

wider variety of oak (*i.e.*, Oregon white oak, tanoak (*Lithocarpus densifloris*), Sadler oak (*Quercus sadleriana*), canyon live oak (*Quercus chrysolepis*), California black oak (*Quercus kelloggii*), valley oak (*Quercus lobata*) and pine species (*i.e.*, sugar pine (*Pinus lambertiana*), Jeffrey pine (*Pinus jeffreyi*), lodgepole pine (*Pinus contorta*)) than are available to western gray squirrels in the Puget Trough of Washington (Carraway and Verts 1994; Marshall *et al.* 1996).

In California, the western gray squirrel is dependent on mature stands of conifer and oak habitats and is closely associated with oaks (CDFG 1990). Oak species in western gray squirrel habitat in California include valley oak (*Quercus lobata*), blue oak (*Quercus douglasii*), California black oak, interior live oak (*Quercus wislizenii*), and scrub oak (*Quercus dumosa*). In addition to Douglas-fir and ponderosa pine, other tree species in California western gray squirrel habitats include Fremont cottonwood (*Populus fremontii*), digger pine (*Pinus sabiniana*), white fir (*Abies concolor*), sugar pine, giant sequoia (*Sequoiadendron giganteum*), redwood (*Sequoia sempervirens*), and eucalyptus (*Eucalyptus globulus*) (Carraway and Verts 1994).

Although western gray squirrels consume hypogeous fungi and seeds and nuts of various trees and shrubs, acorns and pine seed may be more critical in the diet because they are high-energy foods needed for overwintering (Ryan and Carey 1995a). In the Puget Trough, acorns are the principal diet from late summer through early spring. Mushrooms and truffles are mostly eaten in spring and fall, and Douglas-fir seed are eaten upon ripening in the late summer through fall. However, mast crops differ each year caused by the depletion of food reserves in a heavy seed year, weather in year of fruiting or previous years, diseases and parasites, and maturation differences among tree groups (Ryan and Carey 1995a). Oak mast production is sporadic and unpredictable, with good mast years occurring only once in 7 to 10 years. During an 8-year study in northern Oregon, there were 4 years with poor Oregon white oak acorn crops. In 1991, there was no acorn crop in the Columbia River Gorge and an insignificant crop in 1992. When ponderosa pine is not available, western gray squirrels also rely on Douglas-fir seed (WDW 1993). However, environmental factors make the Douglas-fir seed crop erratic, and abundant crops are produced sporadically, from 2 to 11 years apart. One crop failure and two or more light

to medium crops usually occur between heavy crops (U.S. Forest Service 1974).

**South Cascades Population.** Although Booth (1947) noted that western gray squirrels were uncommon in the southern part of the Cascade Mountains and more common in Pierce County, the South Cascades population currently is the largest remaining population of western gray squirrels in Washington. The western gray squirrel appears to be widely distributed across Klickitat County, but the populations are localized. Western gray squirrels remain along the Klickitat River and Catherine, Major, and Rock Creeks (WDW 1993). Between 1994 and 1996, systematic field surveys to delineate western gray squirrel distribution in the Columbia River Gorge documented the presence of individuals or their sign (*e.g.*, nests) in 22 watershed administrative units. Surveys were conducted in parts of 275-square mi (712-square km) sections containing suitable western gray squirrel habitat; their presence was recorded in 61 percent of these sections (M. Linders, pers. comm. 2003d).

Based on intensive and widespread surveys in Washington from 1994 to 2000, 89 percent (1,642 of 1,847) of all western gray squirrel nests and observations occurred in Klickitat County (D. Brittell, *in litt.* 2002). Eighty-three percent (514 of 618) of the occupied survey blocks had nest locations alone, and 10 percent (59 of 618) of the survey units had both western gray squirrels and their nests. The 7 percent (45 of 618) of the survey units having western gray squirrels with no known nest locations may have represented dispersal or breeding movements. Nest-only sites likely had associated western gray squirrels. Because nests persist for several years, however, a die-off would be difficult to detect (D. Brittell, *in litt.* 2002). More recent information is limited to forest practice surveys and random encounters. Residents noticed a decline of western gray squirrels in Klickitat County, particularly following introduction of California (Beechey's) ground squirrels (*Spermophilus beecheyi*) (Rodrick 1987; WDW 1993).

Statewide surveys from 1994 to 2002 established that most observations of western gray squirrels and their nests occurred in Klickitat County (M. Linders, pers. comm. 2003c). Surveys in 2000 and 2001 on the Klickitat Wildlife Area documented density estimates of 0.08–0.13 western gray squirrels/ha and a more recent estimate for western gray squirrels in this area was slightly higher (0.1–0.2 squirrels/ha) (M. Linders, pers. comm. 2003b). Density estimates for western gray squirrels in California

ranged from 1.37/ha in the spring in Lake County to 2.47/ha in the Yosemite Valley (Grinnell and Storer 1924). There are no density estimates for western gray squirrels in Oregon or Nevada.

Booth (1947) described the western gray squirrel as uncommon in the southern Cascade Mountains. In Yakima County, western gray squirrels were abundant in the Ahtanum and Cowiche Creek drainages, and less common along Oak Creek prior to the 1950s. A mange epidemic in the 1940s and 1950s decimated western gray squirrel populations (Stream 1993). Western gray squirrels may have been extirpated from the Oak Creek Management Area following a severe mange epidemic in the 1940s and 1950s; a reintroduction attempt in the area, using western gray squirrels from Oregon, was not successful (WDW 1993).

Little is known about western gray squirrels on the Yakama Indian Nation Reservation. Between 1995 and 1998, the Yakama Indian Nation conducted limited surveys across the reservation. Small nest clusters, scattered individual western gray squirrels, and negative surveys were reported (D. Brittell, *in litt.* 2002).

**North Cascades Population.** The North Cascades population has received the least attention of the three Washington populations; no population or trend data, including density estimates, are available. There were no systematic attempts to delineate the distribution of western gray squirrels in the North Cascades prior to 1995. During 1995 surveys by WDFW on the west side of the Methow Valley of Okanogan County, 21 western gray squirrels (including 3 killed by automobiles) and 2 nests were observed. In 1996, 22 western gray squirrels, including roadkills, and 89 nests were observed. No western gray squirrels were observed during surveys of the east side of the Methow Valley in 1997. When interviewed, residents of the upper Methow Valley believed that numbers of western gray squirrels were declining, but residents of the lower Methow Valley thought the populations had been stable over the past 15 to 30 years (M. Linders, pers. comm. 2003d).

In 2000, surveys of all areas previously known to have western gray squirrel nests detected only 3 remnants out of the 89 nests recorded in a 1996 survey (M. Linders, pers. comm. 2003d). Eighteen previously unreported nests were documented and four western gray squirrels were observed. Relocating individual nests, however, can be difficult without detailed mapping and marking (Vander Haegen *et al.* 2003). Also, western gray squirrels build and