas to forage, they are highly dependent on mature forests. Consequently, in Region 2, the maintenance of local and regional American three-toed woodpecker population viability will likely be positively correlated with the extent of old-growth spruce-fir forests. Currently, data on the exact size and shape requirements necessary to support American three-toed woodpecker home ranges are not available. In addition, there is a lack of information on how much core home range old-growth forest is necessary to support viable populations. This is an area that is a critical source of information for land managers and
is consequently in need of further research (see Information Needs section).

2) **Fire suppression** – Aside from the core old-growth forests, an important but ephemeral habitat for American three-toed woodpecker is recently burned forest. Several studies (e.g., Koplin 1969) have noted significant increases in American three-toed woodpecker abundance in areas of recently (within 1 to 3 years) burned forest. Recently burned forests provide the optimal substrate for wood-boring beetle infestations and also provide vast numbers of dead/dying trees that may become American three-toed woodpecker nest sites. Hutto (1995) has suggested that declines in American three-toed woodpecker populations are correlated with widespread fire suppression practices that have reduced the size and frequency of burns. Although suppression of forest fires is common practice in Region 2, it is most aggressive in lower elevation pine forests, such as ponderosa pine, where most residential development occurs. The extent to which fire-suppression has impacted higher-elevation spruce-fir and lodgepole pine habitats is less clear. Fires in spruce-fir forests are typically large-scale stand-replacement fires, occurring relatively rarely during periods of drought. Aside from observations of increased abundance of American three-toed woodpecker at burned sites, detailed studies of the short and long-term impacts of local fires on American three-toed woodpecker populations are lacking. For example, the extent to which American three-toed woodpecker may benefit from large vs. small-scale fires is unclear (see Information Needs section). In addition, it remains unclear to what extent and for how long American three-toed woodpecker will abandon their “normal” breeding habitats (e.g., spruce-fir, lodgepole pine) to breed near new burns or bark beetle outbreaks in nearby habitats (e.g., ponderosa pine, aspen). If such behavior by American three-toed woodpecker is common with Region 2, then fire suppression policy may be having a larger effect than is currently assumed.
3) **Salvage and suppression logging (of burned/infested trees)** – Suppression logging is typically carried out to slow the rate and spread of bark beetle infestations (Samman and Logan 2000). Salvage logging may also be used for the same function, but it is typically aimed at extracting economically viable timber from recently burned/windthrown or beetle infested areas. In both cases, logging is normally carried out within two years of the burn, before trees are heavily affected by beetle attacks and desiccation. There is now considerable evidence that salvage and suppression logging in western forests may reduce the local abundance of American three-toed woodpecker (Hitchcox 1996, Hoffman 1997, Hoyt and Hannon 2002). Hoyt and Hannon (2002) suggested that post-burn salvage and suppression logging in boreal forests of Alberta may significantly reduce the local numbers of American three-toed woodpecker, especially 1 to 2 years following burns when such stands are most attractive to American three-toed woodpecker. They also noted that the effects of salvage logging would be relatively greater in smaller burns, where extraction of viable trees is more easily accomplished. Within national forests in Region 2, salvage/suppression logging in spruce-fir habitat is relatively rare (Figure 5; B. Short personal communication 2003), but the extent to which such logging may affect American three-toed woodpecker populations in other forest types (e.g., lower elevation) is unknown.

While there is a good data set on the frequency of historical fires for many areas in the western United States, there is less information on historical (long-term) patterns of bark beetle infestations. Recent data from Region 2 (e.g., www.fs.fed.us/database/feis) suggest an increase in the prevalence and size of forest patches damaged by bark and wood-boring beetles and other forest insects. While there is evidence that certain forestry practices (e.g., stand thinning) can significantly increase bark beetle abundance and alter their reproductive behavior (Hindmarch and Reid 2001a,b), the question of whether there has been a change in overall infestation levels remains unclear. In addition, there is conflicting evidence on the effects of thinning on the abundance of beetles within managed forests (Mitchell et al. 1983, Hindmarch and Reid 1999).

4) **Short logging rotations** – Short logging rotations, whereby forests are cut prior to reaching old growth or “over mature” stages, eliminate American three-toed woodpecker nesting and foraging habitat and may lead to significantly reduced American three-toed woodpecker abundance, or even local extirpation. Although it is a common forest management practice to reduce the natural preponderance of old-growth forest while increasing the percentage of younger stands (see Figure 2 in Imbeau et al. 2001), this does not appear to be a problem under current forest management practices in Region 2 where spruce-fir and lodgepole pine forests are now only rarely logged (Figure 5; B. Short personal communication 2003). Short logging rotations are most likely to be a problem in smaller, isolated patches of habitat, such as that in the Black Hills National Forest where limited logging of spruce-fir and lodgepole pine still occurs on a routine basis (Region 2 SILVA data). For a longer term perspective on the effects of logging rotations on American three-toed woodpecker habitat, a 30 to 50 year historical comparison of stand age structures would help to clarify whether forest management has led to a decrease in old-growth spruce-fir and lodgepole pine forest in Region 2.

**Conservation Status of the American Three-toed Woodpecker in Region 2**

American three-toed woodpecker are currently not considered threatened within Region 2, although the population in the Black Hills is relatively small (South Dakota Ornithologists’ Union 1991; A. Panjabi personal communication 2003). Because this species is difficult to detect using typical avian census methods (e.g., BBS routes along roads), it is difficult to assess whether populations have increased or decreased over the past century. Versaw (1998) suggested that in Colorado, American three-toed woodpecker populations are likely at historically average densities in unburned forests, but that sporadic population increases correlated with fires are no longer as prevalent as they were historically, due to fire-suppression policies. While several of the regional BBS data sets show large annual declines in American three-toed woodpecker
abundance since 1980 (e.g., -12.6 percent/year in Colorado, -11.4 percent/year in the southern Rockies; Sauer et al. 2004), the data sets are so small that the statistical power linked to these tests is very low. In areas like Region 2, where there is concern over potential declines in American three-toed woodpecker abundance, there is clearly a need for dedicated surveys for American three-toed woodpecker.

From the data currently available, there are no indications that predation, competition, or natural disturbances (e.g., drought) are having significant adverse effects on American three-toed woodpecker populations in Region 2. Rather, habitat loss and degradation appear to be the primary threats to American three-toed woodpecker population viability. Logging activity within spruce-fir and lodgepole pine forests in Region 2 national forests has declined in recent years (Figure 5) to levels that do not appear to pose a significant threat to American three-toed woodpecker. Nonetheless, monitoring the status of American three-toed woodpecker populations, especially in the Black Hills where logging is most common and where the American three-toed woodpecker population is relatively isolated, remains warranted given the species’ low abundance and sensitivity to logging.

In addition to old-growth forests, disturbed (e.g., fire, beetle outbreaks, windthrow) forests also represent an important habitat for American three-toed woodpecker. Disturbed forests often attract high densities of woodpeckers, and American three-toed woodpecker may exploit such areas for several years post-disturbance. On national forest lands, the extent of fire and beetle outbreaks is often reduced by fire and insect suppression activities (e.g., fire suppression, salvage logging, forest thinning). While these forest management activities may pose a threat to potential American three-toed woodpecker habitat, the data currently available suggest that fires and beetle outbreaks continue to occur on a regular basis throughout Region 2. Nonetheless, from a forest management perspective, a balanced view of the potential benefits of natural disturbances may help to create improved conditions for American three-toed woodpecker.

An insightful approach to American three-toed woodpecker conservation would be to link changes in the species’ abundance to changes in the extent and health of, as well as the fire history within, old growth spruce-fir forests in Region 2. As mentioned elsewhere in this assessment, this approach would best be carried out at the local scale, for example within a single national forest unit with a known logging history and with a tractable American three-toed woodpecker population. Of particularly critical importance is the degree to which American three-toed woodpecker may show shifts in nesting habitat choice as a result of local burns or insect infestations. As an example, if American three-toed woodpecker shift nesting locations to lower elevation habitats (e.g., ponderosa pine) in response to beetle infestations, then fire suppression practices within ponderosa pine (and other forest types) may be having a more significant impact than is currently realized.

Management of the American Three-toed Woodpecker in Region 2

Implications and potential conservation elements

As noted above, the information currently available suggests that current levels of old-growth spruce-fir and lodgepole pine forest, as well as various sources of disturbance (wildfire, beetle outbreaks, windthrow), are sufficient to support viable populations of American three-toed woodpecker in Region 2. However, this conclusion can best be viewed as tentative, as the available data on American three-toed woodpecker population trends are not statistically robust. Within any of the Region 2 forest units, relatively large (1 km$^2$) areas of mature and old-growth spruce-fir and lodgepole pine forest are likely to support American three-toed woodpecker populations.

An ideal landscape matrix to support viable populations of American three-toed woodpecker would be comprised of primarily old-growth spruce-fir and/or lodgepole pine, supplemented (at least occasionally) with areas of disturbed forest. While old-growth spruce-fir and lodgepole pine forests appear to support the majority of American three-toed woodpecker populations in Region 2, areas of burned, windthrown, and beetle infested forest may contribute significantly to population viability by providing abundant food and thereby (temporarily) increased adult and juvenile survival. The critical mix of habitat elements that appear necessary to support viable American three-toed woodpecker populations are:

- large, unfragmented blocks of old-growth spruce-fir and lodgepole pine forest
- an abundance of dead, dying, and diseased trees to supply suitable nest sites and foraging substrates. These typically will be found in old-growth forest under natural conditions but could be artificially induced
when necessary (e.g., during periods of any noticeable American three-toed woodpecker population declines).

- occasional disturbances (e.g., fire, beetle outbreaks) to high and mid-elevation conifer forests

Forest management practices currently include logging (on a small scale) as well as fire and insect suppression activities. Suppression activities in Region 2 appear to have reduced the extent but not the frequency of fires and insect outbreaks, and thus they have likely had minimal impacts on American three-toed woodpecker populations. Logging (especially clear-cut and salvage) has the potential to more seriously affect American three-toed woodpecker populations, as it removes critical foraging and nesting habitats for long periods of time. Consequently, the most important conservation element for American three-toed woodpecker in Region 2 is continuation of the current low level of logging of old-growth spruce-fir and lodgepole pine (Figure 5).

Imbeau et al. (2001) analyzed threats posed by modern forestry practices (e.g., habitat fragmentation, prioritization of old-growth and recently burned stands for logging) to (Canadian) boreal forest birds and concluded that American three-toed woodpecker and black-backed woodpeckers were the species whose population viability were most threatened. Imbeau et al. (1999, 2001) suggested that two alterations of forest management practices would greatly benefit American three-toed woodpecker. First, standard land management policy should allow for large, unlogged areas of mature conifer forest within managed landscapes. These areas would act as core (or “source” in metapopulation terms) sites within an otherwise fragmented habitat. Second, forestry practices should include a mixed fire suppression policy (whereby some fires are allowed to burn), an easing of existing suppression and salvage logging practices, and an increase in the length of logging rotations to allow for over-maturation of some stands. Unpublished graduate theses from the northern Rockies suggest that salvage logging (Hitchcox 1996, Hoffman 1997) and clear-cutting (Caton 1996) had significant negative effects on American three-toed woodpecker abundance.

Habitat management recommendations for American three-toed woodpecker based upon Partners in Flight state Bird Conservation Plans are summarized in Table 9. Ideally, a regional management plan for American three-toed woodpecker would be preceded by and based upon an analysis of the following information: 1) a robust data set on American three-toed woodpecker abundance, distribution, and reproductive success in Region 2, and 2) a data set (collected during the same period as the data in point 1) on the proportion of old-growth spruce-fir forest, the frequency and extent of fires in high elevation conifer habitats, and records of the extent of suppression and salvage logging in such habitats.

Tools and practices

**Inventory and monitoring of populations and habitat**

**Species inventory/population monitoring.** American three-toed woodpecker are difficult to census because they occur sparsely at naturally low densities in remote, dense conifer forests and are relatively quiet and unobtrusive. Consequently, passive point counts or line transects may not be sufficient to accurately census American three-toed woodpecker. Imbeau and Desrochers (2002) located American three-toed woodpecker with playbacks of drumming and calling at intervals of at least 1 km. This technique should probably be modified such that playbacks occur at 0.5 km intervals in appropriate habitat. Annual census work would ideally be carried out in the early breeding season, when adults are most responsive to playbacks, and in the morning, when birds respond more aggressively to conspecific calls (Goggans et al. 1988).

At the regional level, an American three-toed woodpecker population monitoring plan would ideally include standardized inventories for American three-toed woodpecker in the Black Hills (isolated population) and in as many of the National Forest units as possible. Conducting inventories in early May under relatively mild weather conditions (i.e., avoiding rain and high winds) would provide the best results. Monitoring in a range of habitats, including undisturbed mature and old-growth conifer forest as well as similar forests exposed to various silvicultural treatments and/or natural disturbances, would provide a broad-based picture of American three-toed woodpecker population status. It would be particularly instructive to carry out paired inventories within each forest, one in unmanipulated “control” areas, and another in a nearby area that was scheduled for forest management (e.g., thinning). Such an inventory protocol would allow for within and among forest unit comparisons. Details on sampling protocols and woodpecker inventory methods in general (including variants for different survey goals, and statistical analysis) have been produced by...
Table 9. A summary of published management recommendations for American three-toed woodpeckers (TTW) within Partners in Flight state Bird Conservation Plans. Region 2 state is in bold.

<table>
<thead>
<tr>
<th>State</th>
<th>Recommendations</th>
<th>Presumed benefits</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nevada</td>
<td>Maintain Engelmann spruce stands with a diversity of age classes and active decadence promoting an increase in snag density.</td>
<td>Preserve nesting and foraging habitat.</td>
<td>Neel 1999</td>
</tr>
<tr>
<td></td>
<td>Determine the range, status and trend of TTW in Nevada.</td>
<td>Determine distribution and changes in population size.</td>
<td></td>
</tr>
<tr>
<td>Montana</td>
<td>Avoid intense logging practices in TTW habitats.</td>
<td>Avoid habitat destruction.</td>
<td>Casey 2000</td>
</tr>
<tr>
<td></td>
<td>Salvage logging operations should be eliminated or decreased in frequency.</td>
<td>Improve foraging/nesting habitat.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allow forests to reach “over-mature” stages.</td>
<td>Improve foraging/nesting habitat.</td>
<td></td>
</tr>
<tr>
<td>Utah</td>
<td>Leave burned forest intact for 3-5 years after stand replacement.</td>
<td>Improve foraging habitat.</td>
<td>Parrish et al. 2002</td>
</tr>
<tr>
<td></td>
<td>In salvage areas, leaves clumps of snags rather than isolated trees.</td>
<td>Reduce negative effects of logging.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Snags with bark and trees with heartrot should be available.</td>
<td>Provide nesting sites.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maintain old-growth aspen patches.</td>
<td>Provide nesting sites.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Establish large (214 hectares or 528 acres) management areas where salvage logging and commercial harvest are not permitted.</td>
<td>Establish long-term core population areas.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allow fires to burn in areas where possible.</td>
<td>Improve foraging habitat.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interpret insect infestations at the landscape scale and not in terms of the loss of wood fiber on individual sites.</td>
<td>Improve foraging habitat.</td>
<td></td>
</tr>
<tr>
<td>Arizona</td>
<td>Maintain key habitat components in Engelmann spruce and subalpine fir forests including snags &gt;12 inches dbh for nesting, and trees averaging a dbh of 25 inches for foraging.</td>
<td>Improve foraging/nesting habitat.</td>
<td>Latta et al. 1999</td>
</tr>
<tr>
<td></td>
<td>Maintain patches of 75+ acres of diseased or burned areas.</td>
<td>Maintain foraging patches.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allow some fires (e.g. lightning strikes) in spruce-fir, mixed conifer and ponderosa pine to burn, especially in wilderness areas.</td>
<td>Improve foraging habitat.</td>
<td></td>
</tr>
</tbody>
</table>

the British Columbia Environment Ministry (British Columbia Environment Ministry 1999).

A suggested Region-wide inventory scheme is presented in Table 10. While these sampling techniques have been used previously in other parts of American three-toed woodpecker range, the intensity of sampling necessary to adequately survey a particular area will vary according to habitat structure and woodpecker abundance. Consequently, these suggestions should be viewed as a working outline to be modified according to local conditions.

Population monitoring supplemented with efforts to locate and monitor nest sites would provide a more accurate picture of breeding season distribution of American three-toed woodpecker. There is currently little information on variation in breeding season habitat choice in the southern Rocky Mountains. In addition, data on reproductive success over a range of habitats...
Table 10. Region-wide species inventory and local population monitoring recommendations for American three-toed woodpeckers (TTW).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surveys</strong></td>
<td>Call and drum playback to determine presence/absence and/or relative abundance</td>
</tr>
<tr>
<td>Survey type</td>
<td>Once during early breeding season (typically mid-May)</td>
</tr>
<tr>
<td>Sampling frequency</td>
<td>Call and drum playbacks at 0.5 km intervals along 5 to 10 km routes</td>
</tr>
<tr>
<td>Sampling protocol</td>
<td>Playbacks in good weather (no steady rain) from 0600 to 1100</td>
</tr>
<tr>
<td></td>
<td>Four playback transects within each forest tract sampled</td>
</tr>
<tr>
<td></td>
<td>Four forest tracts (ideally differing slightly in structure/composition/management) sampled per forest unit</td>
</tr>
<tr>
<td><strong>Population monitoring</strong></td>
<td>Follow steps above to locate breeding pairs in early May</td>
</tr>
<tr>
<td></td>
<td>Follow up with intensive nest searches in areas where presence noted</td>
</tr>
<tr>
<td></td>
<td>Use nest “peeper” (fiber optic camera) to monitor nest contents</td>
</tr>
<tr>
<td></td>
<td>Quantify clutch size, clutch initiation date, hatching date, fledging date and fledging success</td>
</tr>
<tr>
<td></td>
<td>If possible, band adults and young at nest site (band adults when young are ca. 1 week old)</td>
</tr>
<tr>
<td></td>
<td>Collect local habitat variables (see BC Environment Ministry 1999) for correlation with American three-toed woodpecker demographic traits</td>
</tr>
</tbody>
</table>

and years would allow for a greater understanding of the factors affecting local and regional population dynamics. This is a key piece of knowledge that is lacking and thereby hampering efforts to construct conservation plans. Specifically, data are needed on timing of breeding, clutch size, hatching and fledging success, nest predation, and dispersal of adults and young. Nest searches would best be carried out within a week of species inventory playbacks in areas where American three-toed woodpecker were heard or where they were attracted to playbacks.

**Habitat inventory/monitoring.** There are no existing protocols for carrying out habitat inventories or monitoring specifically for American three-toed woodpecker. Habitat inventory and monitoring work should ideally identify the following factors (ranked in relative importance): 1) extent and spatial configuration of old-growth spruce-fir and lodgepole pine forests; 2) abundance of and degree of decay of dead and dying trees within the stand (see Figure 6 and transect methods in British Columbia Environment Ministry 1999); 3) location and extent of bark and wood-boring beetle infestations; and 4) location and extent of recently burned stands. As both fire and insect infestations can vary dramatically from year to year, points 3 and 4 above would ideally be carried out on an annual basis. It should be noted that, at least on the broad scale, data on wildfire and insect infestations are already being collected by the USDA Forest Service and other federal agencies within Region 2.

Taken together, population inventories and habitat monitoring schemes could provide valuable cues to the current and potential health of American three-toed woodpecker populations. The steps outlined above suggest the following data should be collected:

- Establish regular (e.g., bi-annual) monitoring of local American three-toed woodpecker populations using the techniques outlined in the Species inventory/population monitoring section above.
- Develop and maintain inventories (including digital maps) of old-growth spruce-fir and lodgepole pine forest, together with the American three-toed woodpecker population estimates derived from step 1.
- Develop and maintain digital databases on the location and extent of forest fires, beetle outbreaks, windthrow, and avalanche-damaged trees.
- Use information from steps 1 through 3 to assist in developing population and habitat management strategies (see below).

**Population or habitat management approaches**

A lack of critical data on American three-toed woodpecker population demography makes it difficult to formulate a population management strategy. Once data on survivorship, breeding success (including variation in different habitat types), and dispersal have been gathered, a coherent population management approach would become feasible. To date, the approach taken by
Figure 6. Decay classifications for conifer (upper) and deciduous (lower) trees, as presented in surveying techniques for woodpeckers in British Columbia (see British Columbia Environment Ministry 1999).
most American three-toed woodpecker conservation efforts (e.g., Partners in Flight state Bird Conservation Plans) has been to develop habitat management plans, with the understanding that providing suitable habitats for American three-toed woodpecker will lead to viable local populations. Given the lack of demographic data on American three-toed woodpecker, this represents a reasonable approach.

Several Partners in Flight state plans have considered American three-toed woodpecker, and their habitat recommendations are summarized in Table 9. These recommendations could act as core considerations for any future management efforts for American three-toed woodpecker. All of these suggestions have stressed the importance of a less aggressive fire suppression policy, as well as a relaxation of intensive suppression and salvage logging in western forests. The primary rationale for these recommendations is the positive correlation observed between local American three-toed woodpecker abundance and recent fires or bark beetle infestations. Logging practices that eliminate or minimize old growth forests are also singled out as detrimental to American three-toed woodpecker, as this forest type represents the core habitat for the species.

When spruce-fir forests are thinned by logging (whether for harvest or for suppression/salvage purposes), strategies that promote uneven-aged stands (i.e., retaining patches that contain a mix of young, mature and decaying trees) are likely to provide continued foraging and nesting sites for American three-toed woodpecker. Snags and decayed mature trees are best retained within patches of trees rather than in isolation, as they thereby offer better foraging and nesting substrate and are less disposed to windthrow. In addition, logging that targets individual trees rather than the removal of groups of trees would provide better canopy closure and improved conditions for American three-toed woodpecker.

Managing logged spruce-fir forest to create uneven-aged stands may also show benefits in reducing the frequency and intensity of spruce beetle outbreaks. Spruce beetle infestations are difficult to prevent due to the beetle’s short generation time and rapid spread. However, uneven-aged stands may decrease the spread of beetles by creating patches of relatively unsuitable habitat. Although spruce beetle infestations are difficult to halt once started, their effects may be lessened (and some patches may be spared) by varying the age-structure within spruce-fir stands.

As in many other areas of this assessment, there is currently a lack of suitable data on American three-toed woodpecker population response to forest management practices. This is particularly true at the landscape level, where the size and quality of suitable habitat patches necessary to support viable American three-toed woodpecker populations remain unknown. This represents a critical lack of information, as land managers are faced with uncertainty regarding the effects of their actions on American three-toed woodpecker populations. In particular, the following information is lacking:

- to what extent does fragmentation of suitable habitat lead to habitat abandonment, lowered American three-toed woodpecker reproductive success, hampered dispersal, and thereby increase the chances of local extirpation?
- can American three-toed woodpecker populations persist on landscapes where forest disturbances (e.g., fire, beetle outbreaks) have been reduced to a minimum level?
- how do American three-toed woodpecker respond to stand-replacement fires in spruce-fir forests?

Until such data have been collected, forming an integrated Regional/landscape/local management plan will be exceedingly difficult (see Information Needs section). However, as mentioned elsewhere in this assessment, American three-toed woodpecker are currently found on all National Forest units within Region 2 and do not appear threatened due to forestry management activities. The most critical land management activity that can be carried out to support viable American three-toed woodpecker populations is to maintain current levels of old-growth spruce-fir and lodgepole pine habitat. Maintenance of this core habitat should allow for stable populations while critical demographic and habitat data are collected. These data can then be used to develop the comprehensive population and habitat management approaches that were a primary goal of this assessment.

**Information Needs**

The primary information needed for the successful conservation of American three-toed woodpecker is
a better understanding of habitat use and its relation to local population viability. Thus far, information on habitat use has largely come from studies in boreal forests and in wet forests of the Pacific Northwest. For Region 2, further data are needed on how American three-toed woodpecker utilize old-growth spruce-fir and lodgepole pine, as well as other forest types. In particular, the degree to which American three-toed woodpecker use disturbed (burned, beetle infested) forests for foraging and nesting, and how successful such nesting attempts are would give a better understanding of the role of forest disturbance in regulating local populations of woodpeckers.

The other primary information need is how landscape configuration affects population viability. Studies relating local population density and reproductive success to variation in the size, shape, and distribution of suitable habitat would provide valuable information to land managers. Currently, there is little information available on how territory size fluctuates within different habitat types, how patch size and shape affect territoriality, and how patch connectivity influences dispersal of adults and young. Once these parameters are better understood, the effects of forest management practices on woodpecker ecology could then be related to such baseline data.

At present there is little information available on the response of American three-toed woodpecker to fine and broad scale changes in habitat characteristics. This applies to human-induced changes (e.g., forestry practices) and to natural disturbances such as wildfire and beetle outbreaks. Throughout this assessment reference has been made to American three-toed woodpecker utilizing recently burned forests as well as forests that have undergone some form of damage and subsequent beetle infestation. However, there are no data available on how such temporal habitat patches affect local American three-toed woodpecker population viability. Consequently, the most critical information need is to determine how local American three-toed woodpecker populations respond to habitat changes (e.g., burns, beetle outbreaks). For example, a long-term (5 year) study within several national forest units, incorporating undisturbed spruce-fir or lodgepole pine forest as well as disturbed areas would provide a wealth of information. In particular, breeding density, reproductive success, dispersal, and survival in disturbed versus undisturbed habitats would allow for an evaluation of how habitat disturbances (and some forest management practices) may affect regional populations of American three-toed woodpecker. In addition, the long-term value of disturbed habitats has not been studied in Region 2. Elsewhere in the species’ range, disturbed habitats decline in suitability from approximately three years post-disturbance. Similar data from Region 2 would provide a better understanding of how and for how long disturbed habitats influence local population dynamics.

The effect of logging of old-growth forest is also in need of further research. Although it is clear that large-scale clear-cutting of old-growth leads to the local extirpation of American three-toed woodpecker, it is not clear how the species responds to smaller-scale clear-cutting and thinning of old-growth. Recent work has shown that salvage and suppression logging may reduce local numbers of American three-toed woodpecker. However, whether these activities induce mortality (e.g., through decreased food supply) or emigration remains unknown. Further information on short and long-term movements in response to natural and human disturbances is therefore needed.

It is known that wood-boring beetles and some species of bark beetles typically respond positively to natural disturbances (e.g., fire, windthrow); local beetle abundance typically increases dramatically after such events, at least for the first one to three years. However, the direct and indirect effects of the various logging practices used in modern forestry on local beetle abundance and life histories need further investigation. As mentioned previously, there is emerging evidence that current forestry practices may have significant unintentional impacts on beetle life histories (e.g., an increase in local abundance after forest thinning; Hindmarch and Reid 2001a). Whereas the literature on the effects of forestry practices on American three-toed woodpecker ecology typically assumes direct suppression of beetle abundance (e.g., through suppression logging), there is a clear need to investigate what effects the various logging practices have on local beetle abundance and diversity.

The demography of American three-toed woodpecker is currently poorly understood. There are only scattered measures of breeding success, very little information on survival and dispersal, and virtually no data on changes in reproduction with age, seasonal patterns of reproductive success, patterns of breeding site fidelity and natal philopatry, or differences in breeding biology before/after local fires/beetle outbreaks. Such data could be gathered as part of a larger study of the species’ response to local habitat changes (see above) and would be particularly valuable in situations where populations are isolated and thus more prone to local extirpation, like that of the Black...
Hills National Forest. Demographic data that would provide particularly valuable information include local population density and spatial organization, clutch size, timing of breeding, reproductive success, dispersal, and survival.

Another problem in assessing the conservation status of American three-toed woodpecker in Region 2 is a lack of knowledge of the species’ current and historical status. Available population monitoring tools (e.g., BBS, CBC) do not adequately sample for American three-toed woodpecker. Survey methodology has not been developed for American three-toed woodpecker in Region 2, where the species inhabits high-altitude conifer forests, occurs at relatively low density, and is relatively unobtrusive. Preliminary surveys using the methods described in Table 10 would be a good starting point from which to develop population monitoring protocols for American three-toed woodpecker in Region 2.

Although a number of foraging studies of American three-toed woodpecker have been performed, there remains little information on foraging ecology within Region 2. Such data are critical, given that habitat choice likely varies geographically. Detailed behavioral observations during foraging bouts would ideally include the tree species used as a foraging substrate, the health of the tree (e.g., burned, decay class, beetle infested), the sex of the foraging bird, the amount of time spent on each tree, as well as seasonal patterns of foraging tree choice.
REFERENCES


Bailey, F.M. 1928. Birds of New Mexico. New Mexico Department of Game and Fish, Santa Fe, NM.


Bendire, C. 1895. Life histories of North American birds: from the parrots to the grackles. Smithsonian Institution Special Bulletin No. 3.


Knight, W.C. 1902. The birds of Wyoming. University of Wyoming Agricultural Experiment Station Bulletin Number 55, Laramie, WY.


South Dakota Ornithologists’ Union. 1991. The birds of South Dakota. 2nd ed. South Dakota Ornithologists’ Union, Aberdeen, SD.


Steeger, C. and M. Machmer. 1996. Pilot project to investigate the ecology of Three-toed Woodpeckers and their role as biological control agents of bark beetles in interior forests of British Columbia. Science Council of British Columbia, Ref. no. FR-95/96-98.


The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA’s TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, DC 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.