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U.S. DEPARTMENT OF AGRICULTURE

Rocky Mountain Region / Black Hills National Forest

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Black Hills National Forest

Revised Forest Assessment:

Insects, Disease, and Invasive Species

Black Hills aerial photo of mountain pine beetle impacts, 2009 (photo credit USDA Forest Service).

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Chapter 1. Introduction

The Black Hills National Forest is managed by the United States Forest Service, an agency of the U.S. Department of Agriculture (USDA). The mission of the Forest Service is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations. The National Forest Management Act requires all national forests to develop a land and resource management plan (forest plan) to guide management actions and decisions. The current forest plan for the Black Hills National Forest was approved in 1997. Substantial plan amendments were last approved in March 2006, and relatively minor amendments occurred through 2018. The National Forest Management Act requires forest plans be periodically updated. In order to revise the current forest plan, the Forest Service has identified and evaluated existing information about relevant ecological, economic, and social conditions, trends, and sustainability—and how those conditions relate to management direction in the forest plan. This assessment documents that work regarding the current status of insects, disease, and invasive species in the Black Hills National Forest.

Overview

Insects, disease, and invasive species are all disturbance agents that play an integral part in the Black Hills National Forest ecosystem and help produce heterogeneity throughout the forest system. It is important to understand these disturbances so land managers can make informed management decisions based on disturbance history and prevalence to improve forest health.

Insects and Disease

Insects play an important role in pollinating plants, recycling nutrients, decomposing, vegetating, and providing food for wildlife. Several insects and diseases significantly influence the structure and composition of the forests (Thom et al. 2020).

Tree mortality and other impacts of insects and diseases regulate forest vegetation composition, influence stand density and structure, provide wildlife habitat in dead and dying trees, and contribute nutrients to soils. Insects are also food for birds and other wildlife. While insects and disease can have positive impacts on forest ecosystems, they can also negatively affect the forest. For example, at low infestation levels, individual trees are weakened and killed, resulting in small-scale changes affecting limited areas. Trees weakened by one organism are often susceptible to attacks by other organisms. When conditions such as stand maturity, overcrowding, drought, blowdown, or poor site conditions act independently or in combination to stress large groups or stands of trees, populations of forest insects and pathogens can increase in these stressed trees, resulting in widespread mortality ("outbreaks").

Invasive Species

The 2012 Planning Rule, Executive Order 13112, and Executive Order 13751 all define invasive species as alien species whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health. For this document invasives species includes both terrestrial plants and aquatic nuisance species.

Aquatic nuisance species are organisms that disrupt the ecological stability of infested inland (e.g., rivers and lakes), estuarine, or marine waters. Beyond doing ecological damage, the infestation may impair the recreational, commercial, and agricultural uses of the water body. They are defined as nonindigenous species that threaten the diversity or abundance of native species, the ecological stability of infested waters, or commercial, agricultural, aquacultural, or recreational activities dependent on such waters. The

Black Hills National Forest has developed an Aquatic Nuisance Species Action Plan (USDA Forest Service 2014a). The overall strategy for aquatic nuisance species management is to work closely with state and county resource agencies and other partners to provide a well-coordinated effort for the early detection of aquatic nuisance species in a cost-effective manner.

In this assessment, the terms invasive plants and weeds will include non-native plants and noxious weeds. The term "noxious weed" refers to a legally defined category of non-native invasive plants. Federal and State governments define noxious weed as follows:

- The Federal Government, in the Plant Protection Act of 2000, defines noxious weeds as any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment.
- South Dakota State Statute 38-22-1.2 defines a weed as a plant deemed detrimental to crop or livestock production or the welfare of state residents. Administrative rule 12:62:02 defines noxious weed as a weed which the commission has designated as sufficiently detrimental to the state to warrant enforcement of control measures.
- Wyoming State Statute 11-5-102 defines a designated noxious weed as a plant species that is detrimental to the general health and welfare of the state because it can aggressively invade plant communities and crops, is injurious to livestock, can carry disease or parasites, and can negatively impact the management of agriculture or natural systems.

Invasive plants have the potential to alter the ecosystem by displacing native plants, causing undesirable, irreversible changes. According to Sieg et al. (2003), invasive plants can displace native plants, cross with native flora, alter nutrient cycling and other ecosystem functions, and even change flammability of an ecosystem.

The decision document for the first environmental assessment for treating noxious weeds in the Black Hills National Forest was signed in 1980. The Forest Service had been treating undesirable vegetation previously, but that is the first known environmental assessment and associated decision document. The 1980 plan called for treating 12,617 acres using a combination of biological, chemical, mechanical, and fire treatments. In 2003 a new environmental assessment was completed for the currently used Noxious Weed Management Plan (USDA Forest Service 2003), which incorporates integrated weed management methods and prevention practices. The weed management plan includes a variety of ground-based herbicide application methods but does not allow for aerial application of herbicides.

Invasive species action plans for the Black Hills National Forest are developed as strategic tools for implementing the invasives species management program; the latest action plan was updated in 2018 (USDA Forest Service 2018). The action plans do not replace the Noxious Weed Management Plan, but rather outline ways to strategically implement the plan across the forest by identifying priority species, priority treatment areas, organizational capacity, funding opportunities, and specific coordination with partners.

The forest plan was amended in 2005 to include additional management direction related to noxious weeds and non-native pests. In the intervening years, this has been broadened to include aquatic nuisance species on National Forest System lands.

Best Available Scientific Information

This assessment was informed by a variety of data and information including:

- A Scenario Based Assessment to Inform Sustainable Ponderosa Pine Timber Harvest in the Black Hills National Forest,
- Black Hills Mountain Pine Beetle Strategy Collaborative Accomplishments Report,

- Region 2 Aerial Detection Survey Data,
- Black Hills National Forest Watershed Condition Classification,
- Ecology, Silviculture, and Management of the Black Hills Ponderosa Pine,
- Black Hills National Forest 1997 Land and Resource Management Plan, as amended,
- Black Hills National Forest Land and Resource Management Plan Monitoring and Evaluation Reports,
- Final Environmental Impact Statement for the Black Hills National Forest Phase II Amendment,
- Black Hills National Forest Invasive Species Action Plan FY 2018-2020, and
- Black Hills National Forest Aquatic Nuisance Species Action Plan FY 2014-2016.

Data Gaps Identified

- Comprehensive invasive species surveys of the Black Hills National Forest.
- Comprehensive studies on disease specific to the Black Hills National Forest.
- Comprehensive studies on insect species other than the mountain pine beetle specific to the Black Hills National Forest.
- The Watershed Condition Framework cited in this document uses data from 2010, updates are needed.

Chapter 2. Insect, Disease, and Invasive Species Stressors

Stressors are defined by the FSH 1909.12-Land Management Planning handbook as, "…factors may directly or indirectly degrade or impair ecosystem composition, structure, or ecological process in a manner that may impair its ecological integrity… loss of connectivity, or the disruption of a natural disturbance regime." While insects and disease are not always continuous stressors on the ecosystem as a whole, they do have the potential to become major stressors. Invasive plants can be continuous stressors on the ecosystem as they do not have natural control agents in the ecosystem in which they are considered invasive.

Insects and Disease

Currently, the insects and diseases having the most significant impact in the Black Hills National Forest are mountain pine beetle (*Dendroctonus ponderosae*), Armillaria root disease (*Armillaria ostoyae*), and occasionally the pine engraver beetle (*Ips pini*). While white nose syndrome has not yet made a significant impact on bat populations in the Black Hills National Forest, but it has been detected near Jewel Cave National Monument and has the potential to cause major declines in bat colonies in the Black Hills National Forest.

The mountain pine beetle is native to western North America and is also called the Black Hills beetle or the Rocky Mountain pine beetle. This native species is part of the Black Hills ecosystem, and the forest is subject to periodic epidemics (Thom et al. 2020). The mountain pine beetle primarily develops in pines such as lodgepole, ponderosa, scotch, and limber pines, and less commonly affects bristlecone and pinon pines (Leatherman et al. 2011). Their life cycle lasts one year. Concentrated mass attacks by many beetles are common. The first recorded epidemic, which was reported in the late 1890s and continued through the early 1900s, killed about 90 percent of the merchantable timber in the plan area that required large-scale reforestation efforts to replace (Thom et al. 2020, Custer County 2008). The mountain pine beetle has

periodic outbreaks approximately every 20 years, with the most recent occurring from approximately 1996 through 2016. Approximately 8,631,500 ponderosa pine mortalities were attributed to the most recent mountain pine beetle outbreak (maps in appendix A) (Graham et al. 2021).

Armillaria is a root disease that can either kill trees by attacking the cambium and inner bark, causing decay over time, or by stressing trees thereby predisposing them to attacks by insects and pathogens. Armillaria also has a propensity to reside in trunks of trees for several decades. This has resulted in a positive correlation between stands where silvicultural treatment has occurred and increased Armillaria infection. Increased infection results from soil disturbance associated with such treatments, which splits Armillaria and causes them to grow new tips and increases the likelihood of tree infections. This is especially problematic in areas experiencing new growth due to regeneration (such as areas recently affected by the mountain pine beetle) because new growth does not have the vigor to resist armillaria, red rot, needle cast, western gall rust, and other pathogens (Sheppard and Battaglia 2002, Graham et al. 2021).

The pine engraver beetle or ips beetle is also native to the Black Hills and attacks pine trees. Although it is similar to the mountain pine beetle, its life cycle and management recommendations are different. Pine engraver beetles breed in windthrown ponderosa pine trees, trees damaged by wind and snow, and logging slash greater than 2 inches in diameter (Sheppard and Battaglia 2002). During times of drought, pine engravers have been known to cause high mortality in unthinned young stands (Sheppard and Battaglia 2002). For updated reports of ips beetle occurrences, check the most recent forest health protection report.

White nose syndrome is a fungal disease caused by *Pseudogymnoascus destructans* in bats that was first observed in the United States in 2006. The fungus grows on the muzzle, wings, and other soft tissues of bats. Since 2006, it has killed millions of bats in both the United States and Canada and continues to spread. *P. destructans* is a cold-loving fungus originally native to Europe or Asia and lives in cave environments. Infection with the fungus disrupts bats' natural hibernation cycles during winter months, causing them to fly outside during the day when food resources are not available, resulting in death and the decline of colonies. White nose syndrome was documented in a bat caught in the Black Hills National Forest in 2018 near Jewel Cave National Monument. (U.S. Fish and Wildlife Service 2021).

Invasive Species

Invasive species in the Black Hills National Forest include an entire suite of non-native invasive plants, as well as aquatic nuisance species.

At the time of the Phase II forest plan amendment, there were an estimated 100,000 acres of invasive plant infestations in the Black Hills (USDA Forest Service 2005b). By 2018 the estimate was over 372,000 acres. Some of that increase may be due to better inventory methods, but it is clear (as stated in the 2018 action plan, USDA Forest Service 2018) *we are losing significant ground each year to invasive species*.

Every activity that occurs in the Black Hills National Forest has the potential to contribute to the spread and establishment of invasive plants. Ground-disturbing activities such as timber management, fuel treatments, mining, road construction and maintenance, off-road vehicle traffic, wildfire, and prescribed fire create a seedbed for invasive plants. While less disturbing activities such as dispersed recreation, grazing (by livestock and wildlife), traffic on forest roads, etc., act as vectors to transport and spread invasive plant seed or plant parts.

The currently known infested acres, by species, as recorded in the Forest Service Activity Tracking System database, are listed in table 1. Because many of the species are co-mingled on any given acre, the total acres infested by each species does not necessarily equal the total acres infested in the forest. Species accounts for all species known to occur in the forest (table 1) are available in appendix B.

Table 1. Known infestations of invasive weed species in the Black Hills National Forest

Common Name	Scientific Name	Acres Infested
Black henbane	*Hyoscyamus niger*	952
Brown knapweed	*Centaurea jacea*	80
Canada thistle	*Cirsium arvense*	203,483
Common mullein	*Verbascum thapsus*	40,256
Common tansy [P]	*Tanacetum vulgare*	12,687
Dalmatian toadflax	*Linaria genistifolia*	443
Diffuse knapweed	*Centaurea diffusa*	13
Houndstongue	*Cynoglossum officinale*	86,179
Leafy spurge [P]	*Euphorbia esula*	21,547
Musk thistle	*Carduus nutans*	60,230
Orange hawkweed	*Hieracium aurantiacum,*	5
Oxeye daisy [P]	*Leucanthemum vulgare*	5,612
Russian knapweed	*Centaurea repens*	1
Salt cedar	*Tamarix ramosissima*	32
Spotted knapweed [P]	*Centaurea maculosa*	5,377
St. Johnswort [P]	*Hypericum perforatum*	9,800
Sulfur cinquefoil	*Potentilla recta*	2,500
Tall buttercup	*Ranunculus acris*	1,000
Whitetop/Hoary cress	*Cardaria draba*	79
Yellow toadflax [P]	*Linaria vulgaris*	18,005

[P] indicates high-priority species for the Black Hills National Forest.

The Black Hills National Forest is an active member of the Black Hills Invasive Plant Partnership (BHIPP), an organization of agencies and individuals who have an interest in working cooperatively to manage invasive plants in the local area. While all noxious weeds are targeted for treatment, budget and workforce constraints require identifying priority species and locations for treatment. BHIPP identifies priority management species for the area (taken from the state-listed noxious weed species); the BHIPP priority list is the basis for identifying priority species for treatment in the Black Hills National Forest.

The BHIPP criteria for high-priority management include moderate population sizes within the region, feasibility of containing the species, the species' ability to establish dominance in plant communities, the species ability to spread rapidly, and the species' capability of invading a variety of healthy ecosystems. The current BHIPP Invasive Plant Priority Management List is available in appendix B.

The current priority management species for the Black Hills National Forest are leafy spurge (*Euphorbia esula*), yellow toadflax (*Lineria vulgaris*), spotted knapweed (*Centaurea maculosa*), oxeye daisy (*Chrysanthemum leucantheman*), common tansy (*Tanacetum vulgare*), and St. Johnswort (*Hypericum perforatum*). Species-specific details are available in the species accounts in appendix B.

The amended forest plan has an objective to treat at least 8,000 acres of invasive plants annually (objective 231), but the amount treated is restricted by the availability of funding. The acres of invasive plants treated from 2003 through 2022 (USDA Forest Service 2018 and Forest Service Activity Tracking System database) is shown in figure 1. The steady decrease in acres treated is directly related to available funding. For example in 2006 the forest was funded to treat over 15,000 acres, while in 2018 the funding received was enough to treat just over 3,000 acres. During that same time period an increase in recreation

(particularly off-road vehicle traffic), large-scale logging activities and wildland fires considerably exacerbated the weed issues (USDA Forest Service 2018). The forest currently accomplishes weed treatments through contract, cooperative agreements with all six counties, as well as in-house.

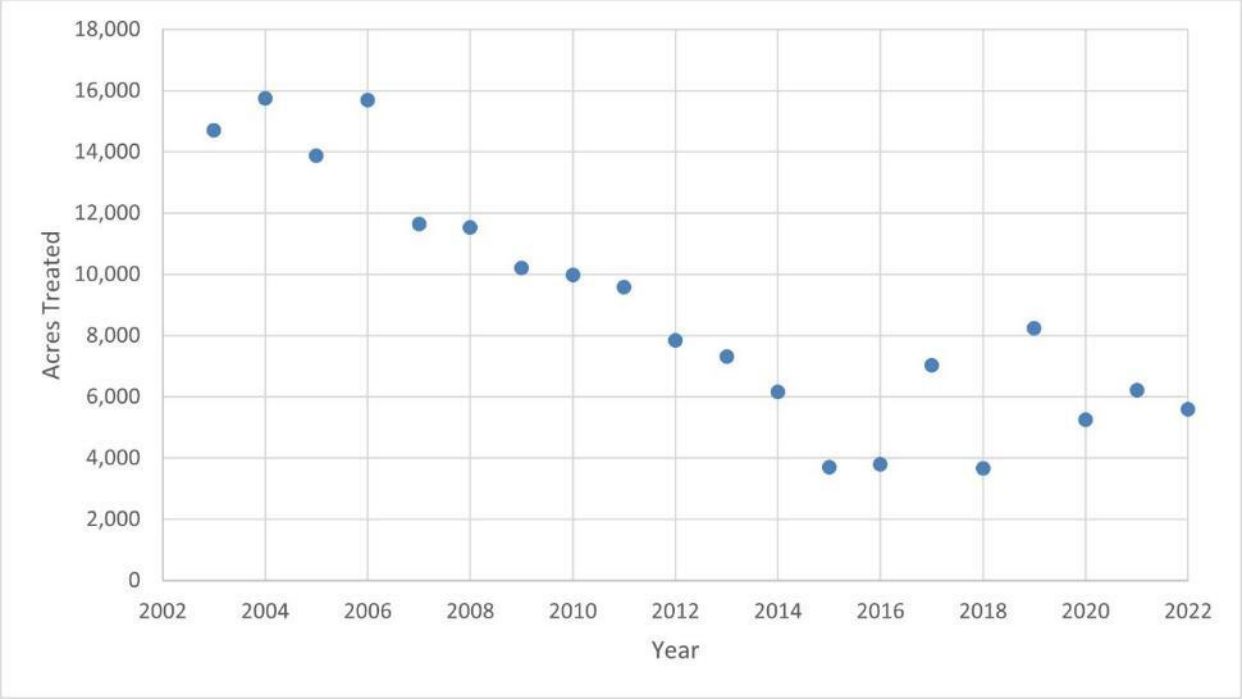

Figure 1. Acreage of invasive plant species treated from 2003 through 2022

Several isolated populations of aquatic nuisance species currently exist in the Forest and the potential for new introductions is an ongoing threat. The aquatic nuisance species action plan (USDA Forest Service 2014a) identifies species that are currently present in the Black Hills National Forest in addition to species that have the potential to occur and assigns priority to each (table 2).

Table 2. Aquatic nuisance species currently occurring in the Black Hills National Forest and those with the potential to occur

Name	Total Occurrences (miles or acres)	Location of Occurrence	Priority Level
Didymo *Didymosphenia geminata*	21 miles	Rapid Creek, Castle Creek	High
Zebra and Quagga mussels *Dreissena* spp.		Detected in Lake Pactola, Suspected in Angostura Reservoir	High
Chytrid fungus *Batrachochytrium dendrobatidis*	11 sites	Solomon Gulch Pond, Pactola Reservoir, Victoria Creek Pond, Reder Pond, Slate Creek Pond, Newton Fork Pond, Willow Springs, Reno Gulch Pond, Sheridan Reservoir, Horsethief Lake, Road 305 Wetland, and Lakota Lake	Medium
Curlyleaf pondweed *Potamogeton crispus*	380 acres (Sheridan Lake) 4,407 acres (Angostura Reservoir)	Sheridan Lake, Angostura Reservoir	Medium
Red-rimmed melania *Melanoides tuberculata*	2 sites	Cascade Springs, Fall River	Medium
Ranavirus *Ranavirus* ssp.	none	-	Medium
Eurasian watermilfoil *Myriophyllum spicatum*	none	-	Medium
Brittle naiad *Najas minor*	none	-	Medium
New Zealand mud snail *Potamopyrgus antipodarum*	none	-	Medium
Viral hemorrhagic septicemia	none	-	Medium
Whirling disease *Myxobolus cerebralis*	none	-	Medium
Rusty crayfish *Orconectes rusticus*	none	-	Medium
Asian clam *Corbicula fluminea*		Angostura Reservoir	Medium
Common carp, Asian carps	none	-	Medium
European rudd *Scardinius erythropthalmus*	1,230 acres	Pactola Reservoir, Sheridan Lake	Low
Snakehead *Channa* ssp.	none	-	Low

Chapter 3. Effects on Ecosystems

Insects and Disease

Insects and diseases can drastically increase tree mortality throughout the ecosystem of the Black Hills National Forest. The disturbance caused by increased tree mortality is an integral part of the forest system that, in turn, increases heterogeneity in the forest structure, which affects timber volume, wildlife habitat, biodiversity and nutrient cycling to name a few (Sheppard and Battaglia 2002).

The mountain pine beetle is the most prevalent insect that contributes significantly to natural disturbances in the Black Hills National Forest. For example, it is the leading cause of ponderosa pine mortalities in the Black Hills National Forest (Thom et al. 2020). As noted in the insects and disease section above, the mountain pine beetle can dramatically change the forest structure during periodic epidemics and has been known to kill up to 90 percent of merchantable timber during a single epidemic (Thom et al. 2020, Parrish et al. 1996).

As mentioned above, the mountain pine beetle populations in the Black Hills National Forest substantially increase approximately every 20 years in periodic epidemics that have occurred during the early 1900s, 1940s, the 1960s through the 1980s, and from approximately 2000 through 2017 (Graham et al. 2021). The most recent epidemic began with minor sporadic occurrences throughout the Black Hills National Forest during the period 1995-2000. (Appendix A contains separate maps of all insect damage sustained from 1995 through 2020). Damaged areas were initially concentrated in small areas of the central Black Hills, gradually increasing throughout much of the planning area. By 2012, widespread damage could be observed in the central Black Hills, Northern Black Hills, and Bear Lodge Mountains (appendix A). The epidemic subsided in 2017 (appendix A).

Outbreaks occur in response to increases in favorable beetle habitat. Favorable habitat for mountain pine beetle includes ponderosa pine forests with susceptible trees that have a diameter of 8 to 12 inches (although mountain pine beetles have been known to attack trees with diameters greater than 20 inches) and stands with basal areas over 120 square feet per acre (Sheppard and Battaglia 2002). During the most recent epidemic, all limber pine over 5 inches in diameter were also killed by mountain pine beetle near Harney Peak (USDA Forest Service 2013a).

With insect and disease outbreaks comes an increased risk for fire throughout the ecosystem. This is due to an increase in snag densities produced by diseased tree mortalities (Sheppard and Battaglia 2002, Parrish et al. 1996). Some insects such as the pine engraver and red turpentine beetle (*Dendroctonus valens)* also further increase tree mortality post-fire, during times of drought, and during other insect or disease outbreaks. This elevates the risk of fire even further. Outside of large epidemics, the effects of insects and disease are not always negative, as the reduction in the forest overstory leads to increased understory growth and tree regeneration, resulting in healthier uneven aged forest stands with increased wildlife habitat (Sheppard and Battaglia 2002).

Invasive Species

Invasives species ecology defines four distinct stages of biological invasion: 1) entry, 2) establishment, 3) spread, and 4) impact(s) to the receiving environment (Andersen 2004 as cited in Landis et al. 2015). As displayed in table 1 (and further in appendix B), some of the invasive species present in the Black Hills National Forest are in stage 1; they are considered new invaders and are targeted for treatment even if not identified as a management priority species. But many of the species present in the Black Hills National Forest are already at stage 4 and currently impacting the ecosystem.

Invasive plants have been recognized as second only to land development in causing loss of biodiversity. They impact native plant communities and biodiversity in several ways, including changes in plant community structure that result in changes in native species richness and abundance. Mechanisms for changes in plant communities due to invasives species include changes in soil chemistry; changes in nitrogen cycling, or allelopathy; changes in soil biota and soil moisture; changes in habitat and nutrition quality and quantity for producers (green plants) and consumers (wildlife, livestock); changes in competition patterns for resources such as light and nutrients; and changes in ecosystem processes, such as hydrologic regimes, decomposition rates, and natural fire frequencies.

Invasive plant species can impact soil biota and nutrient cycling in several ways. They can increase or decrease available nitrogen (Levine et al. 2003). Some invasive species such as leafy spurge excrete chemicals, often through the roots, that are toxic to other plant species. Invasive species sometimes have shallower root systems than species native to a site, which can result in increased soil erosion (Bossard et al. 2000). Increased biomass inputs to the litter layer may also occur altering resource cycling. Changes to soil microbes, including fungi, bacteria, and invertebrates, can impact native communities by altering important symbiotic relationships and changing nutrient cycling.

Invasive species can impact hydrologic regimes by altering sedimentation rates, changing transpiration timing and rates, and altering erosion rates. This results in changes in flooding patterns and riparian community structure (Levine et al. 2003, Bossard et al.2000).

In addition to the invasive weeds identified in table 1, the introduction of non-native cool season grasses such as Kentucky bluegrass (*Poa pratensis*), smooth brome (*Bromus inermis*) and timothy (*Phleum pratense*) is decreasing native plant diversity, thus creating decreased range condition where they occur throughout the Black Hills National Forest. In some locations in Black Hills National Forest, particularly in the northern portions, invasive plants are so abundant there may be an irretrievable loss of native plant communities if the increase cannot be curtailed.

Infestations of didymo *(Didymosphenia geminata),* a diatom, in waterways of the Black Hills National Forest can have harmful effects on the native biota of these areas. Didymo is often referred to a rock snot and it can form thick, mat-like growths that can last for months. These mats often inhibit growth of native organisms that live on stream bottoms, which can have devastative impacts on aquatic food chains, including those of desirable game fish like trout (James 2015). There is some indication that the didymo infestation in Rapid Creek is not impacting trout there. While aquatic invertebrates are smaller there than in comparable non-infested streams, trout are able to consume enough of them to maintain healthy growth and energy reserves (James 2015).

Another aquatic nuisance species, red-rimmed melania (*Melanoides tuberculate,* a snail native to Africa and introduced to the United States by the aquarium industry), poses a risk to native aquatic ecosystems because it is a host to several pathogens that threaten native fish (Daniel et al. 2019). Chytrid fungus (*Batrachochytrium dendrobatidis*) is easily transferred from one waterbody to another and can cause disease in amphibian species.

Chapter 4. Ecosystem Adaptations to Changes in Insect, Disease, and Invasive Species

Following the mountain pine beetle epidemic that ended in 2016, it is believed that there has been an increase in forest structural stages 2 and 3a (USDA Forest Service 2013a, Graham et al. 2021). Forest structure 2 is defined as a forest structure that comprises seedlings and saplings and forest structure 3a is defined as a forest structure that comprises young forest with 0 to 39 percent canopy cover (Vandendriesche 2013). As a result, it is common to find forest stands with seedling and sapling densities of 5,000 to 10,000 per acre. These stands, when combined with the increased fire risk present in the Black Hills National Forest due to the number of snags present because of the mountain pine beetle epidemic, have the potential to act as ladder fuels, allowing ground fires to transition to crown fires if management actions are not taken (Graham et al. 2021).

Invasive species are well-established in the Black Hills National Forest and detecting, treating, and managing outbreaks is a main focus for the Forest Service. Many infestations tend to follow timber sale disturbances including skid trails, logging roads, and slash pile locations. The infestation often spills over to adjacent meadows and clearings and can sometimes take over these areas because the invasive species out-compete the native vegetation. Roads and trails are well known vectors, with infestations often spreading from the road or trail into the adjacent undisturbed areas.

In addition to the noxious weeds currently identified for management, non-native cool season grasses such as Kentucky bluegrass, smooth brome, and timothy are outcompeting native grass species in some areas of the Black Hills and will require extensive action to reduce populations. These grasses crowd out native forbs and grasses while hampering pine regeneration resulting in reduced native plant diversity and producing areas dominated by monocultures of non-native grass (please see the *Non-forested/Rangeland Ecosystems* assessment for details regarding non-native cool season grasses).

Yellow toadflax, leafy spurge, spotted knapweed, oxeye daisy, common tansy, and St. Johnswort are aggressive invasive plant species that are currently priority species for treatment in the Black Hills National Forest. These six species were identified as priority for treatment because they currently have a moderate population size within the region, have the potential to spread rapidly, and are capable of invading a variety of relatively healthy ecosystems (USDA Forest Service 2018). Other invasive species such as Canada thistle thrive in disturbed, open habitats such as those where changes in tree establishment and succession due to the recent mountain pine beetle outbreak resulted in the lack of overstory that would normally shade these species out. Thistle establishment risk varies over time associated with logging, with the greatest risk occurring in either the first or third year after logging (Landis et al. 2015). In all cases, native plant diversity is being lost due to this encroachment, increased competition and altered ecosystem.

Forest Service staff used the Watershed Condition Framework to classify the functioning condition of watersheds on National Forest System lands in 2010 (more information about the Watershed Condition Framework is presented in the *Soils and Watershed* Assessment). That framework is a 12-indicator model that considers both aquatic and terrestrial physical and biological indicators and rates each watershed as good (functioning properly), fair (functioning at risk), or poor (impaired function) according to a standardized rule set. There is a terrestrial biological indicator for invasive species in the Watershed Condition Framework. In 2010 a total of 54 watersheds out of 95 (57 percent) watersheds in the Black Hills National Forest were functioning properly with regards to terrestrial invasive species. An additional 39 watersheds out of 95 (41 percent) were functioning at risk with regards to invasive species. Only 2 percent of watersheds were classified, at that time, as impaired function regarding invasive species (see map in appendix A). It's important to note there has been a marked increase in invasive species since that 2010 evaluation. Four watersheds were reassessed in 2015 and 2016, but more updates are needed.

The Watershed Condition Framework also includes an aquatic biological indicator, which includes a sub-indicator for exotic and/or invasive species. In 2010 the sub-indicator was functioning properly for 53 percent of watersheds (50 of 95), functioning at risk for 27 percent of watersheds (26 of 95) and at risk in 20 percent of watersheds (19 of 95). In 2010, the Watershed Condition Framework indicated aquatic invasive species were potentially more of an impairment than terrestrial invasive species since 20 percent of sub-watersheds were impaired with respect to aquatic invasive species versus 2 percent for invasive species.

Landscape Influences on Ecosystems within the Forest

The conditions on the broader landscapes are influenced by a wide range of natural process and management practices. Conditions such as presence of drought, fire, climate change, precipitation, and management practices such as timber harvest and insect and non-native plant control methods all influence conditions within the plant community. These influences can either make the forest vulnerable to attack from insects, disease, and encourage invasive species encroachment or make the plant community and broader ecosystem resistant to such attacks and encroachments. Drought conditions stress trees and leave them vulnerable to attack from insects and disease (Timberlake et al. 2021). Years of average or above average precipitation, and forest management practices leave trees less stressed, lessening the chances of insect and disease infestation.

Conditions such as climate change will result in warmer temperatures in the Black Hills National Forest. This may result in earlier snowmelt and prolonged growing seasons as well as a shift in predominant winter precipitation from snow to rain (Timberlake et al. 2021). Not only will fire frequency increase due to a resulting prolonged fire season, but fire intensity may also increase due to the effects that climate change has on insects such as the mountain pine beetle. A major population controller of mountain pine beetle populations is extreme cold during the winter. These weather events act to reduce populations of mountain pine beetle larvae. Without this population control, outbreaks could become more frequent, not only greatly reducing pine tree populations, but also creating higher forest fuel loads due to the increase in snags and deadfall (Graham et al. 2021). The draft Climate Change Vulnerability Assessment (Timberlake et al. 2021) developed for the Black Hills National Forest also reached this conclusion. The increases in fire frequency and intensity may also result in an increase in tree mortalities due to ips and red turpentine beetle due to their propensity to attack and kill trees that have sustained fire damage, while increasing armillaria root rot presence (Sheppard and Battaglia 2002). Increases in disturbances such as these are also often associated with the increasing spread of terrestrial invasive plants that commonly invade areas following large-scale disturbances.

The Black Hills National Forest is a dynamic system that changes and evolves over time in response to many drivers and influences from the broader landscape. Conditions such as decreased precipitation and unthinned forest stands have created a forest structure that comprises dense stands of saplings, which greatly increases fire risk (USDA Forest Service 2013a, Graham et al. 2021). Increases in invasive weeds and non-native grasses is resulting in a loss of native plant communities. As changes to these landscape conditions continue to evolve due to climate change, and additional management practices are undertaken, the ecosystem will adapt and continue to challenge forest managers in many different and unforeseen ways.

Chapter 5. Existing Management Direction

Existing Forest Plan Management Direction

The Black Hills National Forest 1997 Land and Resource Management Plan contained management direction to manage outbreaks of insect and disease and to control the introduction of new invasive species infestations and reduce established infestations. Original direction was revised in 2005 during the Plan II amendment process in order to better provide for species conservation and fire and insect hazard reduction. The current management direction for insects and disease and invasive species includes:

Insects and Disease

- Establish and maintain a mosaic of vegetation conditions to reduce occurrences of catastrophic fire, insect, and disease events, and facilitate insect and disease management and firefighting capability (Forestwide Goal 10),
- Where outbreaks of mountain pine beetle could present risks to management objectives for ponderosa pine, reduce acreage of ponderosa pine stands that are in medium or high risk for infestation (Forestwide Objective 10-07),
- Using analyses of insect-and-disease occurrences, prioritize suppression strategies to meet management objectives and minimize value loss of tree vegetation affected by outbreaks of insect-and-disease pests Forestwide Objective 10-08),
- Plan management activities with consideration for potential insect or disease outbreaks. Use integrated pest management strategies where insect or disease outbreaks may adversely affect management objectives. Utilize preventive vegetation management practices, including silvicultural treatments, to protect forest stands from insect and disease epidemics (Forestwide Guideline 4201.a),
- During scheduled management activities, minimize susceptibility to mountain pine beetle epidemics by reducing average basal area to 70 or less in pine stands, except where denser stands are needed to meet other management objectives (Forestwide Standard 4201.b),
- Use the following insect-and-disease protection measures: Manage vegetation in and adjacent to high-use recreation areas to improve forest condition, as needed to maintain or improve the desired recreation setting(s) or to conserve Rocky Mountain Region sensitive or species of local concern and snails. In and adjacent to developed recreation sites, actively treat insects and diseases (e.g., sanitation removal, insecticide application, pheromones) to reduce pest populations and tree mortality objectives (Forestwide Standard 4201.c),
- Consider spatial array of stand conditions when planning harvests to reduce their potential for mountain pine beetle epidemics. For example, silvicultural treatments may be appropriate within or adjacent to dense mature stands objectives (Forestwide Standard 4201.e),
- In high use areas identify hazard trees, such as those weakened, damaged, or killed by insects and diseases, that may pose a threat to people, property, and other high value resources, and schedule management activities to remove hazards to minimize adverse risks. Prioritize according to risk and values (Forestwide Guideline 4202),
- Where buildup of ips populations poses a threat to management objectives, especially in developed recreation and dry sites and adjacent to other land ownerships where insect spread may cause concern, avoid leaving concentrations of fresh (green) slash and logging debris greater than 2 inches in diameter during spring (April through June). Lop and scatter promotes faster drying than piling slash, so this method of treatment may be more appropriate for use in high risk ips areas (Forestwide Guideline 4203),

- Consider potential disease and insect hazards, especially in spruce sites, when designing and developing new recreation, parking, or other high-use areas (Forestwide Guideline 4204),
- Consider applying preventive silvicultural treatments or other integrated pest management strategies to National Forest System land adjoining other land ownerships to reduce the likelihood of insect and disease epidemics and spread. Plan suppression strategies to reduce mountain pine beetle populations in pine stands during epidemics. Prioritize according to values, risk, and management objectives. Priority should be given to areas in which values to be protected exceed the cost of protection (e.g., adjacent to subdivisions, metropolitan areas, recreation sites, or areas of concentrated public use) (Forestwide Guideline 4205),
- Project plans should consider existing infestations of insects or disease within a project area. Activities should be designed to minimize the risks of spreading the infestation while still providing habitat for those wildlife species dependent upon the presence of insects and disease (Forestwide Guideline 4206), and
- Apply eradication or suppression activities for gypsy moth when needed as determined by surveys and in accordance with the integrated pest management approach (USDA Forest Service, Animal and Plant Health Inspection Service FEIS; Gypsy Moth Management in U.S., 1996) (Forestwide Guideline 4207).

Invasive Species

- Eradicate or limit spread of new introductions of non-native pests to minimize ecosystem disruption (Forestwide Objective 230),
- Prevent new infestations and manage to reduce established noxious-weed infestations. Treat at least 8,000 acres per year during the next 10 years to limit noxious weed infestations (Forestwide Objective 231),
- After ground-disturbing activities, revegetate areas with native species in seed/plant mixtures that are noxious-weed free (Forestwide Standard 1110),
- For all proposed projects or activities, determine the risk of noxious weed introduction or spread, and implement appropriate mitigation measures and treatment (Forestwide Standard 4301),
- Develop a noxious-weed management program that addresses awareness, prevention, inventory, planning, treatment, monitoring, reporting, and management objectives. Control noxious weeds using the following priority order:
  - Rocky Mountain Region sensitive and species of local concern occurrences of snails and plants;
  - Research natural areas;
  - Botanical areas;
  - New invaders;
  - New areas of infestation;
  - Spreading or expanding infestations;
  - Existing infestations (Forestwide Guideline 4303),
- Treat individual plants or groups of plants in areas where Rocky Mountain Region sensitive or species of local concern plants occur. Use a treatment method that is the least risk to the species being protected (Forestwide Standard 4304),
- Use certified noxious-weed-free seed, feed, and mulch. (Forestwide Standard 4306), and
- Monitor weed treatments used at Rocky Mountain Region sensitive and species of local concern plant occurrences and re-treat as needed during the season (Forestwide Standard 4309).

Other Forest Service Direction

Forest Service Manual 2900, Invasive Species Management, defines the authority, objectives, and responsibility at different levels of the Forest Service for managing invasive species. There is also a National Strategic Framework for Invasive Species Management (USDA Forest Service 2013b), which prioritizes and guides the prevention, detection, and control of invasive insects, pathogens, plants, wildlife, and fish that threaten terrestrial and aquatic ecosystems.

Executive Orders 13112 and 13751

Executive Order 13112 – Invasive Species was signed in 1999 and directs Federal agencies to prevent the introduction of invasive species; to control populations of such species in a cost-effective and environmentally sound manner; to monitor invasive species populations; to provide for restoration of native species and habitat conditions in ecosystems that have been invaded; to conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and to promote public education on invasive species and the means to address them. This Executive Order also established the National Invasive Species Council (Council).

In 2016, Executive Order 13751 – Safeguarding the Nation from the Impacts of Invasive Species was signed. It directs actions to continue coordinated Federal prevention and control efforts related to invasive species. This order maintains the Council and the Invasive Species Advisory Committee; expands the membership of the Council; clarifies the operations of the Council; incorporates considerations of human and environmental health, climate change, technological innovation, and other emerging priorities into Federal efforts to address invasive species; and strengthens coordinated, cost-efficient Federal action.

National Environmental Policy Act documentation associated with the forest plan will document how the plan will comply with these directives.

Actions of Others

The South Dakota Weed and Pest Control Commission has the authority to identify noxious weeds, the South Dakota Department of Agriculture and Natural Resources has the authority to manage noxious weeds, non-native tree insects and diseases that threaten the State's forestry resources. South Dakota Game, Fish and Parks has the authority and responsibility for managing aquatic nuisance species in the State's waterways.

The Wyoming Department of Agriculture is responsible for the identification and management of weeds and pests in the State of Wyoming. Twenty-three Weed and Pest Control Districts have been established in Wyoming as part of the Wyoming Weed and Pest Control Act of 1973. These Districts provide cost-sharing assistance to landowners to eradicate or slow the spread of invasive species, treat weed outbreaks, and provide public and professional training and education on weed identification, treatment, and prevention. The Wyoming State Forestry Division monitors and manages threats to forest health, and the Wyoming Game and Fish Department identifies and manages aquatic nuisance species.

Chapter 6. Potential Need for Forest Plan Changes

The Black Hills National Forest may need plan revisions to provide better direction for invasives species. The current forest plan direction (as outlined above) is fairly strong for insects, diseases, and invasives species, yet as noted throughout this document, native plant communities are still being lost to invasive plants. The focus should be on managing to maintain resiliency to provide for ecosystem services and buffer anticipated impacts from climate change. Potential changes to consider:

- The current forest plan has an objective for the treatment of noxious weed infestations (objective 231 includes 'treat at least 8,000 acres per year…'), yet, as discussed in this document, treatment at that level has not been occurring due to budget constraints. Consider strengthening the forest plan direction for preventing the disturbances that exacerbate the spread of invasive species, especially when funding is not available for treatment to mitigate the results of those disturbances.
- Guideline 4303 identifies a priority order for treatment of noxious weeds; consider editing that guideline to be reflective of the priorities developed by the Black Hills Invasive Plant Partnership.
- Consider strengthening the direction regarding public awareness of invasive plants and the harm they do to the native plant communities, particularly considering the increase in recreation uses in the forest.
- Consider adding forest plan direction designed to prevent invasive plant infestation and spread such as requiring ground-disturbing equipment to be cleaned of weed seed/propagules; installing boot cleaning stations on trails; and general public education about vectors of weed spread.
- Explore options to integrate Forestwide weed treatment into the forest plan, including aerial application of herbicides. Aerial application of herbicides using drone technology is rapidly becoming a viable option in weed management. That tool is not available for use in the forest under the current weed treatment plan.

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Appendix A: Map Documents

The following maps are provided as separate PDF documents on the land management plan revision assessment phase webpage for the Black Hills National Forest.

Appendix A-1: All vegetation damage determined during aerial detection surveys, Black Hills National Forest, 1995 through 2020.

Appendix A-2: All vegetation damage determined during aerial detection surveys, Black Hills National Forest, 1995 through 1999.

Appendix A-3: All vegetation damage determined during aerial detection surveys, Black Hills National Forest, 2000 through 2003.

Appendix A-4: All vegetation damage determined during aerial detection surveys, Black Hills National Forest, 2004 through 2011.

Appendix A-5: All vegetation damage determined during aerial detection surveys, Black Hills National Forest, 2012 through 2016.

Appendix A-6: All vegetation damage determined during aerial detection surveys, Black Hills National Forest, 2017 through 2020.

Appendix A-7: Known locations of terrestrial invasive species and watershed condition rankings for terrestrial invasive indicator, Black Hills National Forest.

Appendix B – Invasive Plants in the Black Hills National Forest

Species Accounts

Black Henbane

Black henbane (*Hyoscyamus niger*) is a Mediterranean native that was introduced as an ornamental and medicinal plant in the 17th century. It is an annual or biennial that grows up to three feet tall. The entire plant is covered with greasy hairs. Prolific seed production increases the spread of this plant, as a single plant can produce up to half a million seeds. Black henbane is poisonous to most mammals. It can be found along roadsides, in pastures, fields, and disturbed areas. This species is classified as Class B (plants that have a moderate population size within the region, established in some areas but less abundant or absent in other areas) by BHIPP. It can be found in isolated patches across the Black Hills National Forest.

Brown Knapweed

Brown knapweed (*Centaurea jacea*) is a perennial plant in the Aster family with a woody root crown that grows 20 to 48 inches tall. It prefers moist, cooler conditions than other knapweed species. It can be found growing in grasslands, open woods, meadows, pastures, woodland clearings, and in cutover areas of forest. As with other knapweed species it is capable of forming large infestation under favorable conditions. BHIPP classifies it as a Class A invasive (invasive plants that are generally not found in the region or have a relatively low population size making early detection and rapid response to prevent spread warranted). In the Black Hills National Forest it is found only in the Galena area. Those isolated patches are treated in an attempt to eradicate or at least prevent spread.

Canada Thistle

Canada thistle (*Cirsium arvense*) is a colony-forming perennial species with erect stems 1.5 to 4 feet tall. It has extensive underground roots, which are capable of producing new plants. One plant can produce 1,500 to 5,000 seeds that are capable of germinating 8 to 10 days after flowers open. It grows in barrens, glades, meadows, prairies, fields, pastures, and waste places. It does best in the disturbed upland areas, but also invades wet areas with fluctuating water levels. It is considered a Class C (established in the region) invasive by BHIPP. It is widespread throughout the Black Hills National Forest, particularly in areas of disturbance.

Common Mullein

Common mullein (*Verbascum thapsus*) is a biennial or short-lived perennial found that produces an abundance of long-lived seeds. One plant can produce 100,000 to 180,000 seeds with viability up to 100 years. It adapts easily to a wide variety of open site conditions but is intolerant of shade. Primarily a weed of pastures, hay fields, roadsides, rights-of-way, and abandoned areas. It is classified as Class C by BHIPP. Common mullein is widespread throughout the Black Hills National Forest.

Common Tansy (Priority Species)

Common tansy (*Tanacetum vulgare*) is a perennial herb first introduced to North America for use in folk remedies and as an ornamental plant. It invades disturbed sites and is commonly found on roadsides,

fence rows, pastures, stream banks, and waste areas throughout North America. Common tansy spreads mainly by seeds, and less commonly from creeping rhizomes, to form dense clumps of stems. BHIPP classifies it as a Class B invasive. Infestations have increased in the recent past (particularly in the northern portion of the Black Hills National Forest) resulting in it being identified as a priority species in 2018.

Dalmatian Toadflax

Dalmatian toadflax (*Linaria dalmatica)* is an introduced ornamental, perennial weed from eastern Europe. It is quick to colonize open sites and is capable of adapting to a wide variety of environmental conditions. Once established, this species can suppress other vegetation mainly by intense competition for limited soil water. Seeds can remain dormant for at least 10 years. These dormant seeds can rapidly re-infest a site following control applications, even when pre-emergent herbicides are used, because only a portion of the seeds will germinate in any given year. BHIPP classifies it as a Class B invasive. Dalmatian toadflax infestations are not as prevalent as yellow toadflax infestations in the Black Hills National Forest.

Diffuse Knapweed

Diffuse knapweed (*Centaurea diffusa*) is a biennial or short-lived perennial with abundant seed production. A single plant can produce up to 18,000 seeds. Seeds germinate in both early spring (primarily) and fall. In the fall, diffuse knapweed breaks off at ground level and disperses widely as a tumbleweed. The allelopathic chemical may reduce recovery potential as its presence in the soil may hinder the resurgence of natives. Dormant seeds may germinate and re-infest an area. BHIPP classifies it as a Class B invasive. Few acres are known to occur in the Black Hills National Forest and even though it is not considered a priority species, those few acres are treated in an attempt to eradicate or at least prevent it from spreading further.

Houndstongue

Houndstongue (*Cynoglossum officinale*) is a biennial or short-lived perennial introduced from Eurasia. It has a thick branching taproot, extending to depths of more than 40 inches. Reproduction is by seed. The seeds have a spiny husk and protruding barbs, enabling long distance dispersal as the seeds attach to fur and clothing. Houndstongue is most abundant in areas with more than 10 percent bare ground. It is toxic to livestock and wildlife. BHIPP classifies it as a Class C invasive. It is widespread throughout the Black Hills National Forest.

Leafy Spurge (Priority Species)

Leafy spurge (*Euphorbia esula*) is an aggressive, up to 3 feet tall, creeping perennial with roots often exceeding 25 feet deep. Upon maturation the seed capsule ruptures, dispersing seed as far as 15 feet. Leafy spurge spreads by its extensive root system, by seed and vegetatively at a rate of several feet per year. Leafy spurge invades prairies, pastures, and other open areas. It tolerates a wide range of soils from rich, moist soils of riparian zones to nutrient-poor, dry soils of western rangelands. It is most aggressive in semi-arid situations where competition from associated species is less intense. BHIPP classifies it as a Class B invasive.

Musk Thistle

Musk thistle (*Carduus nutans*) is a biennial member of the sunflower family that grows to 6 feet tall. In one growing season a single plant can produce over 100,000 seeds; therefore, it can increase from a single plant to a rather large infestation within two or three years. The seeds can remain viable in the soil for

roughly 15 years, which necessitates intensive monitoring of sites and repeat treatments. Musk thistle does best in disturbed areas but also can invade undisturbed areas. It can occur in almost all habitats except dense forests, high mountains, deserts, and frequently cultivated farmlands. BHIPP classifies it as a Class C invasive. It is widespread throughout the Black Hills National Forest.

Orange Hawkweed

Orange hawkweed (*Hieracium aurantiacum)* is a showy escaped ornamental native to Europe. It has shallow fibrous roots with above-ground stolons and below-ground rhizomes that allow for aggressive vegetative reproduction. It invades different habitats including moist meadows, pastures, hay fields, roadsides, gravel pits, forested areas, and riparian areas. Plants prefer full sun or partial shade and soils that are well drained and coarse textured. BHIIPP classifies it as a Class A invasive. The small, known infestations in the Black National Forest are in the central and northern Black Hills. Those isolated patches are treated in an attempt to eradicate or at least prevent spread.

Oxeye Daisy (Priority Species)

Oxeye daisy (*Leucanthemum vulgare*) is a shallow-rooted rhizomatous perennial. The plant is a prolific seed producer; a single plant can produce up to 26,000 seeds. Reproduction occurs primarily through seed dispersal and germination, although spreading rootstalks contribute to its propagation. Germination occurs throughout the growing season, but most new seedlings emerge in spring. Seeds that do not germinate in the spring may remain viable for many years. BHIPP classifies oxeye daisy as a Class B invasive. It is most prevalent in the northern portion of the Black Hills National Forest but appears to be moving southward.

Russian Knapweed

Russian knapweed (*Rhaponticum repens*) is a deep-rooted, long-lived perennial that reproduces from seed and vegetative root buds. These buds develop into adventitious roots enabling the species to colonize large areas quickly. Russian knapweed produces compounds that suppress growth in native plants, which allows it to form dense monocultures. Russian knapweed does not readily establish in healthy native vegetation, it seems to require disturbance. But once established, it emits allelopathic compounds to inhibit other plants. BHIPP classifies Russian knapweed as a Class A invasive. Very little Russian knapweed is known to occur in the Black Hills National Forest.

St. Johnswort (Priority Species)

St. Johnswort (*Hypericum perforatum)* is a tap-rooted perennial weed that reproduces by seeds and short runners. The taproot may reach depths of 4 to 5 feet. Lateral roots grow 2 to 3 inches beneath the soil surface but may reach depths of 3 feet. Developing capsules become very sticky and contain 400 to 500 seeds. Seeds may remain viable in soil for up to 10 years. St. Johnswort is classified as a Class B invasive by BHIPP. In the Black Hills National Forest it is more prevalent in the northern portion of the forest.

Salt Cedar

Salt cedar (*Tamarisk* complex) is a deciduous shrub that can grow up to 15 feet in height. It is found in many riparian areas throughout the West. It was introduced as an ornamental and for erosion control. It out-competes native riparian trees by forming deep root systems that can remove underground water not available to native species. It invades streambanks, sandbars, lake margins, wetlands, moist rangelands, and saline environments. BHIPP classifies it as a Class B invasive. There are few acres of salt cedar infestation in the Black Hills National Forest.

Spotted Knapweed (Priority Species)

Spotted knapweed (*Centaurea maculosa)* is a biennial or short-lived perennial from central Europe. It is best adapted to well-drained, light-textured soils in areas that receive some summer rainfall. Each plant can produce up to 40,000 seeds per plant. Most seeds fall within 4-foot radius of the parent plant and can remain viable for up to 20 years. Once established, it emits allelopathic compounds to inhibit other plants, eventually resulting in a monoculture of knapweed. BHIPP classifies it as a Class B invasive. Spotted knapweed infestations have been increasing in the Black Hills National Forest in recent years, resulting in it being identified as a priority species in 2018.

Sulfur Cinquefoil

Sulfur cinquefoil (*Potentilla recta)* is a long-lived, tap-rooted perennial herb. It reproduces primarily through seed; a single plant can produce thousands of seeds annually and it can be spread by roots if they are moved by tillage or on soil-moving equipment. In western North America, sulfur cinquefoil invades native forest, shrub, and grassland plant communities as well as disturbed habitats that typically harbor weeds. It can dominate a site within 2 to 3 years. New shoots can develop annually from the outer portion of the main root allowing a plant to live for extended periods as long as 20 years. BHIPP classifies it as a Class B invasive.

Tall Buttercup

Tall buttercup (*Ranunculus acris*) is a short-lived perennial native to temperate Asia and Europe. Its short, thick rhizomes enable it to spread vegetatively but its primary mode of spread is likely due to the short-hooked beak on the seed that attaches readily to fur or clothing. Range-wide it can be found in moist fields, pastures, grasslands, and sub-irrigated meadows. BHIPP classifies it as a Class A invasive. In the Black Hills National Forest it is known from isolated patches in the Dumont area. Those isolated patches are treated in an attempt to eradicate or at least prevent spread.

Whitetop/Hoary Cress

Whitetop, also known as hoary cress, (*Cardaria draba*) is a member of the mustard family, native to Russia. It likes non-shaded, disturbed conditions, including roadsides, waste places, fields, gardens, feed lots, watercourses, open grasslands, and along irrigation ditches. Hoary cress is a deep-rooted perennial, with roots growing 12 to 30 feet deep. One plant can spread 12 feet in its first year. BHIPP classifies it as a Class B invasive. There are few whitetop infestations in the Black Hills National Forest.

Yellow Toadflax (Priority Species)

Yellow toadflax (*Linaria vulgaris*) is an introduced ornamental that is quick to colonize open sites and is capable of adapting growth to a wide variety of environmental conditions. It is a prolific seed producer—a single plant may produce 15,000 to 30,000 seeds. Once established, this species can suppress other vegetation mainly by intense competition for limited soil water. Mature plants are particularly competitive with winter annuals and shallow-rooted perennials. Seeds can remain dormant as long as 10 years. BHIPP classifies it as a Class B invasive. Acres of yellow toadflax infestation have increased substantially in the Black Hills National Forest in recent years.

Black Hills Invasive Plant Partnership (BHIPP) Priority Management List

Class A invasive plants (table 3) are generally not found in the region **or** have a relatively low population size within the region and are of the highest priority. Early Detection Rapid Response (EDRR) action is taken when found.

Table 3. Class A invasive plants

Common Name	Scientific Name	Occurrence
Brown knapweed	*Centaurea jacea*	Isolated patches in the Galena area
Common teasel	*Dipsacus fullonum*	Isolated patches along Bear Butte Creek in Sturgis
Dyer's woad	*Isatis tinctoria*	No known populations in the region
Eurasian watermilfoil	*Myriophyllum spicatum*	Aquatic plant found in the Missouri River
Giant knotweed	*Fallopia sachalinensis*	Isolated patches along Yellow Creek and Whitewood in Lawrence County
Meadow sage	*Salvia pratensis*	Isolated patch in Vanocker Canyon near Elk Creek
Meadow hawkweed	*Hieracium caepitosum*	Isolated population identified and treated by Black Hills National Forest staff
Medusa head	*Taeniatherum caput-medusae*	Invasive grass in Western states, no known populations in the region
Myrtle spurge	*Euphorbia myrsinites*	Isolated patches landscaped yards in Hot Springs and Rapid City
Orange hawkweed	*Hieracium aurantiacum*	Isolated plants in central and northern Black Hills
Perennial pepperweed	*Lepidium latifolium*	No known populations in the region
Purple loosestrife	*Lythrum salicaria*	Isolated patches along Rapid Creek in Rapid City
Russian knapweed	*Centaurea repens*	Isolated patches outside of the Black Hills
Sickleweed	*Falcaria vulgaris*	Isolated patches in the Buffalo Gap National Grasslands
Spurge flax	*Thymelaea passerina*	In and around Badlands National Park
Tansy ragwort	*Jacobaea vulgaris*	No known populations in the region
Tall buttercup	*Ranunculus acris*	Isolated patches in the Dumont area
Tall hawkweed	*Hieracium piloselloides*	Isolated population identified and treated by Black Hills National Forest staff
Ventenata	*Ventenata dubia*	Also known as N. African grass. Invasive grass in Western states, no known populations in the region
Wild parsnip	*Pastinaca sativa*	Isolated patches north of Sturgis and Wind Cave NP area
Yellow flag iris	*Iris pseudacorus*	Isolated patches along Lime and Rapid Creeks in Rapid City and small patch in Hot Springs
Yellow starthistle	*Centaurea solstitialis*	No know populations in the region

Class B invasive plants (table 4) have a moderate population size within the region, established in some areas but less abundant or absent in other areas. Class B plants are eradicated where less abundant and suppressed in areas where established through integrated management tactics (herbicide, mechanical, biological control).

Table 4. Class B invasive plants

Common Name	Scientific Name
Absinth wormwood	*Artemisia absinthium*
Black henbane	*Hyoscyamus niger*
Common tansy	*Tanacetum vulgare*
Dalmatian toadflax[1]	*Linaria dalmatica*
Diffuse knapweed	*Centaurea diffusa*
Garlic mustard	*Alliaria petiolata*
Hoary cress	*Cardaria draba*
Leafy spurge	*Euphorbia esula*
Oxeye daisy	*Leucanthemum vulgare*
Perennial sow thistle	*Sonchus arvensis*
Phragmites	*Phragmites*
Salt cedar	*Tamarix spp.)*
Spotted knapweed	*Centaurea maculosa*
St. Johnswort	*Hypericum perforatum*
Sulfur cinquefoil	*Potentilla recta*
White horehound	*Marrubium vulgare*
Yellow toadflax[1]	*Linaria vulgaris*

1 – Including all hybrid species of toadflax.

Class C invasive plants (table 5) are established in the region. Management is by containment of established areas and suppression of smaller isolated patches through integrated management tactics (herbicide, mechanical, biological control).

Table 5. Class C invasive plants

Common Name	Scientific Name
Baby's breath	*Gypsophila*
Bull thistle	*Cirsium vulgare*
Canada thistle	*Cirsium arvense*
Chicory	*Cichorium intybus*
Common burdock	*Arctium minus*
Common mullein	*Verbascum thapsus*
Curly pondweed	*Potamogeton crispus*
Houndstongue	*Cynoglossum officinale*
Musk thistle	*Carduus nutans*
Poison hemlock	*Conium maculatum*
Puncturevine	*Tribulus terrestris*
Scotch thistle	*Onopordum acanthium*
Water hemlock	*Cicuta* spp.