Conservation Report
Summer 2004
By Mike Marsh, WNPS Conservation Committee

The Shrub-Steppe Working Group, an informal associatioin of working ecologists and interested lay people, organized a symposium at the Northwest Scientific Association's annual meeting in Ellensburg on March 26, 2004. I am preparing two reports on the shrub-steppe sessions. This report describes important aspects of the endangered shrub-steppe habitat of eastern Washington and its animal occupants, and shows how they are changed by invasion of cheatgrass, and by fire. A second installment in a subsequent issue of *Douglasia* will consider methods being tried to identify and restore native lands overun by cheatgrass or other aliens, or which have lost shrub cover.

Steppe refers to a treeless plain. The shrub-steppe of eastern Washington and Oregon's Columbia Basin includes several bunchgrass plant associations, united by the presence of a shrub overstory, usually Wyoming big sagebrush, *Artemisia tridentata*. The community occurs in an arid climate with winter rainfall amounting to between 6-8 amd 14 inches.

The majority of the land originally occupied by shrub-steppe has been converted to agriculture or residential and industrial development. Much of the remaining has been invaded by an exotic grass, downy brome (*Bromus tectorum*), and fires have caused extensive losses of shrub cover. Recognition of these problems has led studies of the remaining examples of the plant associations represented and of their animal inhabitants to determine their interrelationships more clearly. Attempts to restore damaged examples of the community types represented are also underway.

Introduction of cheatgrass to the shrub-steppe

Many studies in this area have focused on downy brome, commonly called cheatgrass. Introduced accidentally by Europeans and their domestic livestock in the last decades of the 19th century, it has spread widely in the Columbia Basin and in the Great Basin of Idaho, Nevada and Utah. In a self-perpetuating process, cheat- grass, grazing animals, and fire have altered the character of the shrub-steppe, converting much low-elevation land to an alien landscape in which natives are scarcely represented.

Invasive alien species often arise from stocks that show no such tendencies in their homeland. The question—"What made the difference?"—is an obvious one. Several authors have suggested that differences in the new habitat, such as an absence of biological enemies, are responsible. Cecilia Lynn Kinter, now at the University of Wyoming, wondered if genetic differences between cheatgrass plants from their native range and those introduced into the new habitat were important. Individuals in a population vary in their genetic makeup. If a new population starts from a very few individuals, it is likely that the so-called "founder effect" will be very important. Only a small sample of the genes in the parent population are present in the founders of the new one. Is it a fair sample, or are some characteristics over- or under-represented?

There are a variety of sites in the Old World where cheatgrass is not even a frequent component of the vegetation. It was introduced in the South Island of New Zealand and persists there, but is not invasive, although Kinter found it in sites very similar to those where it is invasive in eastern Washington. Washington State University (WSU) research workers had sampled extensively in central Europe for possible sources of US founders. They had also sampled at locations in the United States where it was thought that founders began their New World experience. Kinter's group at WSU decided to look at phenotypic differences between plants at the different sites they visited, and they did some genetic tests to see whether the phenotypes were genetically based.

Kinter raised a generation from seed to reduce maternal effects. They raised plants from these seeds in greenhouses, using potting soil. They found that North American populations were highest in most of 18 measures taken, such as height, leaf width, and weight. European plants were intermediate, and New Zealand plants ranked lowest in most of these factors throughout growth period. North American populations were much more efficient in water use: they suffered only 1/3 as much mortality in

a low water treatment as the New Zealand and European plants. They also had higher nitrogen levels Most interesting to Kinter, the North American plants flowered earlier than the others.

The New World populations have narrower genetic variability than European plants, but they fall within the range of variation of the European populations. Kinter still cannot offer a solid reason for the greater success of the New World plants.

Wildfire

Among the most troubling aspects of cheatgrass invasions is that cheatgrass dries early in the spring and it is quite flammable. By occurring in a continuous carpet rather than in discrete bunches, it propagates fires over long distances. Historical studies find that both the frequency of fires and their extent have increased since cheatgrass invaded the Columbia Basin.

Jim Evans described changes he found in the abundance of cheatgrass over a three-year period following a large wildfire on the Hanford Reach National Monument in June, 2000. His work has been funded under a cooperative agreement between The Nature Conservancy and the U.S. Fish and Wildlife Service. The fire swept over 164,000 acres, including much of the 77,000 acre Fitzner Eberhardt Arid Lands Ecology Reserve. Intensity of the burn varied, with greater damage where sagebrush stands existed prior to the fire. Woody fuels make a hotter fire, and there was greater loss of perennial natives on a site which supported a stand of big sagebrush before the fire.

Evans reported that cheatgrass abundance declined sharply just after the fire, but recovered rapidly in the sec ond year except in former big sagebrush stands on sandy soils, where cheatgrass abundance was still reduced three years after the fire. Density increased by 900% after the fire, and in the best sites, with natives, cheatgrass density continued to increase in 2003. Frequency (the propor tion of plots in which cheatgrass was found) was greater in 2003 than before the fire. The temporary reduction of cheatgrass abundance in the year after a fire offers a window of opportunity (on silt-loam sites) to reintroduce natives with minimal competition from cheatgrass.

A number of factors seem to mediate the abundance and invasiveness of cheatgrass. It was abundant below 1,400 feet both before and after fire. Higher-elevation sites receive more moisture and support a greater cover of native species, and the highest had periods of persistent snow cover, which is unfavorable for winter annuals like cheatgrass. Some authors feel that higher native plant cover confers some resistance to invasive species. Steep slopes, which are unfavorable for animal and human use, may have been less disturbed historically.

Soil crust

Lichenologist Roger Rosentreter described the benefits of biological soil crust, the thin layer of lichens, mosses and bluegreen algae which cover the soil in undisturbed bunchgrass steppe. Soil crust provides a living mulch, and improves water infiltration and soil water retention. It prevents wind erosion and, compared to most light-colored dry soils, it absorbs and traps more solar heat. It promotes carbon fixation and in the case of many black lichens, promotes nitrogen fixation. The best parent materials for crust development are silty soils from sedimentary rock, and stable exposed rock. Sand and flat soil pavements are the worst scenarios.

There is a close relationship between the presence of soil crust and of native bunchgrass vegetation. The more intact the biological crust, the less cheatgrass you get. Soil crust apparently prevents cheatgrass from germinating. In California, *Bromus rubens*, a related Old-World grass invader, is almost completely prevented from germinating on crust.

Native bunchgrasses trap snow and the spaces between bunches provide room for birds and other small creatures to walk around. The space between bunches also means that fire does not propagate well in bunchgrass, so that fires started by lightning or other causes remain localized. Rosentreter described soil crusts on rangeland as sacrifice areas, which still are not protected by land managers today. Because of overgrazing and neglect, the Snake River Wildlife Conservation Area now is an ocean of *Bromus tectorum,* burning repeatedly because the cheatgrass is a continuous carpet. Each fire consumes more of the remaining perennial bunchgrasses.

Big sagebrush

Bruce Welch, with the Rocky Mountain Research Station, U.S. Forest Service, attracted a lot of attention with a report based on his recent research paper with Craig riddle, "Countering misinformation concerning big sagebrush?' In their paper, the authors state and then debunk eight axioms held by many range managers. These relate to the "natural" extent of canopy cover before range modification, the presumed negative relationship between sagebrush cover and grass (forage) cover (on the basis of which range managers advocate moving sagebrush from rangeland), its palatability to other organisms, its influence on biodiversity, the degree to which fire has been a part of sagebrush history, its role in allelopathy (any effect of a plant on its surrounding soil which inhibits the establishment of other plants), and its functioning as a highly competitive, dominating, excluding life form.

The commonly held belief that big sagebrush roots exclude grasses and forbs is refuted by actual observations, which show greater cover of grasses and forbs under and near big sagebrush roots. Sago lily, for example, grew taller, and produced more flowers under big sagebrush. At least two research papers found that both grass cover and big sagebrush cover increased during recovery from overgrazing.

Welch questions whether big sagebrush overstory reduces the amount of bunchgrass ("forage") on the land. He measured vegetation cover with a line transect on a site that was scheduled to be burned by Forest Service employees. There was 29% cover of big sagebrush, 74% cover of perennial grasses, and over 20% cover of forbs. Asked if a rancher would raise more or less beef if he didn't clear the sagebush, Welch said that some grasses and forbs are sheltered from grazing by sagebrush, so he might not raise more.

Range managers have written that big sagebrush "normally" or "often" recovers quickly from fire by rapid germination of seedlings, but Welch and Criddle find this unlikely: It has seeds which lack fire resistance or adaptations that favor sprouting after a fire, and its flowering and seed dispersal occur in fall and winter, long after the end of the usual fire season. In field studies of thirteen big sagebrush stands in Idaho after burns, they find little re-establishment 13 and 15 years after a fire (big sagebrush does not re-sprout from roots after a fire), and Welch has found that it takes from 50 to 75 years for shrub cover to recover to pre-burn levels. He stressed the importance of maintaining sagebrush cover for survival of animals which depend on this structure in one way or another.

Insects

Chris Looney described efforts by Washington State University entomologists to collect insects and other in vertebrates on the Hanford Monument. Collecting sites included sagebrush steppe and cheatgrass-dominated lands, sand dunes, and springs. Diverse collecting methods were used. They have collected 100,000 individuals, identified 2,500 species, and obtained phenological information for hundreds of species. Forty-two species are new to science, including nine dipterans (flies and mosquitoes), seven hymenopterans (wasps, bees and ants), four coleopterans (beetles), and twenty lepidopterans (butterflies and moths). Hundreds of species of invertebrates in their collection remain to be identified.

They found some interesting specific associations with diverse habitats and plant species. Beetle species' richness was greatest at springs and lowest on dunes. The greatest number of endemics was found in an ephemeral lake habitat. Twenty-five species of insects were found on balsamroot.

The greatest sharing of species between sage brush and cheatgrass was for carabid beetles. The difference between habitats in numbers of individuals, however, was great, with herbivorous and carnivorous carabids nearly equal in sagebrush, while in cheatgrass there was an enormous dominance of herbivorous insects. As to non-insects, such as spiders, the predaceous species have all but vanished in cheatgrass.

Birds

Matthew Vander Haegen, with the Washington Department of Fish and Wildlife, examined the effects of landscape changes on songbird populations. Rainfall and soil type affect plant communities. Big sagebrush is typically found on deeper soils. Three sagebrush obligates, Brewer's Sparrows, Sage Sparrows and Sage Thrashers, nest in sagebrush (Sage Sparrows and Sage Thrashers also nest under sagebrush on the ground) We

have lost about 50% of our sagebrush habitat in Washington by agricultural and other conversion. The remainder is highly fragmented. In Lincoln County, for example, the deep soils which have good sagebrush, have for the most part been converted into agriculture. Shallow soil communities are much better represented.

Vander Haegen found that birds such as the Sage Sparrow and Sage Thrasher, which are associated with deeper soil communities, have been more seriously affected by habitat fragmentation than other birds such as the Loggerhead Shrike. There were fewer Sage Sparrows in patches of sage smaller than 100 acres, even though they defend territories which are only a small fraction of that. Nestling mortality, too, was significantly higher in fragmented landscapes.

Using artificial nests, Vander Haegen found that small mammals and corvids (magpies, crows and ravens) are nest predators. The intensity of small mammal predation did not differ in continuous and fragmented landscapes, while corvid predation was significantly higher in fragmented landscapes, resulting in lower nest productivity. Brewer's Sparrow males paired and nested with equal frequency in fragmented and continuous landscapes, but significantly fewer young fledged in fragmented landscapes. With the great loss of acreage in the deep soil community, overall reduction of habitat, and the declining condition of extant habitat, Vander Haegen asks, "are sensitive species being lost from the fragments?"

Seeking to "connect the dots' Vander Haegen is currently looking at the role of lands set aside under the Conservation Reserve Program (CRP) of the Natural Resources Conservation Program. The US Department of Agriculture pays farmers to seed previously cropped land in grass species and to keep this land fallow and ungrazed for the period of the contract, usually 10 years. Vander Haegen has selected 48 sites, in three different vegetation types, comparing those with few shrubs to those with many. His third vegetation type is native landscapes, fragmented and unfragmented. He is finding that some CRP land in Douglas County which is adjacent to native steppe land serves as an extension of habitat.

Sagebrush often has seeded naturally into old CRP lands which are near native land, while isolated CRP lands rarely have big sagebrush. The more recent CRP contracts required seeding of young sagebrush and a more varied bunchgrass and forb mixture, so sagebrush is present even in sites that are far from the native lands. Vander Haegen found a lot of birds in CRP land. Those seen in new CRP lands were mainly grassland species such as Meadowlarks, Vesper Sparrows and Horned Larks. Perhaps the lack of sagebrush obligates in these fields, in spite of the fact sagebrush had been planted, reflected the immaturity and small size of the sagebrush plants. In old CRP lands, there were significant numbers of sagebrush obligates, especially in plots next to natural grasslands.

The trouble with reliance on the Conservation Reserve Proram is that it is a fixed term program. After the payments end, the farmer may put that land into agricultural production again, or graze it. Still, CRP, because of its broad extent, is providing more habitat than we could afford to buy with either public or private funds.

A questioner asked Vander Haegen if it is the plant structure, rather than the particular native species that provides habitat for birds. Yes, he said, insectivorous species find food on non-native species as well as on native ones.

Heidi Newsome, with the U.S. Fish and Wildlife Ser e at Hanford Reach National Monument, discussed e effects of large-scale wildfire on shrub grassland feeding birds on the Fitzner-Eberhardt Arid Lands Ecology Reserve (ALE). The wildfire on ALE in summer 2000 consumed all of the sagebrush in study plots. Big sagebrush cover had "recovered" only to 0.2% by 2003 those same stands. It does not re-sprout from roots after a fire. Threetip sagebrush fared a bit better, since it sprouts. Its percent cover on study plots dropped from about 10% pre-fire to less than 2% in 2001 (10 stands) and had recovered to about 4% in 2003.

Bird abundance was measured at 33 points. Ten-minute counts were made between May l and June 15 of all birds seen or heard within 50 meters. The observers found a 3% reduction of Western Meadowlark after the fire. Vesper Sparrows and Grasshopper Sparrows declined significantly (from 1.5 to 0.6 observations per count), Sage Sparrows also declined significantly. Horned Larks apparently increased, but the change was not statistically significant. Lark Sparrows showed a one-year surge in abundance, but numbers have declined to

about their previous level. Newsome, replying to a question, said that there had been no increase in Black-billed Magpie numbers after the fire.

In summary

The reports summarized here indicate the pervasive presence of cheatgrass in the shrub-steppe, and its ability to spread after a fire. They show how continuous cheat- grass cover mediates more extensive spread of fires, and how woody sagebrush fuel mediates a hotter fire with greater damage to perennial herbs. The effects of loss of shrub vegetation on bird life were documented as well.

The Oxford English Dictionary cites Busching, a geographer who wrote in 1762: “The steppe, or wide desert plain of Astracan, . . . is a dreary waste.” Washington’s shrub-steppe, with its abundance of showy flowering forbs, is far from being a dreary waste, and it urgently needs our care and protection.