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Black Hills National Forest

Draft 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

What is an Assessment Report?

The Black Hills National Forest (Black Hills NF) is managed by the United States Forest Service (USFS), an agency of the U.S. Department of Agriculture (USDA). The mission of the USFS 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) in order to guide management actions and decisions. The current Black Hills NF forest plan was approved in 1997 and has been amended twice. The National Forest Management Act requires that these forest plans be periodically updated. In order to revise the current forest plan, the Black Hills NF 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 preliminary draft assessment report documents that work.

Insects, Disease, and Invasive Species on the Black Hills National Forest

This document is an assessment of the current status of insects, disease, and invasive species in the Black Hills NF, or the "plan area."

Chapter 2. Conditions and Trends

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 that foresters 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

Both the 2012 Planning Rule and Executive Order 13112 define invasive species as an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

The term noxious weed is defined for the Federal government in the Plant Protection Act of 2000 and in some individual State statutes 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. Aquatic nuisance species (ANS) 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.

In this assessment, the terms invasive plants and weeds will include non-native plants and noxious weeds as described above. Invasive plants have the potential to alter the ecosystem by displacing native plants. They have been found (although not limited) to impact wildlife habitat by decreasing the amount of forage, change fire frequency by forming dense stands of flashy fuels, change soil characteristics by altering soil nutrients, and change grassland, shrubland, open woodland, and riparian ecosystems by out-competing native plants.

At the time of the Phase II forest plan amendment, there were an estimated 100,000 acres of existing invasive species infestations on the Black Hills (USDA Forest Service 2005b). Better inventory methods, and an increase in invasive species infestations have since brought that estimate to over 180,000 acres (USDA Forest Service 2015). Activities that are known to contribute to the spread and establishment of invasive species infestations include timber management, road construction and maintenance, grazing, and prescribed fire, recreation, or any other ground disturbing activity associated with potential propagule movement.

The Black Hills NF began implementing a Noxious Weed Management Plan in 2002, which has been updated at least twice, and has associated environmental compliance documentation. The weed-management plan directs the Forest to implement prevention, education, administration, planning, and integrated control in the Forest weed-management effort. 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 (ANS) on National Forest System lands.

Aquatic nuisance species (ANS) 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 NF has developed an ANS Action Plan (USDA Forest Service 2014a). The overall strategy for ANS management is to work closely with State Resource Agencies and other partners to provide a well-coordinated effort for the early detection of ANS in a cost-effective manner.

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 on 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 2010-2012, and
- Black Hills National Forest Aquatic Nuisance Species Action Plan FY 2014-2016.

Data Gaps Identified

- Comprehensive invasive species surveys of the Black Hills NF.
- Comprehensive studies on disease specific to the Black Hills NF.
- Comprehensive studies on insect species other than the mountain pine beetle specific to the Black Hills NF.

Overview

Insects

Currently, the insects and diseases having the most significant impact on the Black Hills NF are mountain pine beetle (MPB) (*Dendroctonus ponderosae*), Armillaria root disease (*Armillaria ostoyae*), and occasionally the pine engraver beetle (*Ips pini*) which is further discussed in the Conclusions section. While white nose syndrome (WNS) has not yet made a significant impact on bat populations in the Black Hills NF, 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 MPB 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). MPB primarily develops in pines such as lodgepole, ponderosa, scotch and limber pines, and less commonly affects bristlecone and pinon pines (Leatherman et al. no date). 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% of the merchantable timber in the plan area (Thom et al. 2020). MPB has periodic outbreaks approximately every twenty years, with the most recent occurring from approximately ~~2000~~ 1996 through ~~2017~~2016. Approximately 8,631,500 ponderosa pine mortalities were attributed to the most recent MPB 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 MPB, 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 (FHP).

WNS 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 which is how

the disease was named. Since 2006, it has killed millions of bats in both the U.S. 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. (United States Fish and Wildlife Service 2021). WNS was documented in a bat caught on the Black Hills NF in 2018 near Jewel Cave National Monument.

Invasive Species

The amended forest plan directs the Black Hills to treat at least 8,000 acres annually, but this varies based on the availability of funding (USDA Forest Service 2015). The number of acres treated from 2003 through 2014, which was the most recent monitoring data available (USDA Forest Service 2015), is shown in figure 1.

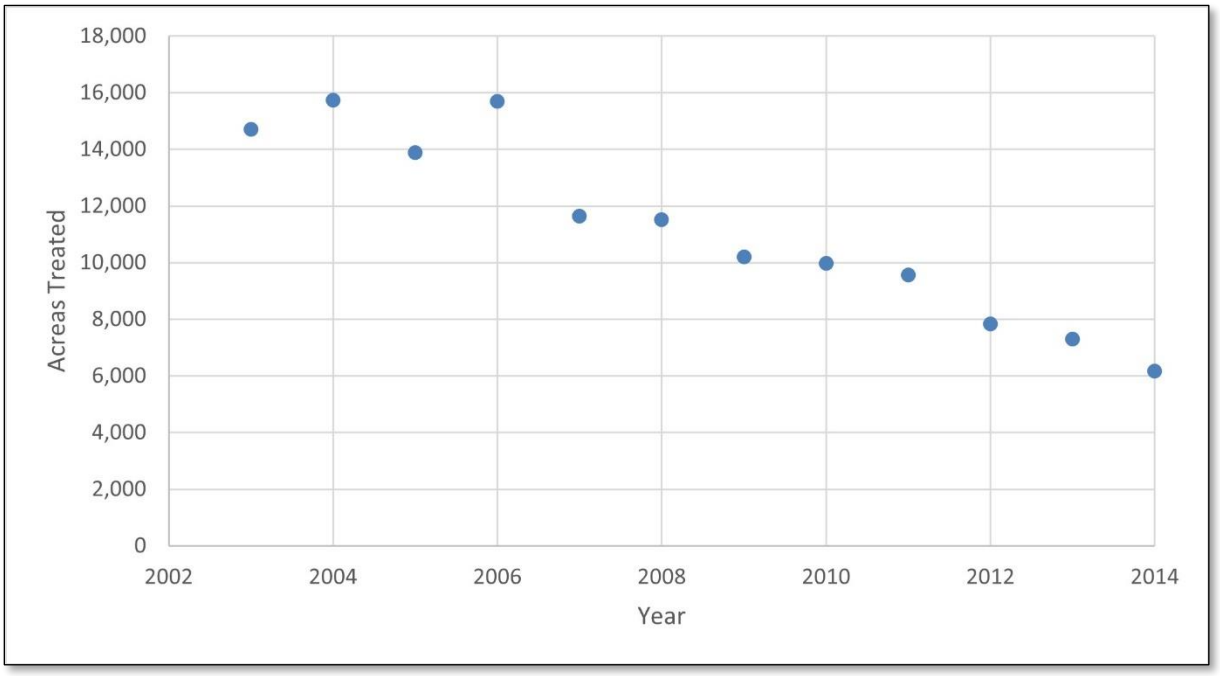

Figure 1. Acreage of invasive plant species treated from 2003 through 2014

Known infestations of invasive weed species are presented in table 1. Acres reported are from the Black Hills National Forest Invasive Species Action Plan (USDA Forest Service 2010), which is the most recent publicly available data. The Black Hills NF monitors and spot treats the eight invasive weed species noted as priority species when found. The criteria for high-priority management is low species abundance, feasibility of controlling the species, the species' ability to establish dominance in plant communities, and the species' capability of invading a variety of healthy ecosystems. If other species are documented and meet this criteria, they will be moved to the high priority list.

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

Common Name	Scientific Name	Acres Infested
Canada thistle	*Cirsium arvense*	175,483
St. John's wort	*Hypericum perforatum*	6,300
Sulphur cinquefoil [P]	*Potentilla recta*	trace
Leafy spurge [P]	*Euphorbia esula*	14,747
Diffuse knapweed	*Centaurea diffusa*	13
Yellow toadflax [P]	*Linaria vulgaris*	4,605
Dalmatian toadflax [P]	*Linaria genistifolia*	193
Spotted knapweed [P]	*Centaurea maculosa*	2,877
Russian knapweed [P]	*Centaurea repens*	1
Saltcedar [P]	*Tamarix ramosissima*	32
Common tansy	*Tanacetum vulgare*	9,287
Common mullein	*Verbascum thapsus*	36,756
Whitetop/Hoary cress	*Cardaria draba*	4
Henbane	*Hyoscyamus albus*	702
Houndstongue	*Cynoglossum officinale*	71,179
Musk thistle	*Carduus nutans*	48,133
Oxeye daisy [P]	*Chrysanthemum leucanthema*	1,612

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

Several isolated populations of ANS currently exist on the Forest and the potential for new introductions is an ongoing threat. The ANS Action Plan identifies species that are currently present on the Black Hills NF in addition to species that have the potential to occur and assigns priority to each (table 2).

Table 2. Aquatic invasive species currently occurring on 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.		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

Insects and Disease Effects on Ecosystems

Insects and diseases can drastically increase tree mortality throughout the ecosystem of the Black Hills NF. 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).

MPB is the most prevalent insect that contributes significantly to natural disturbances in the Black Hills NF. For example, it is the leading cause of ponderosa pine mortalities in the Black Hills NF (Thom et al. 2020). As noted in the insects and disease section above, the MPB 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). See table 1 and table 2 for a list of insects and diseases known to occur on the Black Hills National Forest.

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 outbreak. 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).

Insect and Disease Stressors

Stressor is 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.

As mentioned above, the MPB populations in the Black Hills NF substantially increase approximately every twenty 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 NF 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 MPB includes ponderosa pine forests with susceptible trees that have a diameter of eight to twelve inches (although MPB 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).

The introduction of non-native cool season grasses such as Kentucky bluegrass (*Poa pratensis*), smooth brome (*Bromus inermis*) and timothy (*Phleum pratense*) is creating decreased range conditions where they occur throughout the Black Hills NF.

Infestations of didymo *(Didymosphenia geminata),* a diatom, in waterways of the Black Hills NF 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 ANS, 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.

Ecosystem Adaptations to changes in Insect and Disease Behavior

Invasive species have become well-established in the Black Hills NF and detecting, treating, and managing outbreaks is a main focus for the Forest Service. Many invasive weed (such as oxeye daisy and sulphur cinquefoil among others) infestations tend to follow old 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 it isn't grazed by either wildlife or livestock.

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, resulting in reduced native plant diversity and producing areas dominated by monocultures of non-native grass which results in decreased forage value for wildlife and permitted livestock.

Dalmatian toadflax and yellow toadflax are both aggressive invasive plant species that are present on the Black Hills NF. Like many other invasive plant species in the forest both species thrive in disturbed, open habitats and can outcompete and easily dominate native or desirable plant communities (USDA Forest Service 2013b). Canada thistle and leafy spurge are two examples of noxious weeds that have spread throughout South Dakota and cover thousands of acres of previously native ecosystems (South Dakota Game and Fish 2014). Changes in tree establishment and succession due to the recent MPB outbreak can result in increases of invasive plant species and noxious weeds due to the lack of overstory which would normally shade these species out. In all cases, it is uncertain exactly how the resident plant community composition is changing due to this encroachment and increased competition, but it is likely that diversity overall is decreasing, as has been seen in most plant invasions.

In some areas of the Great Basin, high densities of cheat grass (*Bromus tectorum*) increase fire severity by increasing fine fuel loads and shortening the fire return intervals. At some locations, cheatgrass-fueled wildfires have converted native grasses and sagebrush habitats to cheatgrass-dominated landscapes (Wyoming Game and Fish Department 2017). While cheat grass infestations on the Black Hills NF have not reached the point where they're altering the fire regime, if cheat grass occurrences increase, the forest may see changes like those occurring in the Great Basin.

Following the MPB 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 comprised of seedlings and saplings and forest structure 3a is defined as a forest structure comprised of young forest with zero to thirty nine 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 NF due to the number of snags present because of the MPB 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).

The Black Hills NF uses the Watershed Condition Framework (WCF) to classify the functioning condition of watersheds on National Forest System lands (more information about the WCF is presented in the Soils and Watershed Assessment). The WCF 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 WCF and for the Black Hills NF. As of 2017, a total of 54 watersheds out of 95 (57%) watersheds on the Black Hills NF are functioning properly with regards to

terrestrial invasive species. An additional 39 watersheds out of 95 (41%) are functioning at risk with regards to invasive species. Only 2% of watersheds are classified as impaired function regarding invasive species (see map in Appendix A).

The WCF also includes an aquatic biological indicator, which includes a sub-indicator for exotic and/or invasive species. The sub-indicator is functioning properly for 53% of watersheds (50 of 95), functioning at risk for 27% of watersheds (26 of 95) and at risk in 20% of watersheds (19 of 95). The WCF indicates that aquatic invasive species are potentially more of an impairment than terrestrial invasive species since 20% of sub-watersheds are impaired with respect to aquatic invasive species versus 2% 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. Years of average or above average precipitation, and forest management practices leave trees less stressed, lessening the chances of insect and disease infestation. Overall, conditions such as climate change have the potential to bring about more frequent insect and disease outbreaks while enabling invasive species to take root or expand in the Black Hills NF.

The Black Hills NF 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 comprised of 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 the reduction 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.

What If?

Climate change will result in warmer temperatures in the Black Hills NF. This may result in earlier snowmelt and prolonged growing seasons as well as a shift in predominant winter precipitation from snow to rain. 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 MPB. A major population controller of MPB populations is extreme cold during the winter. These weather events act to reduce populations of MPB 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 NF also reached this conclusion. The increase 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.

There will likely be dramatic interactions between climate change and invasive species infestations that are not yet understood (USDA Forest Service 2013b). Some ecosystems may become more vulnerable to invasion if native vegetative becomes stressed. Changes in the frequency and severity of natural

disturbance regimes (i.e., floods, droughts, fires) could present opportunities for invasive species to gain a foothold where they are not presently located. Climate change could also benefit cool season non-native grasses that are already outcompeting native grasses throughout the Black Hills NF.

Inconsistent Federal budgets can lead to inconsistent and inadequate survey, monitoring, and treatment of insects, disease, and invasive species on National Forest System lands. This can be especially problematic because mitigating and controlling these issues relies on early detection and rapid response.

Increased recreation pressure, and increased demand for water and land-based recreation, has the potential to spread ANS to water bodies that are currently not infested.

Management

Forest Plan 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 MPB 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 MPB 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 R2 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 so as 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 ten 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:
  - R2 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 R2 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 R2 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.

Forest Plan associated National Environmental Policy Act documentation will document how the Plan will comply with these directives.

Actions of Others

The South Dakota Department of Agriculture and Natural Resources has the authority to identify and 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 ANS in the State's waterways.

The Wyoming Department of Agriculture is responsible for the identification and management of weeds and pests in the State. 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 ANS.

Chapter 3. Public Participation in the Planning Process

This section may have some placeholders until after the public has had chance to review the assessment reports and the Forest Service has completed other public engagement activities.

Public Interest

The most likely to be interested in this topic are those currently who live or recreate in or near the Black Hills NF or those who rely on the timber resources for their livelihoods. Pending additional outreach, this section will be revised to reflect current interest and comments.

Future Involvement

Pending additional outreach, this section will answer how do stakeholders want to be informed about this topic as the planning process proceeds.

Public Information Needs

Pending additional outreach, this section will answer what is confusing about this topic and what follow-up could improve understanding?

Chapter 4. Conclusions

Insects, disease, and invasive species have had profound effects on the Black Hills NF and present an ongoing management need.

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Appendix A: Map Documents

The following maps are provided as separate PDF documents on the forest plan revision assessment 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.