Assessment of Invasive Species in Alaska and its National Forests

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Executive Summary

This document assesses the current status of invasive species in Alaska's ecosystems, with emphasis on the State's two national forests. Lists of invasive species were developed in several taxonomic groups including plants, terrestrial and aquatic organisms, tree pathogens and insects. Sixty-three plant species have been ranked according to their invasive characteristics. Spotted knapweed, Japanese knotweed, reed canarygrass, white sweetclover, ornamental jewelweed, Canada thistle, bird vetch, orange hawkweed, and garlic mustard were among the highest-ranked species. A number of non-native terrestrial fauna species have been introduced or transplanted in Alaska. At this time only rats are considered to be causing substantial ecological harm. The impacts of non-native slugs in estuaries are unknown, and concern exists about the expansion of introduced elk populations in southeast Alaska. Northern pike represents the most immediate concern among aquatic species, but several other species (Atlantic salmon, Chinese mitten crab, and New Zealand mudsnail) could invade Alaska in the future. No tree pathogen is currently damaging Alaska's native tree species but several fungal species from Europe and Asia could cause considerable damage if introduced. Four introduced insects are currently established and causing defoliation and tree mortality to spruce, birch, and larch. The results of this assessment will be used to develop a strategy to manage invasive species by applying the principles of prevention, early detection, control, and rehabilitation in cooperation with different agencies and partners throughout Alaska.

Introduction

Invasive species threaten the integrity and sustainability of the world's ecosystems at a time of fluctuating global climate regimes, increasing disturbance—both natural and human caused—and expanding human populations (Simberloff et al. 2005, Pimentel et al. 2000). Until recently, Alaskan ecosystems have remained relatively isolated from invasive species. The state's geographic location, harsh climatic conditions, vast wilderness areas, and sparse human population with limited road access and few transportation corridors have contributed to this protective isolation (Fay 2002, Union of Concerned Scientists 2003). Increased global and national concern regarding the impact of invasive species on ecosystems and biodiversity has propelled natural resource agencies, managers, and scientists to investigate the threats posed to Alaskan ecosystems.

Species are considered invasive if they are not native to an ecosystem, and are likely to cause harm to human health, the economy, or the environment (Executive Order 13112 1999). Interagency working groups such as the statewide Alaska Committee for Noxious and Invasive Plant Management (CNIPM) are beginning to accumulate information on invasive species present or with potential to appear in Alaska. Compared to the contiguous United States and Canada, Alaska currently has fewer aggressive invasive species because of its largely remote landscape and harsh climate (National Agricultural Library 2005, Canadian Wildlife Federation 2003, Fay 2002). However, invasive species are expected to increase and expand in range as transportation networks expand, traffic and travelers increase throughout the Alaskan landscape, and other changes in disturbance patterns and climate occur.

Invasive species alter Alaskan ecosystems by displacing or preying on native species, contaminating gene pools by interbreeding with native species, and through widespread killing of native species, as seen with invasive insects in native forests. Invasive animals have been intentionally introduced for sport hunting or commercial endeavors such as furbearer farms. Invasive plants may originate from escaped ornamental plants, seeding after road construction projects, or as hitchhikers on equipment or gear. Some invasive plant species occur primarily in areas that have been heavily disturbed, such as road corridors. Others, such as nitrogen-fixing plants spread readily where there is any opportunity for them to germinate (such as in riparian areas). Invasive forest insects and pathogens are typically introduced via ornamental plants or forest products.

Scope and Approach

The purpose of this Invasive Species Assessment is to inform USDA Forest Service resource managers, land owners, and other interested people of the known and anticipated threats to Forest Service land from invasive species as identified in Executive Order 13112 (1999). In this assessment, we review all non-native freshwater and terrestrial organisms known to occur on lands managed by the Forest Service in Alaska. Invasive plants, forest pathogens, and forest insects that occur in other parts of the state are included because State and Private Forestry provide technical and financial assistance to address these threats on all forested lands. We also consider species that do not now occur in Alaska, but if introduced have the potential to cause damage. Lag effects may exist between the initial recording of a non-native species and its establishment and dispersal into surrounding ecosystems (Sakai et al. 2001, Alpert et al. 2000, Williamson 1996). These lag times are important to consider given the rapidly fluctuating climatic and disturbance regimes in Alaska.

We have compiled summary assessments for each taxonomic group, a conclusion section outlining priority species in each group, and a comprehensive table of common and scientific species names. We also identify whether each organism occurs in Alaska yet, and provide a relative ranking of invasiveness.

Invasive Plants

Alaska's vast and varied landscapes support plant communities in diverse environments ranging from coastal rainforests and wetlands, to boreal forests and tundra environments,

and newly emerged land surfaces at the edges of retreating glaciers and lands rebounding from glacial melt. Invasive plants may have long-term effects on Alaska native plant communities by displacing and outcompeting native plants. Extreme temperature, moisture, and light gradients at northern latitudes regulate plant composition and diversity of native ecosystems. These factors also limit the establishment and spread of invasive plant species. It is unknown how shifting climatic patterns may affect plant community vulnerability to invasion, especially if combined with disturbance, either natural or human caused. Compared to the lower 48 states, Alaska has a low level of invasive plant colonization. However, as inventories for non-native species have increased, more invasive plants have been located. Spotted knapweed (*Centaurea biebersteinii* DC), one of the worst invaders in the interior West, has been found at five different locations in the state (Alaska Exotic Plant Information Clearinghouse 2005), and may be arriving in the state on vehicles and machinery.

More than 130 non-native plant species have been identified in Alaska (Alaska Exotic Plant Information Clearinghouse (AKEPIC) 2004). Many of these species are naturalized, and others will remain contained to suburban yards or locally disturbed sites. Currently, 63 more common non-native plants have been ranked for invasiveness in Alaska on a 0-100 scale (Alaska Weed Ranking Program (http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm)), with resulting values falling between 34 and 89 (as of April 2005). Of these 63 species, 29 have an invasive ranking of 60 or greater, indicating a significant threat for invasion (Table 1). This list is still being compiled and is expected to contain nearly 100 species upon completion[1]. A number of species ranked in this project have not yet been found in Alaska but are likely to arrive soon. The ranked species range from known destructive species such as Japanese knotweed (*Polygonum cuspidatum Sieb & Zucc.*) and reed canarygrass (*Phalaris arundicacea* L.) to the common and benign pineapple weed (*Matricaria discoidea DC*).

Alaska currently has two statewide programs in place to track and rank invasive plant species in Alaska: the Alaska Exotic Plant Information Clearinghouse (2005) database and the Weed Ranking Program. The Weed Ranking Program was initiated and funded by the USDA Forest Service, Forest Health Protection Program to better assess what species will be most problematic within Alaskan ecosystems. Both of these programs are coordinated by the Alaska Natural Heritage Program and are collaborative efforts with the USDA Forest Service, Forest Health Protection Program, National Park Service, USDA Agricultural Research Service, University of Alaska Anchorage, University of Alaska Fairbanks Cooperative Extension Service, and US Geological Survey.

In ranking the invasiveness of a particular species within the framework of the Weed Ranking Project, the invasive characteristics of plants are evaluated according to their potential and actual occurrence in Alaska within three broad climatic zones: South Coastal, Interior-Boreal, and Arctic-Alpine. The ecological impact of a species on ecosystem processes is also factored into the invasiveness score. This is measured by the

[1] Shephard, Michael. 2005. Personal Communication. Ecologist, USDA Forest Service, State and Private Forestry, Suite 202, 2201 'C' Street, Anchorage, AK 99503

ability of a species to alter plant community composition and structure, its reproduction and dispersal capabilities (both natural and disturbance-enhanced), impacts higher on the food chain, and occurrence in wetland or riparian habitats. Other considerations in the invasiveness ranking include assessing global distribution, known impacts in natural areas, and feasibility of control and management.

Highly invasive plants compete effectively for resources and generally have aggressive reproductive mechanisms. On a positive note, many of these species also have rather limited dispersal capabilities, thereby increasing the chance of successful control in small populations. All of these highly invasive plants are easily spread by human activities. These species may produce many seeds or possess aggressive sprouting characteristics. In some species, any part of the plant is capable of reproducing, not just the seeds, roots and stems. Many highly invasive plants in Alaska frequently form dense thickets of vegetation and have seeds that can remain viable in soil for more than 3 years. Many of our invasive plants establish with or without ground disturbance, constituting an increased threat to native plant communities once they are introduced. Additional characteristics of highly ranked invasive plants in Alaska include recent or historical presence on three or more continents (frequently with successful invasion occurring in arctic/subarctic environments), classification as a noxious weed in most of the lower 48 states or Canada, and once established, generally requiring major long-term investment to control.

Statewide, the highest ranking invasive plant species include spotted knapweed (*Centaurea biebersteinii* DC), Japanese knotweed (*Polygonum cuspidatum* Sieb & Zucc.), reed canarygrass (*Phalaris arundicacea* L.), white sweetclover (*Melilotus alba* Medikus), ornamental jewelweed (*Impatiens glandulifera* Royle), cheatgrass (*Bromus tectorum* L.), Himalayan blackberry (*Rubus discolor* Wiehe & Nees), Canada thistle (*Cirsium arvensis* L. Scop.), bird vetch (*Vicia cracca* L.), orange hawkweed (*Hieracium aurantiacum* L.), garlic mustard (*Alliara petiolata* (Bieb.) Cavara & Grande), false brome (*Brachypodium sylvaticum*. (Huds.) Beauv), and Scotch broom (*Cytisus scoparius* (L.) Link). High ranking species not yet occurring in Alaska include: Eurasian milfoil (*Myriophyllum spicatum* L.), Atlantic cordgrass (*Spartina alternifolia* Loisel.), and giant hogweed (*Heracleum mantegazzianum* Sommier & Levier) (Table 1). Because of the large number of invasive plants, readers are referred to the comprehensive Weed Ranking Project website (http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm) for detailed information about each species.

Eradication of invasive plants is an important activity in any Invasive Species Program, and must be linked with native plant restoration and effectiveness monitoring programs. Decisions to undertake treatment are based on several factors including a landscape analysis of sensitive habitats, site vulnerability, modes of spreading, and traits of individual species including reproductive mechanisms and dispersal capabilities. Certain species with a lower invasive ranking overall may be a higher priority for treatment and control over a more highly ranked species, based on a specific threat. For example, treatments to prevent Canada thistle from entering a wetland or garlic mustard from overtaking a subsistence berry patch would likely be higher priorities than eradicating

knotweed restricted to the roadside, even though knotweed is considered a more aggressive invasive species. Likewise a species that is ranked relatively low may be important to eradicate if it is a small, incipient population that only occurs at a few sites across the state. Individual site evaluations will be needed to determine appropriateness and priority of treatments.

Increasing awareness of invasive plants within urban/rural gardening communities is an important prevention activity. Common mullein (*Verbascum thapsus*) scored 53 in the Weed Ranking Project and is unfortunately being tried as an ornamental planting by gardeners in south-central Alaska. By adding this species to its "Do Not Plant" list, the Cooperative Extension Service is attempting to eradicate small populations of this plant before it naturalizes[2].

Although invasive plant populations in Alaska are currently small, in time these populations can be expected to expand and may compromise natural ecosystems and habitats (Williamson 1996). By acting now with comprehensive inventories and eradication, monitoring, and prevention strategies, the threat from invasive plants may be manageable. It is important to recognize, however, that no other state or Canadian province has been successful in limiting the spread of invasive plants to date. Results of current invasive plant surveys conducted in Alaska suggest highest invasive plant occurrences in areas of local disturbance, including industrial, commercial, and residential sites, highways and roads, campgrounds, trailheads, and other recreational areas (DeVelice 2003, Duffy 2003, Lapina and Carlson. 2005). The Alaska Committee for Noxious Invasive Plant Management (CNIPM) formed recently as a statewide network to deal with invasive plant issues, and is an important resource for individuals and organizations interested in managing invasive plants (Alaska Committee for Noxious and Invasive Plants Management 2004). Local collaborative efforts to target species of concern must be developed to make decisions on eradication, as the nature of threat will be different across the range of environmental and site conditions. Target species in the interior of Alaska may be different than in coastal areas because of climate variation, number of roads, and wetland and wilderness habitats that may facilitate or limit spread of invasive plants.

Preventing the spread of invasive plants requires the cooperation of community members and organizations to provide a unifying focus for various land management activities. Cities and boroughs, environmental groups, and others must work collaboratively with land management agencies to prevent invasive plants from spreading within local communities and across the Alaskan landscape.

Invasive (and Non-native) Terrestrial Animals

Although non-native terrestrial animal species are found in Alaska, few are considered invasive or threatening to ecosystem health and integrity. In this assessment we identify terrestrial animals that have been introduced to coastal habitats in Alaska, even if they are not considered to be invasive at this time. Rats and other rodents, raccoons, hares,

[2] Shephard, Michael. 2005. Personal Communication. Ecologist, USDA Forest Service, State and Private Forestry, Suite 202, 2201 'C' Street, Anchorage, AK 99503

pigeons, starlings and slugs have been introduced to southeast and south-central Alaska and occur on National Forest lands. Some species were transplanted in various Alaskan locations to establish additional hunting or trapping opportunities. Elk were introduced to Afognak Island and southeast Alaska, and marten and red squirrels were transplanted into new habitats in southeast Alaska. Other introduced species include foxes, rabbits, muskox and bison; however, none of these species occupy habitats on National Forest lands.

Concentrations of Norway rats (*Rattus norvegicus* Berkenhout) occur throughout Alaska, in areas of human settlement or on coastal islands with abundant food resources. Rats likely became established along Alaska coastal islands following shipwrecks of early European explorers. Seaports continue as points of entry today (Jarrell et al. 2001). Ground-nesting birds can be negatively affected when rats colonize islands, as observed in the Aleutian and Queen Charlotte Islands (Murie 1959). This has resulted in a rat-trapping program in the Alaska Maritime Refuge System and in the Aleutian and Pribilof Islands. It is unknown what impacts rats may be having on nesting shorebirds of forested islands and other habitats in coastal Alaska. Small rodents, in particular the house mouse (*Mus musculus* Linnaeus), are likely to occur in close proximity to human habitation. House mice are commensally adapted with people, and although they are present throughout the state, exact local distributions are unknown (National Wildlife Federation 2003). There is no evidence of serious harm caused by mice.

Raccoons (*Procyon lotor* Linnaeus) were first introduced in the mid-1930s on Long Island near Kodiak and on Baranof and Prince of Wales Islands (Jarrell et al. 2001). Later introductions occurred in southeast Alaska, but with limited survival of individuals. The current population distribution of raccoons in Alaska is very small and not considered a threat to coastal Alaskan ecosystems.

Snowshoe hares (*Lepus americanus* Erxleben) were transplanted to Juneau and Douglas Island in 1924, as well as to Kodiak Island and several Aleutian Islands (Davis 1979). Generally, introductions of hares and rabbits to the wet, forested islands of southeast Alaska have been unsuccessful, with hares persisting elsewhere in low numbers. Any detrimental impact is considered to be low.

Rock doves or pigeons (*Columba livia*) and starlings (*Sturnus vulgaris*) are both well established in the cities and boroughs of Alaska north to Fairbanks (Kessel 1979, Gibson and Andres 2002). These birds are often considered pests by humans, but may not pose threats to wildlife species in Alaska. Although starlings are known as competitors to other cavity-nesting birds, the extent of their impact in Alaska in unknown.

Garden slugs (*Arion* sp.) have been found in clusters in small towns and boroughs in Alaska, most notably Anchorage, Cordova, and Yakutat. The European black slug (*Arion ater*) and leopard slug (*Limax maximus*), the most common species in Alaska, were most likely imported on horticultural materials. People in Anchorage and Cordova have raised concerns about slugs invading home gardens. It is assumed that slugs are able to overwinter in Cordova and Yakutat, and there is some concern that slugs may

move from towns into adjacent wetland habitats. It is unknown if non-native slugs are invasive or pose a threat to native vegetation or communities (Wittwer 2005),

Elk (*Cervus elaphus* Linnaeus) are not native to Alaska but were historically introduced to develop sport-hunting opportunities in south-central and southeast Alaska. Although elk are not traditionally considered an invasive species, questions exist about the effects of their population expansion. As early as 1929 elk were successfully transplanted to Afognak Islands (Van Daele and Crye 2004), but early attempts at transplants were unsuccessful in southeast Alaska. In 1987 elk were successfully established on Etolin Island in southeast Alaska (Lowell 2004). The established population on Afognak still persists, as does the population on Etolin and Zarembo Islands in southeast Alaska. Sightings have been reported for five other islands in southeast Alaska including Wrangell, Mitkof, Kupreanof, Prince of Wales and Farm islands (USDA Forest Service 2005). There are concerns that increasing elk densities will result in increased competition with native Sitka black-tailed deer (*Odocoileus hemionus* Rafinesque), an important subsistence and sport-hunting species. There is wide overlap in the habitat and diets of these two species and increases in elk population densities may lead to declines in deer densities where the two species occur together (Lowell 2004).

Range extensions of native species have been encouraged by transplants of individual animals from one area into unoccupied suitable habitats. These transplants are generally viewed as beneficial to improve hunting and trapping opportunities, but the transplanted animals may also be considered non-native to that particular system. Sitka black-tailed deer have been introduced to Prince William Sound, Yakutat, and Kodiak/Afognak Islands (Alaska Department of Fish and Game 2003). American marten (*Martes Americana* Turton) and red squirrels (*Tamiasciurus hudsonicus* Erxleben) were released in southeast Alaska to support expanding furbearer populations. Red squirrels were released on Baranof, Chichagof, and Admiralty Islands in the 1930s to supplement the diet of marten, and are not considered invasive (USDA Forest Service undated). American marten were released on Prince of Wales and Baranof Islands in 1934 and to Chichagof Island in 1949. Marten are well-established on these islands and now exist on adjacent islands. There has been recent recognition of two species of pine marten (*Martes americana* and *Martes caurina*), the latter being native to southeast Alaska (MacDonald and Cook 2000). It is unknown whether populations of *M. americana* have different life history strategies than *M. caurina*, although populations of both species may be found in places such as Admiralty Island. It has been suggested that divergence in life history traits may be reflected in different responses to forest management in southeast Alaska.[3] [4]

The European rabbit (*Oryctolagus cuniculus* Linnaeus) occurs on several islands in Alaska (Burris and McKnight 1973). Harvestable populations of European rabbits have

[3] Cook, J. 2005. Personal Communication. Professor, Department of Biological Sciences, Idaho State University, Pocatello, Idaho.
[4] Smith, W. 2005. Personal Communication. Research Wildlife Ecologist, USDA Forest Service, Forestry Sciences Lab, Juneau, Alaska 99801

evolved from unknown numbers introduced in the Aleutian Archipelago on Umnak Island in 1930 and on Rabbit Island in 1940. The time of the release on Hog Island (near Amuknak Island) is unknown. One male and three female rabbits placed on Middleton Island in the Gulf of Alaska in 1954 (O'Farrell 1965) produced a population of between 3,600 and 7,000 by 1961. These rabbits are primarily vegetarians; although there may be negative effects to native vegetation, there may be benefit to avian predators such as eagles.

The threats from invasive animals in Alaska at this point in time are very low, with a few exceptions. Rats are detrimental in coastal ecosystems because they prey on bird nests and impact breeding bird colonies; yet, little is known of rat distribution across coastal forests of Alaska. Other species of interest include non-native slugs and any effects they may be having on native vegetation in estuaries and marshes. It is unknown if these slugs escape the borders of towns such as Yakutat and Cordova, and move into sensitive environments. While elk are not considered an invasive species generally, population numbers of this introduced species are increasing in southeast Alaska. Negative effects are expected for local deer populations, and management plans will need to consider these factors. Because the Alaska Department of Fish and Game has primary responsibility for wildlife in Alaska, any considerations of invasive wildlife management must be coordinated through the Department.

Invasive Aquatic Organisms

Aquatic ecosystems in Alaska are some of the most pristine environments in the world. These high-quality habitats support important subsistence fish harvests, world class sport and commercial fishing opportunities, and a variety of outstanding recreational activities. Maintaining these high-quality environments in Alaska is a priority for all land management agencies. Aquatic habitats may be the most vulnerable to invasion by non-native species because of inherent transport capabilities of flowing water.

A number of non-native fish have been introduced into Alaskan waters over time. Fish species diversity is quite low in Alaska compared to other high-latitude regions of the world, due to physical barriers and geologic history. This has led to illegal introduction of fish from other high-latitude environments in order to establish new fishing opportunities. Because of the wide seasonal ranges in temperature, many of these introduced northern species are extremely hardy and adaptable. These introductions, along with inadvertent transplants of non-sport organisms, pose a serious threat to aquatic ecosystems in Alaska.

Eleven aquatic species are included in this assessment. Six species have already established breeding populations in National Forest lands and other areas in Alaska and include northern pike (*Esox lucius* Linnaeus*)*, yellow perch (*Perca flavescens*), red-legged frog (*Rana aurora*), Pacific chorus frog (*Pseudacris regilla*), rainbow trout (*Oncorhynchus mykiss* Walbaum), and brook trout (*Salvelinus fontinalis*). The other five species are not established in Alaska yet, but cause widespread problems in the lower 48 states and could become problematic in Alaska. These species of concern are the Atlantic salmon (*Salmo salar),* Chinese mitten crab (*Eriocheir sinesis*), New Zealand

mudsnail (*Potamopyrgus antipodarum* Gray**)**, goldfish (*Carassius auratus*), and the signal crayfish (*Pacifacstacus leniusculus*).

The northern pike was identified as the species of greatest immediate concern in the Alaska Aquatic Nuisance Species Management Plan (Fay 2002). The pike is native (endemic) to interior Alaska but not to Cook Inlet drainages, to Prince William Sound drainages, or, with the exception of one isolated population, to southeast Alaska (Fay 2002). Introduced populations of pike have become established throughout the Susitna River drainage, parts of the Kenai system, and a series of small ponds in Yakutat. These introduced populations have proven to be able to spread quickly and virtually eliminate other species in some habitats (Fay 2002). Pike may have a significant effect on salmon production in these systems. Once the introduced population spreads into a complex habitat of interconnected bodies of water, it is likely impossible to control or eliminate. The introduced population in Yakutat may still be contained within the small pond system. If this is so, it could be eliminated before it spreads throughout the Yakutat forelands.

The other five species that have known established populations are the yellow perch, red-legged frog, Pacific chorus frog, rainbow trout, and brook trout. The yellow perch was likely established in a small lake on the Kenai Peninsula by a person wishing to establish a new sport fishery (Fay 2002). This population is thought to have been removed with the use of pesticides.

Introduced non-native frogs have the potential to displace native amphibians from local ecosystems. The red-legged frog, native to the Pacific Northwest, has established populations on Chichagof Island throughout the Pavlov Bay drainage (MacDonald 2003). It is thought they were released there by a schoolteacher at the Freshwater Bay logging camp in 1982 or 1983. Frogs seen elsewhere on the island, near Freshwater Bay and possibly Hoonah, may be this species (MacDonald 2003). Recent surveys suggest range expansion of this species, and the red-legged frog is now found in several drainages along the west coast of Chichagof Island. Its impact to local ecosystems is unknown. At a minimum, the red-legged frog may displace endemic boreal toads (*Bufo boreas*) and/or wood frogs (*Rana sylvatica*). The red-legged frog's ability to persist and spread across drainages may represent a significant threat to local amphibian populations.
The introduced Pacific chorus frog has an established breeding population in a single pond complex on Revilla Island near Ward Lake. This population is thought to have been established in the 1960s (MacDonald 2003). Because boreal toads and rough-skinned newts (*Taricha granulose* Skilton) have successfully reproduced within the same pond complex in recent years, we may conclude that the population of chorus frogs is having little impact on native amphibians. However, this situation may change over time.

Rainbow trout and brook trout were stocked throughout southeast and south-central Alaska through the early 1900s (Fay 2002). The transplanted rainbow trout were from endemic stocks as well as from populations in the lower 48 states. The brook trout were brought up from the lower 48 and introduced to provide new sport fishing opportunities. Accurate records of these original introductions generally do not exist, and most did not

result in self-sustaining populations. The few successful introductions, however, have resulted in a number of healthy rainbow and brook trout populations scattered throughout the Tongass and Chugach National Forests. There is little concern about negative impacts, however, because endemic rainbow populations occur throughout both forests and negative impacts have not been recorded in species that share habitat with the introduced rainbow trout. Introduced brook trout are another story. Generally, where brook trout have become established, endemic Dolly Varden (*Salvelinus malma* Walbaum) are not found. The brook trout may have eliminated the endemic Dolly Varden populations, or it is possible Dolly Varden did not initially exist in these systems. Introduced brook trout populations have been a major contributing factor to the significant declines in bull trout (*Salvelinus confluentus* Suckley) populations in the Pacific Northwest (Rieman et al. 1977).

Since the 1970s, Atlantic salmon that escaped from salmon farming operations in British Columbia have had access to Alaska's coastal waters and fresh water streams. They appear in the commercial saltwater catch and occasionally in fresh water (Alaska Department of Fish and Game 2002). Reproduction has not been observed in Alaska; however, reproduction has taken place in British Columbia streams (Alaska Department of Fish and Game 2002, Volpe et al. 2000). There are concerns that established populations of Atlantic salmon could have significant negative impacts on the local salmon and trout populations and related industries. Control or elimination of established Atlantic salmon populations may be possible depending on the size and complexity of the watersheds involved. Alaska Department of Fish and Game has extensive information regarding Atlantic salmon at the following website: http://www.adfg.state.ak.us/special/as/as_home.php.

Chinese mitten crab, the New Zealand mudsnail, and goldfish are exotics that have become established in the Pacific Northwest and could become established in Alaska in the near future (Fay 2002). The Chinese mitten crab is likely transported by sea-going ships through the uptake and discharge of ballast water. This catadromous species (migrating from freshwater to the sea to breed) has significantly altered the ecosystems in places where it has become established (Sea Grant Washington 2000). Mitten crabs are highly mobile, and efficient predators that in large numbers can cause impacts to local fish populations and to commercial fishing operations (Fay 2002). Alaska Department of Fish and Game has extensive information regarding the Chinese mitten crab at the following website: http://www.wsg.washington.edu/outreach/mas/nis/mittencrab.html.

The New Zealand mudsnail is an exotic organism recently introduced to the western United States, and is currently documented in all western states except New Mexico (Montana State University 2005, U.S. Fish and Wildlife Service 2004). This organism can quickly colonize freshwater environments and dominate the invertebrate community. The mudsnail can alter aquatic ecosystems by consuming large portions of the food resources, outcompeting and physically crowding native species. Mudsnails are spread via fishing gear such as boots and waders, as well as by boat trailers and other equipment.

Goldfish have become a nuisance species throughout the world (Fossa 2004).

The one known established breeding population of goldfish in Alaska occurred on the Clear Airforce Base and was eradicated with the use of pesticides. This population established in a power plant water cooling system and became very dense before successful eradication (Fay 2002). Five large goldfish were removed from a small pond near the Mendenhall Glacier near Juneau, Alaska in 2002. Analysis of the scales showed that the fish were in the wild for 3 years prior to their capture and that they grew very well in the wild[5]. Goldfish could become a problem in small streams and ponds that are important for rearing salmon but do not have many larger predatory fish. This might be the case in some of the smaller urban streams. The mitten crab, mudsnail and goldfish are examples of species that could have impacts on the endemic salmon and trout populations and the industries that rely on them. Once established, control or elimination of these species is unlikely.

The signal crayfish is endemic to the western United States but has become an invasive species throughout the world (Fay 2002). Single individuals have been found on Kodiak Island and near Kenai. Breeding populations have not been found in Alaska, however. Where they have become invasive in many parts of Europe, they have had significant impacts on the local ecosystems (Scottish Fisheries Research Service 2005) by preying on local crayfish, carrying disease, preying on fish eggs and fry, and altering aquatic trophic structures.

An additional aquatic species, the invasive plant Eurasian milfoil, is a threat to aquatic systems. Although not documented yet in Alaska, it is a serious problem throughout the lower 48 states (National Invasive Species Council 2005). This species can become established by the introduction of small pieces of stem material, and is spread through the aquarium industry as well as by boats, trailers, and other water sports equipment. Once established, Eurasian milfoil can dominate its new environment with thick mats that shade out endemic plant species. It can reduce species diversity and increase eutrophication in some pond habitats. Eurasian milfoil is hard to control and likely impossible to eradicate once it is established. Refer to the Invasive Plant section of this document and the associated references for more information about Eurasian milfoil.

Aquatic ecosystems in Alaska are vulnerable to introduced organisms that could seriously impact system function and cause declines in native fish populations. While all of the introduced aquatic organisms are of concern, existing populations of northern pike generate the highest current threat to aquatic systems. If Atlantic salmon becomes established in coastal Alaska the impacts on native salmon populations could be severe. Similarly, introductions of Chinese mitten crab, New Zealand mudsnail, and crayfish will be difficult to control if breeding populations become established. Consideration of invasive aquatic species management must be coordinated through the Alaska Department of Fish & Game.

[5] Martin, D. 2005. Fisheries Ecologist. Personal observation. USDA Forest Service, Alaska Regional Office, Juneau, Alaska 99802

Invasive Pathogens

Invasive pathogens have had devastating ecological, economic, and social effects on forests in the United States (Anonymous 1991, Liebold et al. 1995, Ciesla 2002). White pine blister rust (*Cronartium ribicola*), Dutch elm disease (*Ceratocystis ulmi*), chestnut blight (*Cryphonectria parasitica*) and more recently, sudden oak death (*Phytophthora ramorum*) are all examples of large-scale tree mortality to native tree species. In each example, the native tree species lacked genetic resistance to the introduced pathogen because the two did not co-evolve. In the example of chestnut blight, the introduced pathogen killed every chestnut tree in its native range (Worrall 2005). Alaskan forests may be particularly vulnerable to introduced pathogens because of the relatively small number of native tree species and their narrow genetic base. Many pathogenic fungi primarily disseminate by spores on air currents and can quickly spread over large distances. The introduction of a single pathogen capable of killing one of Alaska's tree species could have enormous consequences for forest ecosystems throughout the state.

Fortunately, to date, Alaskan forests have not been affected by any such introduced tree pathogen (Holsten et al. 2001). Several tree pathogens are known to have been introduced, but their spread has been limited by the available host plants that each can infect. Fungal pathogens such as white pine blister rust (*Cronartium ribicola*) and black knot (*Apiosporina morbosa*), and the bacterial fire blight pathogen (*Erwinia amylovora*) have been introduced into ornamental plantings at several locations, but these organisms are not capable of causing widespread damage to our native tree species (Wittwer 2004).

Without any known significant introductions, the regional strategy for pathogens will focus on prevention and early detection. Unfortunately, the national database on invasive tree pathogens ("EXFOR", North American Forest Commission Exotic Forest Pest Information System http://spfnic.fs.fed.us/exfor/) has few entries on pathogens that could threaten Alaskan tree species. Thus, an assessment of such pathogens is underway by USDA State and Private Forestry forest health specialists, and will be completed in late 2005. This is challenging because minor tree pathogens in their endemic ranges can become epidemic and become agents of major tree mortality on new hosts and in new environments. This assessment evaluates pathogens native to Europe and Asia that attack tree species whose genera are represented in Alaska (e.g., spruce (*Picea*), hemlock (*Tsuga*), birch (*Betula*), etc.), and determines the type of disease they cause, their climatic limitations, and avenues of movement. The type of disease caused (i.e., root, stem canker, vascular wilt, foliar) can indicate the most likely means of introduction. This preliminary assessment has yielded the names of 13 pathogens that are not presently in Alaska, but if introduced, could threaten our native tree species. Species such as *Chrysomyxa abietis* (foliar rust of spruce), *Didymascella chamaecypari* (cedar shot hole), *Cistella japonica* (resinous stem canker), *Seiridium cardinale* (foliar and stem cankering pathogen of cedars), *Phytophthora lateralis* (root disease of cedar), and *Taphrina betulina* (foliar disease of birch) are among the potentially damaging fungi. The pine wilt nematode (*Bursaphelenchus xylophilus*) could cause a vascular wilt to spruce and pine in Alaska, and if ever introduced with its insect vector (the sawyer beetles, *Monochamus* spp.), would disrupt export of spruce wood from Alaska. Our assessment also documents

that many species of tree pathogens already have a circumpolar distribution and are native throughout Europe, Asia, and North America, including Alaska.

Knowledge of probable pathways for potential introductions will be the cornerstone of prevention and early detection. Most tree pathogens are likely to be introduced on live plant material, with ornamental plants in urban areas and towns as the most probable source. Christmas trees and wood products represent other likely sources. Thus, prevention will be conducted through public outreach efforts such as leaflets, brochures, and education and training sessions. The preliminary evaluation of potential pathogens from around the world will provide the names of pathogens that will be the focus of early detection. Monitoring for these potential pathogens occurs in nurseries and landscaping plant outlets, and will also involve observations on native trees located in strategic locations as bio-assays for early detection. Control of any introduced pathogen that is considered threatening should be conducted before it becomes established. Historically, eradication or control of established pathogens has been extremely difficult. Evaluation of economic or ecological impact should be conducted to justify the cost and any negative environmental consequences of control efforts. Restoration usually involves programs aimed at breeding for disease resistance to re-establish the native tree species that was affected. Such programs are expensive, involve long-term commitment, but have proven to be effective.

Currently, no serious outbreaks of invasive tree pathogens are found in Alaska. Thus, prevention and early detection will be the focus of most management effort toward invasive tree pathogens. The foliar rust of spruce, *Chrysomyxa abietis*, probably represents the largest potential threat. Other noteworthy potential pathogens include the foliar, stem, and root fungi of cedars, the foliar pathogen of birch, and pine wilt nematode of spruce and pine.

Invasive Insects

Invasive insects are among the most serious threats to forest ecosystems of the United States, including Alaska (Mattson 1997). Insects that are native to Canada and the lower 48 states as well as species introduced from other continents threaten native Alaskan ecosystems. The movement of insects into Alaska from the lower 48 or Canada is the most serious, and most likely threat, regardless if these insects originate from the North American continent or not. Because Alaska is increasing its role in international trade, other likely pathways of introduction for exotics are ports-of-entry. Once established, introduced insect populations can explode, and potentially bring about widespread ecological change to Alaska's forested ecosystems (Mattson 1997).

To date, several invasive species have become established in the forests of Alaska (Wittwer 2005). Some examples are larch sawfly (*Pristiphora erichsonii*), alder woolly sawfly (*Eriocampa ovata*), spruce aphid (*Elatobium abietinum*), and amber-marked birch leafminer (*Profenusa thomsoni*). Spruce aphid was probably introduced into southeast Alaska about 80 years ago, but appears to be causing more damage to spruce as the climate warms. Present on the continent for over 100 years, the amber-marked birch leafminer was introduced into south-central, interior, and southeast Alaska in the late

1990s. Populations are now established, and severe defoliation on more than 100,000 acres has occurred in south-central Alaska. The western tent caterpillar (*Malacosoma californicum*), a native to the lower 48 and Canada, has also been introduced into the Anchorage Bowl three times on nursery stock used for landscaping. Fortunately, these introduced populations were quickly eradicated.

Prevention is the first priority and will be conducted through public outreach efforts such as leaflets, brochures, and education and training sessions. This outreach will target both the public and natural resource managers and will focus on the risks and dangers associated with introduced insect pests. One such example of early detection and rapid response is the gypsy and nun moth trapping that is being conducted throughout Alaska. USDA Animal and Plant Health Inspection Service (APHIS) and the Integrated Pest Management Technician Program initiated this pheromone-based detection and trapping system over a decade ago, and it will likely continue on an annual basis. Likewise, a National Exotic Woodborer/Bark Beetle Early Warning Detection Program has been initiated in Alaska and will be carried out annually in cooperation with Alaska State and Private Forestry, Forest Health Protection staff and specialists from the Alaska State Division of Forestry.

A biological control program for the amber-marked birch leafminer is underway. A host-specific parasitoid was released in south-central Alaska in 2004 and releases will continue in 2005 and 2006. This is a cooperative program of the USDA APHIS & FS, Alaska Division of Forestry, University of Alberta, Canadian Forestry Service, and the Municipality of Anchorage.

The introduced larch sawfly has defoliated thousands of acres of tamaracks and caused extensive mortality throughout Alaska's interior forests. This insect was introduced to south-central Alaska and is defoliating ornamental Siberian larch as far south as Homer. Evaluations are ongoing to determine the amount and extent of larch mortality, and to determine if genetic conservation practices are needed to restore these severely impacted forested ecosystems.

When the insects on the list of current and potential invasive insect species are carefully considered using not only immediate tree mortality, but the ability to potentially alter an entire natural system, three species rise to the top. A European scolytid bark beetle (*Ips typographus)* has the potential to destroy large swaths of spruce forest throughout Alaska and greatly impact commercial forestry; the amber-marked birch leaf miner causes widespread defoliation of all species of birch found in Alaska, but has an unknown long-term effect on forest ecosystems; and the larch sawfly (*Pristiphora erichsonii)* which effectively kills over 80% of any larch tree attaining four inch diameter breast height and thus alters stand composition and threatens a tree species that exists in Alaska at the edge of its range where it has difficulty regenerating.

Conclusions

This invasive species assessment has identified 176 non-native species present in Alaska (Table 1). To date, 42 of these species pose a significant threat for invasion. Sixty-three plants are ranked according to their invasive characteristics and need to be assessed individually within an ecosystem context for relative importance. The highest ranking invasive plant species include Eurasian water-milfoil (not yet found in Alaska), spotted knapweed, Atlantic cordgrass (not yet found in AK), Japanese knotweed, reed canarygrass, giant hogweed (not yet found in AK), white sweetclover, purple loosestrife (no escapement in AK yet), ornamental jewelweed, cheatgrass, Himalayan blackberry, Canada thistle, bird vetch, orange hawkweed, garlic mustard, false brome, and Scotch broom. Additional plant species will be added to the Weed Ranking Project over time, so readers are encouraged to stay current with these changes.

Although many non-native wildlife species have been introduced or transplanted in Alaska, with the exception of rats in coastal ecosystems, and possibly slugs in estuaries and elk in southeast Alaska, none are considered invasive at the present. Of the nine invasive aquatic organisms identified as threats for Alaska, established populations of northern pike pose the greatest immediate concern, while the Atlantic salmon, Chinese mitten crab, and New Zealand mudsnail are species likely to invade Alaska in coming years.

Invasive tree pathogens are not currently damaging Alaskan ecosystems, but there are numerous species that could cause widespread tree mortality if introduced. Four introduced insects are currently established in Alaska: the larch sawfly, alder woolly aphid, spruce aphid, and amber-marked birch leafminer. These insects are causing widespread tree defoliation and mortality. A number of exotic insects pose a potential threat and are related primarily to transport of infested plant and wood products.

Managing invasive species on National Forest lands in Alaska will be challenging. More information must be made available to managers and landowners. Improved interagency cooperation and development of cooperative invasive species management partnerships is needed to contain Alaskan invasive species populations at current levels. The Forest Service is addressing invasive plant management through the Alaska Region Invasive Plant Strategy (2005) and the Chugach and Tongass National Forest Invasive Plant Management Guides (2005). Within the Forest Service, various approaches are in place to address four action elements in the National Strategy and Implementation Plan for Invasive Species Management (USDA Forest Service 2004). These four elements include **prevention, early detection and rapid response, control, and restoration**. Based on this Invasive Species Assessment, a Forest Service Alaska Region Invasive Species Strategy will be prepared during 2005.

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Table 1. Complete list of invasive species considered threats for invasion to National Forest Land in Alaska including plants, terrestrial fauna, aquatic organisms, insects and pathogens.

Invasive Plants

	Common name	Scientific name	Present in Alaska?	Invasive ranking
1	Eurasian water-milfoil	*Myriophyllum spicatum* L.	No	89
2	Spotted knapweed	*Centaurea biebersteinii* DC	Yes	88
3	Atlantic cordgrass, saltmarsh cordgrass, smooth cordgrass	*Spartina alternifolia* Loisel.	No	86
4	Japanese knotweed	*Polygonum cuspidatum* Sieb & Zucc.	Yes	84
5	reed canarygrass, canarygrass	*Phalaris arundicacea* L.	Yes	83
6	Giant hogweed	*Heracleum mantegazzianum* Sommier & Levier	No	81
7	White sweetclover	*Melilotus alba* Medikus	Yes	80
8	Cheatgrass	*Bromus tectorum* L.	Yes	78
9	Ornamental jewelweed	*Impatiens glandulifera* Royle	Yes	78
10	Purple loosestrife, spike loosestrife	*Lythrum salicaria* L. & L. *virgatum* L.	No	78
11	Himalayan blackberry	*Rubus discolor* Wiehe & Nees	Yes	77
12	Canada thistle	*Cirsium arvensis* L. Scop.	Yes	76
13	Bird vetch, cow vetch, tufted vetch	*Vicia cracca* L.	Yes	75
14 15	Orange hawksweed, devil's paintbrush & meadow hawkweed	*Hieracium aurantiacum* L. and *Hieracium caespitosum*	Yes	71
16	Garlic mustard	*Alliara petiolata* (Bieb.) Cavara & Grande	Yes	70
17	False-brome	*Brachypodium sylvaticum*. (Huds.) Beauv.	No	70
18	English broom, scotch broom	*Cytisus scoparius* (L.) Link	Yes	69
19	Bush honeysuckle	*Lonicera tatarica* L.	No	67
20	Siberian pea shrub	*Caragana arborescens* Lam.	Yes	65
21	Yellow sweetclover, king's crown	*Melilotus officinalis* (L.) Lam	Yes	65
22	Common dandelion	*Taraxacum officinale* G.H. Weber ex Wigg	Yes	64
23	Foxtail barley	*Hordeum jubatum* L.	Yes	63
24	Yellow toadflax, butter and eggs	*Linaria vulgaris* Miller	Yes	63
25	Ragwort, stinking willie	*Senecio jacobaea* L.	Yes	63
26	Smooth brome	*Bromus inermis* ssp. *inermis* Leyss.	No	62
27	Oxeye daisy, white daisy	*Leucanthemum vulgare* Lam.	Yes	61
28	Bull thistle, common thistle	*Cirsium vulgare* (Savi) Ten.	Yes	60
29	European bird cherry	*Prunus padus* L.	Yes	60
30	Quackgrass, couchgrass, dog grass	*Elymus repens* (L.) Gould	Yes	59
31	Perennial sowthistle, moist sowthistle	*Sonchus arvensis* L. ssp. *uliginosis* (Bieb.) Nyman	Yes	59
32	White clover, ladino clover	*Trifolium repens* L.	Yes	59
33	Common tansy, garden tansy	*Tanacetum vulgare* L.	Yes	58
34	Baby's breath	*Gypsophila paniculata* L.	No	57
35	Kentucky bluegrass	*Poa pratensis* L.	No	57
36	Sulphur cinquefoil	*Potentilla recta* L.	No	57
37	Alsike clover	*Trifolium hybridum* L.	Yes	57
38	Common timothy	*Phleum pratense* L.	Yes	56
39	Perennial sowthistle	*Sonchus arvensis* L.	Yes	56

Invasive Plants Cont.

	Common name	Scientific name	Present in Alaska?	Invasive ranking
40	Bigleaf lupine	*Lupinus polyphyllus* Lindl.	Yes	55
41	Creeping buttercup and tall buttercup	*Ranunculus repens* L. and *Ranunculis acris* L.	Yes	54
42	European mountain ash, rowan	*Sorbus aucuparia* L.	Yes	53
43	Common mullein	*Verbascum thapsus* L.	No	53
44	Ground ivy	*Glechoma hederacea* L.	No	52
45	Winter vetch	*Vicia villosa* Roth	No	52
46	Purple foxglove	*Digitalis purpurea* (L.)	Yes	51
47	Annual bluegrass	*Poa annua* L.	Yes	51
48	Common yarrow	*Achillea millefolium* var. *millefolium* L.	Yes	49
49	Sneezewort	*Achillea ptarmica* L.	Yes	47
50	Flixweed	*Descurainia sophia* (L.) Webb ex Prantl.	Yes	47
51	Yellow salsify, goat's bear	*Tragopogon dubius* Scop.	Yes	47
52	Scentless false mayweed,	*Tripleurospermum perforata* (Merat) M.	Yes	
53	Scentless chamomile	Lainz		47
54	Dame's rocket	*Hesperis matronalis* L.	No	45
55	Common plantain	*Plantago major* L.	Yes	44
56	Narrow-leaf hawk's beard	*Crepis tectorum* L.	Yes	43
57	Split-lip hemp-nettle	*Galeopsis bifida* Boenn. and G. *tetrahit* L.	Yes	43
58	Common brassbuttons	*Cotula coronopifolia* L.	No	42
59	Lambsquarters	*Chenopodium album* L.	Yes	35
60	Narrow-leaved hawkweed	*Hieracium umbellatum* L.	Yes	35
61	Disc mayweed, pineappleweed	*Matricaria discoidea* DC.	Yes	34
62	Bouncing bet, soapwart	*Saponaria officinalis* L.	Yes	34
63	Wall lettuce	*Mycelis muralis* (L.) Dumort.	No	32
64	Crested wheatgrass	*Agropyron cristatum* L. Gaertn.	Yes	No Rating
65	Creeping bentgrass, red top	*Agrostis gigantea* Roth	Yes	No Rating
66	Colonial bentgrass	*Agrostis tenuis* Sibth.	Yes	No Rating
67	Water foxtail	*Alopecurus geniculatus* L.	Yes	No Rating
68	Meadow foxtail	*Alopecurus pratensis* L.	Yes	No Rating
69	Redroot pigweed	*Amaranthus retroflexus* L.	Yes	No Rating
70	Western pearly everlasting	*Anaphalis margaritacea* (L.) Benth.	Yes	No Rating
71	Mayweed, stinking chamomile	*Anthemis cotula* L.	Yes	No Rating
72	Tower rockcress	*Arabis glabra* L. Bernh.	Yes	No Rating
73	Chickpea milkvetch, cicer milkvetch	*Astragalus cicer* L.	Yes	No Rating
74	Wildoats	*Avena fatua* L.	Yes	No Rating
75	Rape	*Brassica napus* L.	Yes	No Rating
76	Field mustard	*Brassica rapa* L.	Yes	No Rating
77	Purple-topped turnip	*Brassica rapa* L. var. rapa	Yes	No Rating
78	Soft brome	*Bromus hordeaceus* L.	Yes	No Rating
79	Hedge false bindweed	*Calystegia sepium* (L.) R. Br. ssp. sepium	Yes	No Rating
80	Shepherd's purse	*Capsella bursa-pastoris* (L.) Medik.	Yes	No Rating
81	Larger mouse-eared chickweed	*Cerastium fontanum* Baumg. ssp. triviale (Link) Jalas	Yes	No Rating
82	Sticky chickweed	*Cerastium glomeratum* Thuill.	Yes	No Rating

Invasive Plants Cont.

	Common name	Scientific name	Present in Alaska?	Invasive ranking
83	Pitseed goosefoot	*Chenopodium berlanderieri* L.	Yes	No Rating
84	Chicory	*Cichorium intybus*	Yes	No Rating
85	Field bindweed	*Convolvulus arvensis*	Yes	No Rating
86	Orchard grass	*Dactylis glomerata* L.	Yes	No Rating
87	Delphinium	*Delphinium sonnei* Greene	Yes	No Rating
88	Slender hairgrass	*Deschampsia elongata* (Hook.) Munro	Yes	No Rating
89	Siberian wild rye	*Elymus sibiricus* L.	Yes	No Rating
90	Slender wheatgrass	*Elymus trachycaulus*	Yes	No Rating
91	Wormseed wallflower	*Erysimum cheiranthoides* L. subsp. *cheiranthoides*	Yes	No Rating
92	Common dogmustard	*Erucastrum gallicum* (Willd.) O.E. Schulz*	Yes	No Rating
93	Wormseed mustard	*Erysimum cheiranthoides* L. subsp. cheiranthoides	Yes	No Rating
94	Tall fescue	*Festuca arundinacea* (Schreb.) S.J. Darbyshire	Yes	No Rating
95	Brittlestem hempnettle	*Galeopsis tetrahit* L.	Yes	No Rating
96	Annual (common) sunflower	*Helianthus annuus* L.	Yes	No Rating
97	Mouseear hawkweed	*Hieracium pilosella* L.	Yes	No Rating
98	Leporinum barley	*Hordeum murinum* L. spp leporinum (Link)	Yes	No Rating
99	Common barley	*Hordeum vulgare* L.	Yes	No Rating
100	Common St. Johnswort	*Hypericum perforatum* L.	Yes	No Rating
101	Cat's-ears	*Hypochoeris radicata* L.	Yes	No Rating
102	European beggar's lice	*Lappula myosotis* Moench	Yes	No Rating
103	Prickly lettuce	*Lactuca serriola* L.	Yes	No Rating
104	European stickweed	*Lappula squarrosa*	Yes	No Rating
105	Fall dandelion	*Leontodon autumnalis* L.	Yes	No Rating
106	Common pepperweed	*Lepidium densiflorum* Schrad	Yes	No Rating
107	Pineneedle toadflax	*Linaria pinifolia*	Yes	No Rating
108	Italian rye grass	*Lolium multiflorum* Lam.	Yes	No Rating
109	Perennial rye grass	*Lolium perenne* L.	Yes	No Rating
110	Maltesecross	*Lychnis chalcedonica* L.	Yes	No Rating
111	Yellow alfalfa	*Medicago falcata* L.	Yes	No Rating
112	Black medic, hop clover	*Medicago lupulina* L.	Yes	No Rating
113	Burr medic	*Medicago minima*	Yes	No Rating
114	Blfalfa	*Medicago sativa* L.	Yes	No Rating
115	Night-flowering catchfly	*Melandrium noctiflorum* (L.) Fries	Yes	No Rating
116	Spearmint	*Mentha spicata*	Yes	No Rating
117	True forget-me-not	*Myosotis scorpioides* L.	Yes	No Rating
118	Ball mustard	*Neslia paniculata* (L.) Desv.	Yes	No Rating
119	Iceland poppy	*Papaver nudicaule* L.	Yes	No Rating
120	Canary grass	*Phalaris canariensis* L.	Yes	No Rating
121	Ribgrass, buckhorn, English plantain	*Plantago lanceolata* L.	Yes	No Rating
122	Canada bluegrass	*Poa compressa* L.	Yes	No Rating
123	Glaucous bluegrass	*Poa glauca* Vahl.	Yes	No Rating
124	Fowl bluegrass	*Poa palustris* L.	Yes	No Rating

Invasive Plants Cont.

	Common name	Scientific name	Present in Alaska?	Invasive ranking
125	Spreading bluegrass	*Poa subcoerulea* Sm.	Yes	No Rating
126	Rough bluegrass	*Poa trivialis* L.	Yes	No Rating
127	Knotweed	*Polygonum aviculare* L.	Yes	No Rating
128	Black bindweed, wild buckwheat	*Polygonum convolvulus* L.	Yes	No Rating
129	Willow weed	*Polygonum lapathifolium* L.	Yes	No Rating
130	Silverweed	*Potentilla anserina* L.	Yes	No Rating
131	Norwegian cinquefoil	*Potentilla norvegica* L.	Yes	No Rating
132	Sheep sorel	*Rumex acetosella* L. ssp. acetosella	Yes	No Rating
133	Curled dock	*Rumex crispus* L.	Yes	No Rating
134	Garden dock	*Rumex longifolius* DC.	Yes	No Rating
135	Bitter dock	*Rumex obtusifolius* L.	Yes	No Rating
136	Common groundsel	*Senecio vulgaris* L.	Yes	No Rating
137	Green bristlegrass	*Setaria virdis* L. Beauv.	Yes	No Rating
138	Red catchfly	*Silene dioica* (L.) Clairville	Yes	No Rating
139	Bladder campion	*Silene latifolia* Poir.	Yes	No Rating
140	White mustard	*Sinapis alba* L.	Yes	No Rating
141	Tumbling mustard	*Sisymbrium altissimum* L.	Yes	No Rating
142	Spurry	*Spergula arvensis* L.	Yes	No Rating
143	Purple sand spurry	*Spergularia rubra* (L.) J.& K. Presl	Yes	No Rating
144	Common chickweed	*Stellaria media* (L.) Vill.	Yes	No Rating
145	Common comfrey	*Symphytum officinale*	Yes	No Rating
146	Pennycress	*Thlaspi arvense* L.	Yes	No Rating
147	Red clover	*Trifolium pratense* L.	Yes	No Rating
148	Wheat	*Triticum aestivum* L.	Yes	No Rating
149	Thyme-leaf speedwell	*Veronica serpyllifolia* L. subsp. serpyllifolia	Yes	No Rating
150	Johnny jumpup	*Viola tricolor* L.	Yes	No Rating

Invasive Terrestrial Fauna

	Common name	Scientific name	Present in Alaska?	Invasive ranking
1	Norway rat	*Rattus norvegicus*	Yes	High
2	European black slug	*Arion ater*	Yes	Low
3	Garden slug	*Arion spp.*	Yes	Low
4	Leopard slug	*Limax maximus*	Yes	Low
5	Elk	*Cervus elaphus*	Yes	Moderate
6	House mouse	*Mus musculus*	Yes	Low
7	Starling	*Sturnus vulgaris*	Yes	Low
8	Rock dove	*Columba livia*	Yes	Low

Invasive Aquatic Species

	Common name	Scientific name	Present in Alaska?	Invasive ranking
1	Chinese mitten crab	*Eriocheir sinesis*	No	High
2	Northern pike	*Esox lucius*	Yes	High
3	Eurasian water-milfoil	*Myriophyllum spicatum*	No	High
4	Signal crayfish	*Pacifacstacus leniusculus*	Yes	High
5	Yellow perch	*Perca flavescens*	No	High
6	New Zealand mudsnail	*Potamopyrgus antipodarum*	No	High
7	Red-legged frog	*Rana aurora*	Yes	High
8	Atlantic salmon	*Salmo salar*	Yes	High
9	Pacific chorus frog	*Pseudacris regilla*	Yes	Low
10	Rainbow trout	*Oncorhynchus mykiss* Walbaum	Yes	Low
11	Brook trout	*Salvelinus fontinalis*	Yes	Low
12	Goldfish	*Carassius auratus*	Yes	Low

Invasive Pathogens

	Common name	Scientific name	Present in Alaska?	Invasive ranking
1	Spruce needle rust	*Chrysomyxa abietis* (Wallr.) Unger	No	High
2	Rhododendron-spruce needle rust	*Chrysomyxa ledi* var. *rhododendri* (de Bary.) Savile	No	Moderate
3	Resinous stem canker	*Cistella japonica* Suto et Kobayashi	No	Moderate
4	Cedar shot hole	*Didymascella chamaecyparidis* (J. F. Adams.) Maire	No	Moderate
5	Cedar leaf blight	*Lophodermium chamaecyparissi* Shir & Hara.	No	Moderate
6	Poplar rust	*Melampsora larici-tremulae* Kleb.	No	Moderate
7	Seiridium shoot blight	*Seiridium cardinale* (Wagener) Sutton & Gibson	No	Moderate
8	Phytophthora root disease	*Phytophthora lateralis* Tucker & Milbrath	No	Moderate
9	Needle and twig blight	*Acanthostigma parasiticum* (Hart.) Sacc.	No	Low
10	Black knot	*Apiosporina morbosa* (Schwein.:Fr.) Arx	Yes	Low
11	Pine wilt nematode	*Bursaphelenchus xylophilus*	No	Low
12	White pine blister rust	*Cronartium ribicola* J.C. Fischer: Rabh.	Yes	Low
13	Fire blight	*Erwinia amylovora* (Burrill) Winslow	Yes	Low
14	Sudden oak death	*Phytopthora ramorum* Werres deCock Man in't Veld	No	Low
15	Birch leaf curl	*Taphrina betulae* (Fckl.) Johans.	No	Low
16	Birch witches broom	*Taphrina betulina* Rostr.	No	Low
17	Valsa canker	*Valsa harioti*	No	Low

Invasive insects

	Common name	Scientific name	Present in Alaska?	Invasive ranking
1	Pine moth	*Dendrolimus pini* (L)	No	High
2	European spruce beetle	*Ips typographus* L.	No	High
3	Asian gypsy moth	*Lymantria dispar* L.	No	High
4	Nun moth	*Lymantria monacha* (L.)	No	High
5	Western and forest tent caterpillars	*Malacosoma californicum* (Packard) and *Malacosoma disstria* (Hübner)	No	High
6	Larch sawfly	*Pristiphora erichsonii* (Hartig)	Yes	High
7	Amber-marked birch leafminer	*Profenusa thomsoni* (Konow)	Yes	High
8	Brown spruce longhorn beetle	*Tetropium fuscum* (F.)	No	High
9	Woolly spruce aphid	*Adelges abietis* (L.)	No	Moderate
10	Hemlock woolly adelgid	*Adelges tsugae* Annand	No	Moderate
11	Asian longhorned beetle	*Anoplophora glabripennis* (Motschulsky)	No	Moderate
12	Larch casebearer	*Coleophora laricella* (Hübner)	No	Moderate
13	Spruce aphid	*Elatobium abietinum* (Walker)	Yes	Moderate
14	Birch leafroller	*Epinotia solandriana* L.	Yes	Moderate
15	Birch leafminer	*Fenusa pusilla* (Lepeletier)	Yes	Moderate
16	Larch engraver	*Ips cembrae* (Heer)	No	Moderate
17	European gypsy moth	*Lymantria dispar* (L.)	No	Moderate
18	Sitka spruce weevil	*Pissodes strobe* (Peck)	Yes	Moderate
19	Eastern spruce gall aphid	*Adelges piceae* (Ratzburg)	Yes	Low
20	Uglynest caterpillar	*Archips cerasivorana* (Fitch)	Yes	Low
21	Alder woolly sawfly	*Eriocampa ovata* (L.)	Yes	Low
22	European alder sawfly	*Hemichroa crocera* (Fourcroy)	No	Low
23	Birch-edge leafminer	*Heterarthrus nemoratus* (Fallen)	Yes	Low
24	Currantworm	*Nematus ribesii* (Scopoli)	Yes	Low
25	Strawberry root weevil	*Otiorhynchus ovatus* (L.)	Yes	Low
26	European pine shoot moth	*Rhyacionia buoliana* (Schiffermüller)	No	Low