

Spotted Knapweed, *Centaurea stoebe*, Early Detection and Rapid Response in Alaska

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Summary

Spotted knapweed, *Centaurea stoebe*, is targeted for eradication in Alaska because it presents a serious threat to natural and agricultural resources, and is present in few locations in Alaska. The enclosed report resulted from a 2 year project funded by the U.S. Fish and Wildlife Service (USFWS) through the American Recovery and Reinvestment Act (ARRA). Through this project each infestation of spotted knapweed was visited to confirm its continued presence or absence. The project implemented outreach advertisements through radio, the Milepost, and fliers distributed to passengers of the Alaska ferry system to foster public participation in prevention and early detection. We suggest prevention activities for land managers which include ensuring clean equipment is used if brought from sources outside Alaska. Habitat suitability was modeled from the presence of existing locations with the assistance of the U.S. Geological Survey (USGS). Finally, tasks to continue eradication and prevention efforts into the future are discussed.

Introduction

Spotted knapweed, *Centaurea stoebe*, is recorded as present or having occurred at 23 locations in Alaska. Of those original 23 locations only 5 infestations still persist. Infestations of such highly invasive plants are obvious high priorities for Early Detection and Rapid Response (EDRR) in Alaska.

Spotted knapweed is a notorious invasive plant that has infested millions of acres in the Western United States, and parts of Canada. Knapweed ranks 86/100 according to the Invasive Plant Ranking System for Alaska (Carlson et al. 2008). The ranking applies to the Interior Boreal and Southcoastal ecoregions of Alaska. The arctic and alpine ecoregions are not predicted to be vulnerable to spotted knapweed invasion.

Spotted knapweed is a biennial or short lived perennial with a showy purple flower that is shaped like an urn. For more information on identification see the description in "Invasive Plants of Alaska" (AKEPIC 2005) and Figure 1. Outside of Alaska knapweed is known to create dense stands that crowd out native and desirable plant species in both natural and farm ecosystems. The competitive advantages that spotted knapweed has over other species includes heavy seed production, 20,000 seeds or more (Royer and Dickinson 1999), and the use of allelopathy to inhibit competition of plants (Whitson et al. 2000).

Spotted knapweed along Turnagain arm



Photo courtesy Michael Rasy, University of Alaska, bugwood.org.

When knapweed takes over an area it forms thick stands often reducing native plant diversity, reducing forage quality in pastures and for wildlife. Winter-ranging elk, for example, are known to avoid knapweed infested areas (Rice et al 1997). Invaded areas of the Western United States, normally occupied by native bunch grasses, are known to have approximately three times as much sediment runoff as uninvaded areas (Rice et al. 1997). Increased erosion may present potential problems for water quality that could affect salmon and salmon habitat.

Spotted knapweed arrives to new habitats primarily through interactions with humans. Suspected routes of human dispersal of knapweed include dispersal on vehicles, machinery and aircraft, contaminated products such as hay, commercial seed and floral arrangements (Mauer et al. 1987).

Spotted knapweed eradication is an obvious priority for invasive plant management in Alaska. The combination of threat to resources, and limited number of known infestations lends to the possibility for eradication. Indeed eradication efforts for spotted knapweed in Alaska were already underway, however, the effort was inconsistent with little follow up and no coordination between agencies. The necessary stimulus for coordinating the eradication effort and increasing prevention efforts was provided by the American Recovery and Reinvestment Act.

Spotted knapweed, *Centaurea stoebe*, has been recorded at 23 different locations in Alaska, all in the Southeast or Southcentral region (Figure 1). During the summer of 2009 all known *C. stoebe* infestations were inventoried and treated by removing all *C. stoebe* plant parts found. This effort sought to evaluate the status of current infestations and to begin a coordinated statewide eradication effort.

Field work performed during the summers of 2009 and 2010 provided information necessary for a thorough evaluation of *C. stoebe* populations in Alaska. The Alaska Exotic Plant Information Clearinghouse (AKEPIC, <http://akweeds.uaa.alaska.edu>), a statewide database of invasive plant occurrences and management efforts, currently lists 17 unique *C. stoebe* sites, but it has been found at 23 distinct locations in Alaska.

In addition to the field work performed, research was conducted to compile a thorough history of each location. The geographical discontinuity of Alaskan *C. stoebe* infestations has led to inconsistent data collection, sharing, and control efforts. To better understand the *C. stoebe* inventory and management history all available site observation records were verified and original site observers were contacted for information that was previously not recorded in AKEPIC. These efforts have produced a more comprehensive understanding of *C. stoebe* infestations in Alaska, and are recorded here.

Summer 2009-2010 Fieldwork: Inventory and Eradication

2009-2010 inventory and control efforts confirmed *C. stoebe* persists at 7 of the 23 recorded infestations in Alaska seven populations are widely distributed, with one in a remote region of Prince of Wales Island, one on Kupreanof Island near Kake, one near Haines, three along Turnagain Arm (near Anchorage), and one newly discovered site in Anchorage (Figure 1). The extent of all known populations is small, with none extending beyond 0.5 acres in size. A summary of 2009 and 2010 inventory and management efforts for the 23 known infestations is provided here and in Tables 1 and 2. What follows is a chronology of activities fore each infestation of spotted knapweed in Alaska.

Turnagain Arm

Five *C. stoebe* infestations are recorded along the Seward Highway and Alaska Railroad corridor which parallels Turnagain Arm, bearing southeast from Anchorage. All infestations are located along the stretch of highway between Beluga Point and Indian. The first of these sites was found in 2003 by Michael Shephard (United States Forest Service, USFS). Additional infestations were recorded in the following years, with the most recent, at Beluga Point, found in 2008 by Michael Rasy (University of Alaska Fairbanks Cooperative Extension Service, CES). These infestations were hand pulled at least once annually by CES staff and others since they were found.

In 2009 and 2010 all Turnagain Arm sites were visited twice, surveyed with GPS equipment, and plants were hand-pulled when found. On June 22, 2009 Gino Graziano (DOA), Michael Rasy (CES), and Matt Keltzenberg (Alaska Railroad, ARR) surveyed all sites to evaluate the extent of the infestations. The surveys were conducted 200 meters along the highway or railroad surrounding each infestation. A visit was then conducted on June 23, 2009 by Gino Graziano (DOA), Michael Rasy (CES), Jeff Heys (United States Fish and Wildlife Service, USFWS), Rob Develice (USFS), and Matt Keltzenberg (ARR). *C. stoebe*

was found and pulled at 3 sites (Table 1 and 2) as follows: 54 plants at TURNAGAIN_01 (Beluga Point), 2 plants at TURNAGAIN_03 (Party World), and 16 plants at TURNAGAIN_04 (Falls Creek). No plants were found in surveys of TURNAGAIN_02 (Rainbow) and TURNAGAIN_05 (Indian).

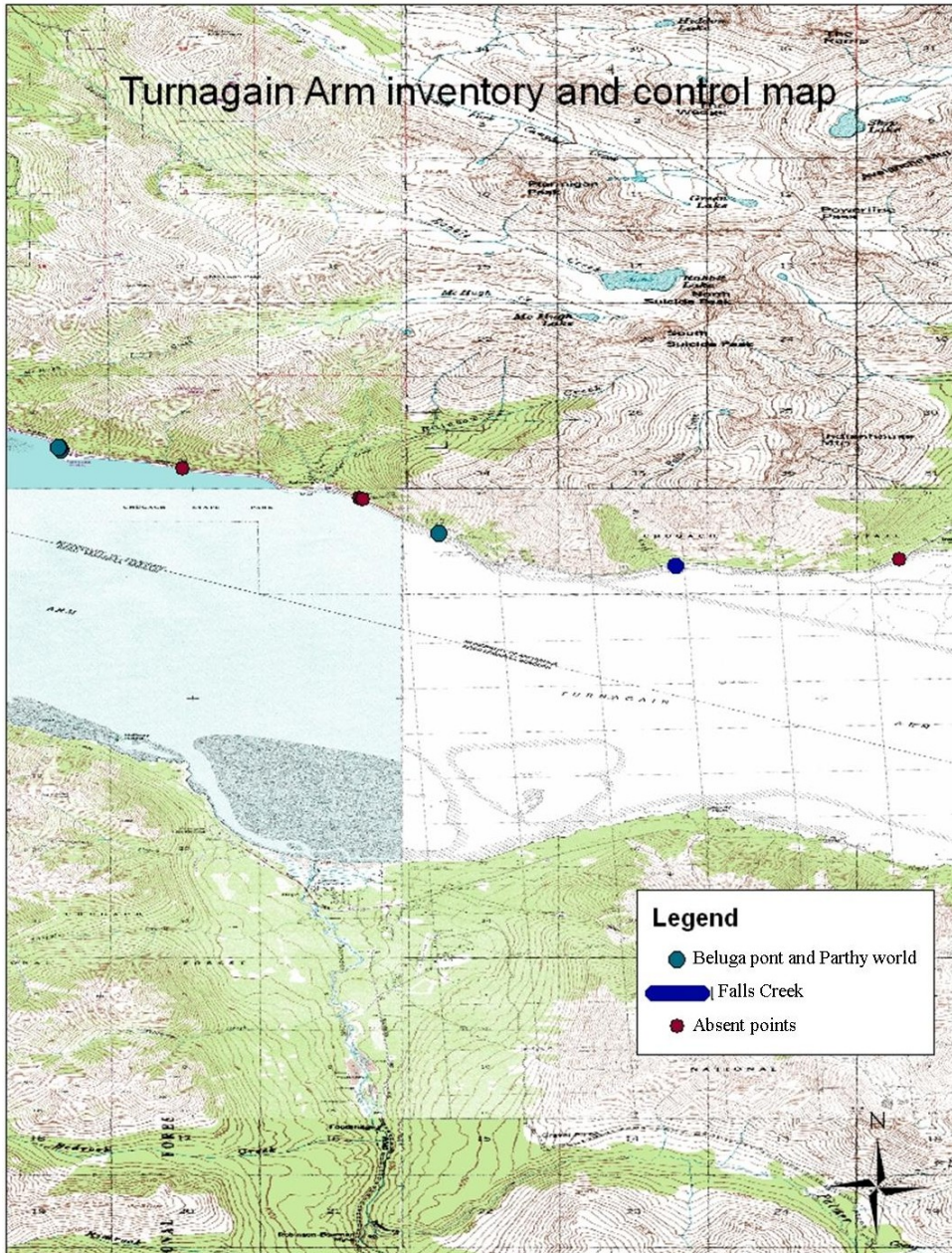
On September 10, 2009, Turnagain Arm sites were revisited by Andrew Weaver (DOA), Gino Graziano (DOA), Rob Develice (USFS), and an ARR employee. *C. stoebe* was again found at and removed from, Beluga Point (124 plants), Party World (20 plants), and Falls Creek (8 plants) (Table 2). No plants were found in surveys of the Rainbow and Indian sites.

2010 field work included two site visits, one on July 8th and the second September 16th. During these visits 87 (July) and 68 (September) stems were pulled at Beluga Point. 6 (July) and 8 (September) were found at Party world, and 4(July) and 0 (September) were found at the infestation near the Falls Creek trailhead. The other sites where infestations were previously recorded along Turnagain arm continue to have no regrowth of spotted knapweed.

Knapweed management along Turnagain Arm



Photos courtesy Jeff Heys USFWS



Latitude	Longitude	Location Notes
-149.69534	61.00724	Seward HWY, Beluga point between the roadside pullout and the railroad tracks around the West end of the parking area to 20 meters west of the parking area
-149.6353681	60.99743602	Seward HWY, Across the seward highway from the Rainbow trailhead, in a very narrow roadside meadow just east of a pull-off on the S side of the highway.
-149.61996	60.99062	Seward HWY, At climbing pullout South of Beluga point. Knapweed located on South side of the highway between the guard rail and the tracks, but up on the bluff above the tracks.
-149.57289	60.98428	Seward HWY, Near the Falls Creek trailhead below retaining wall on South side of highway about 100 m. east of the trailhead, next to the RR tracks.

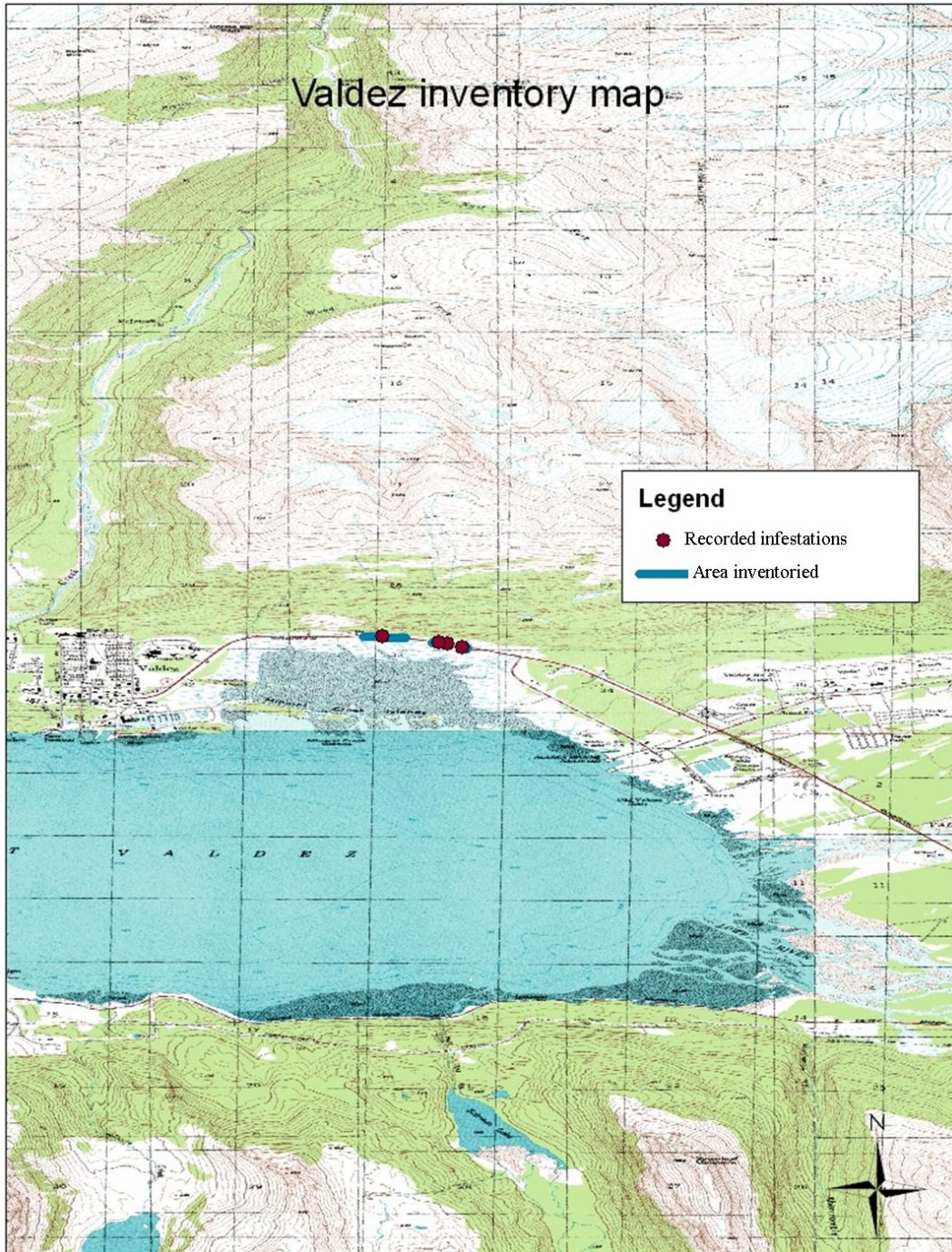
Valdez

Four *C. stoebe* infestations are recorded in AKEPIC for the Valdez area. All sites are found adjacent to a one mile stretch of the Richardson Highway located 3-4 miles East of Valdez. Here the highway skirts a large estuary, very near the location of the grain silos. Sites near Valdez were originally recorded by Michael Shephard (USFS) and Cynthia Snyder (USFS) on Aug. 11, 2004.

In 2009 all four sites were visited twice, on July 08 by Gino Graziano (DNR-PMC) and Trish Wurtz (USFS) and on August 09 by Andrew Weaver (DNR-PMC). Sites were located using GPS equipment and the roadsides were surveyed for 100 meters from the location of the reported infestations in each direction. No knapweed was found during these surveys (Table 1).

General area of reported infestations in Valdez





Latitude	Longitude	Location Notes
-146.3140709	61.13802935	Valdez, Infestation located on North side of the hiway approximately 1 mile from Forest Service Visitors center in Valdez
-146.3060305	61.13715952	Valdez, About 4 miles north of Valdez at turnout along estuary. Original AKEPIC site 04CLS007
-146.3047004	61.13694955	Valdez, About 3 miles north of Valdez along trail between highway and estuary
-146.3030935	61.136055	Valdez, About 4 miles north of Valdez at turnout along estuary

Prince of Wales Island

C. stoebe has been found at 5 locations scattered around Prince of Wales Island (POW), in Southeast Alaska. When initially detected, four of the five infestations consisted of single individuals, while the fifth infestation, found by Susan Wise-Eagle (retired USFS) in September of 2008, was significantly larger.

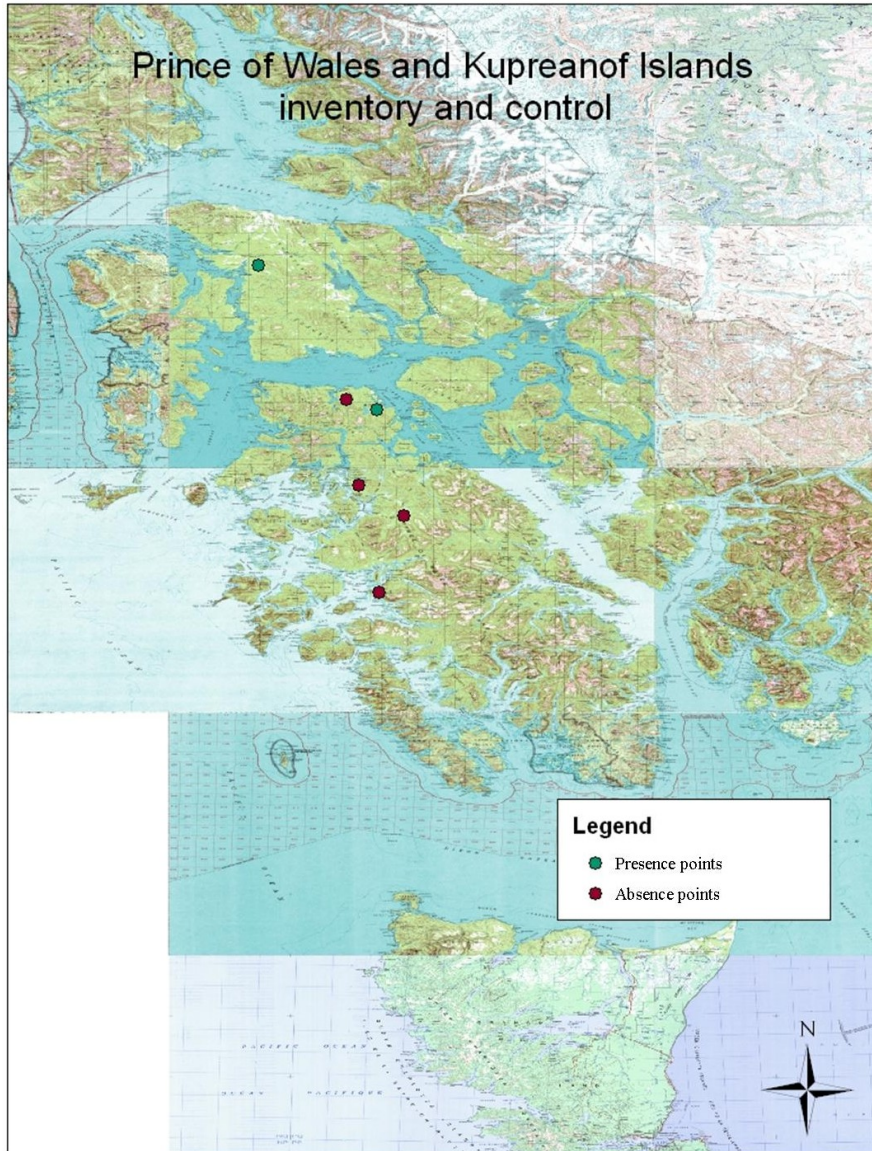
All sites were visited on June 28, 2009 by Kristen Lease (USFS) and Brad Kriekhaus (USFS), and at four of the five sites no knapweed was found (Table 1). The large infestation, found by Susan Wiseeagle (POW_02), was located in a small roadside pull-off in a remote region of the island near Salmon bay. As the infestation consisted of well over 1000 individuals, only those which seemed nearest to flowering were pulled at this time, about 400 plants (Table 2).

A follow-up visit to POW was conducted on September 01, 2009 by Andrew Weaver (DNR-PMC), Gino Graziano (DNR-PMC) and Kristen Lease (USFS), with knapweed again found only at POW_02 (Table 1 and 2). All visible plants were pulled from this site (approximately 1000 individuals), and a survey of the surrounding 3-5 acres of roadside was conducted, as well as a brief search of nearby forested areas. Additional *C. stoebe* found growing next to the road and also in the median, about 25 meters to the North and South of the main infestation was pulled and the sites flagged. No knapweed was found in nearby forested areas.

In 2010 the remaining infestation on POW was visited twice during the summer season. During the July visit 1210 plants were removed from the site, and on 500 plants were removed on September 22. The other knapweed sites on POW were visited in 2010 with no remaining infestations found.

Prince of Wales Island infested area typical of Southeast Alaska Tongass National Forest infested areas.





Latitude	Longitude	Location Notes
-133.6332404	56.83670138	Kupreanof Island. Plants located at a pullout approximately 100 yards up FS road 6337 from FS road 6314. Plants on both sides of the road from the pullout headed towards FS road 6314. None were seen further up the road or in the areas surrounding this.
-133.2699066	56.2827348	POW, 2.75 miles from FR 2000 at intersection, before gate.
-133.22236	55.93205201	POW, Road 20, directly across from Sarkar Lake boat launch
-133.14812	56.24157	POW, Wide spot on FR 30, at an old shovel landing on the East side of the road. Also on the E side of the road, 4 plants were found 25 m. South of the main infestation, 1 plant was found 35 m. North of main infestation. Several plants were found in the r
-133.13631	55.48945	Industrial park lot emmediately adjacent to water.
-133.0363958	55.80716462	POW, 11.0 miles from JCT 929
-133.2699066	56.2827348	POW, 2.75 miles from FR 2000 at intersection, before gate.

Kupreanof Island, Kake

C. stoebe was reported at one site on Kupreanof Island, alongside a logging road near the town of Kake. It was first reported here in 2005 by Katie Arhangelsky and T. Martin (Turnstone Environmental Consultants, Inc.).

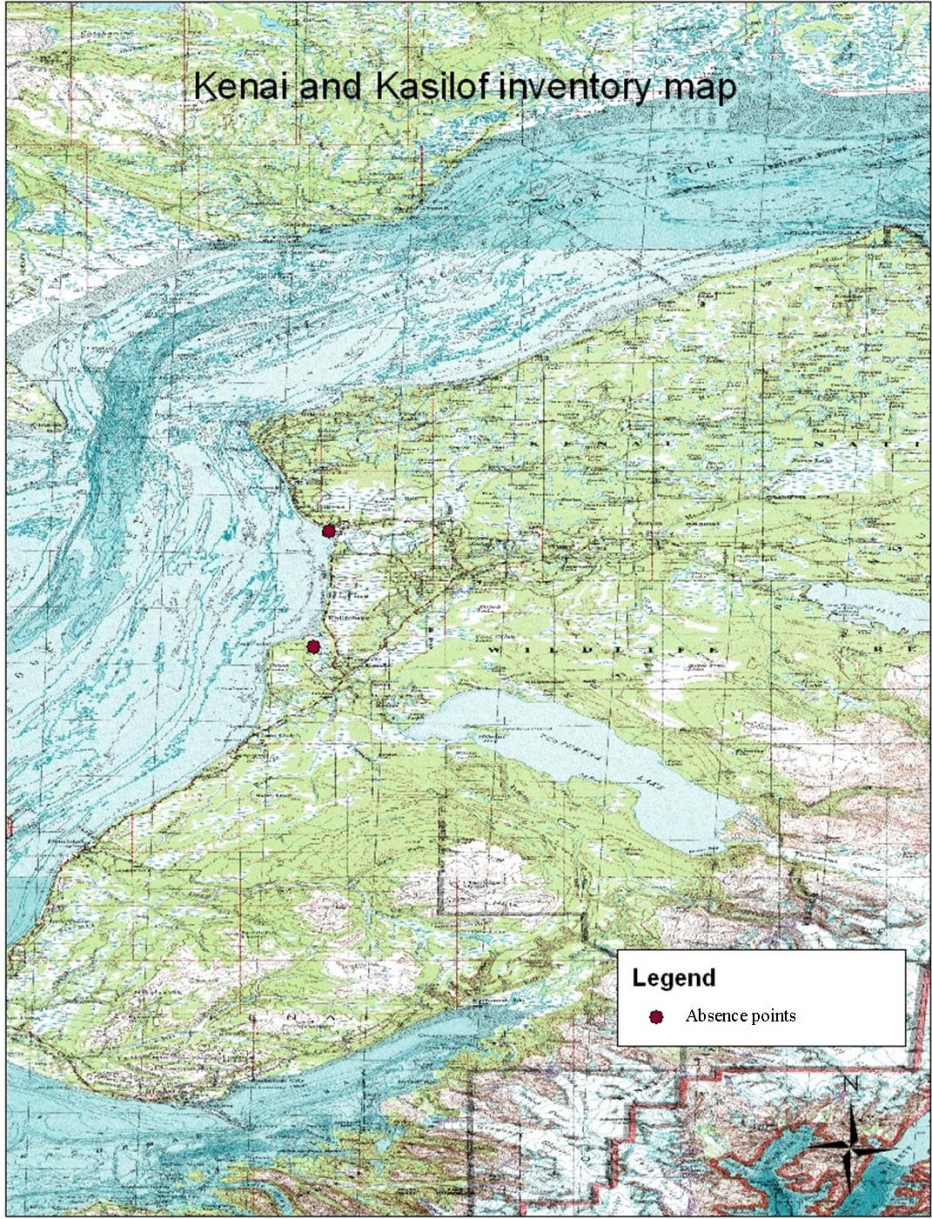
This site was visited on August 04, 2009 by Gino Graziano (DNR-PMC) and Mary Clemmens (USFS). *C. stoebe* was found growing on both sides of forest road 6337, near a pull-off. One hundred and two plants were pulled, many in flower (Table 2). The adjacent roadsides were surveyed for 100 meters in each direction with no additional knapweed found.

In 2010 the site was visited twice. On June 30th, 51-150 (exact stem count was not recorded) plants were found and pulled. On September 21st, 30 plants were found and pulled.

Kenai/Kasilof

A lone *C. stoebe* plant was found and pulled in 2005 by Janice Chumley (UAF-CES) on a gravel roadside of the Kenai Spur Highway near Gill Street. Janice also responded in 2006 to a citizen-reported infestation which consisted of a single spotted knapweed plant. This reported infestation was located in a garden at a private residence on Ness Street, near Kasilof.

Both of these sites were visited by Gino Graziano (DNR-PMC) and Janice Chumley (UAF-CES) on July 15, 2009. The roadside adjacent to KENAI_01 was surveyed for 100 meters in both directions, with no knapweed found (Table 1). The KASILOF_01 residence was visited, and the property searched, with the landowner's permission. No knapweed was found in the original garden location or on any other part of the property (Table 1). Janice Chumley remains the monitorer of these sites.



Latitude	Longitude	Location Notes
-151.30597	60.36494	Kaslof, Plant originally found in garden next to fence, in portion of garden next to the driveway. House is located on Ness Street.
-151.28233	60.56025	Kenai Spur highway, near Gill Street next to a speed limit sign approximately 50 yards from Gill street

Haines

C. stoebe has been found at two locations along the Haines highway. It was initially reported by Michael Shephard (USFS) and Tom Heutte (USFS) in 2004 at mile 24 of the highway near the bridge over the Chilkat River (HAINES_01). An additional site (HAINES_02) was found near highway mile 11 in 2005 by Roy Josephson (Alaska Department of Natural Resources, Division of Forestry DOF) and Greg Palmeri (DNR-F).

Both sites near Haines were visited on July 16, 2009 by Melinda Lamb (USFS), Roy Josephson (DOF), Pam Randles (Haines citizen) and Tyler Stuart (Takshanuk Watershed Council). Ten to fifteen plants, several in flower, were found and pulled at HAINES_01 (Table 1 and 2). No knapweed was found at the HAINES_02 site (Table 1).

In 2010 the sites in Valdez were visited twice during the growing season, and no spotted knapweed infestations were found.



Latitude	Longitude	Location Notes
-135.9288428	59.41619032	Haines Hwy Chilkat River south end of Wells Bridge
-135.68488	59.28792	10.3 miles north of Front/Haines Hwy junction

Ketchikan

One *C. stoebe* plant was reported and pulled on Revillagigedo Island in 2006 by Tom Heutte (USFS). Tom visited this site on July 13, 2009 and found no knapweed.

Latitude	Longitude	Location Notes
-131.689215	55.430158	Revilla Road 2 miles from N. Tongass Hwy

Dyea

C. stoebe was first reported in Alaska in 1997 by Claudia Rector (National Park Service) at two sites in Dyea, near Skagway. These sites were monitored and controlled via hand-pulling and knapweed has not been found there since 2002. One knapweed infestation (DYEA_01) is in the old townsite of Dyea, near the warehouse, and the other (DYEA_02) was found on the Dyea Flats, very near to the high tide line.

DYEA_01 was visited this summer by Jessica Wilbarger (NPS) who was searching for other exotic plant species but kept an eye out for knapweed (Table 1). No knapweed was found in the old Dyea townsite. The DYEA_02 site was not monitored this summer.

Anchorage

The newest *C. stoebe* infestation in Alaska was found in the Jewel Lake area of Anchorage on August 06, 2009 by Troy Zaumsel and Lori Zaumsel (Citizens Against Noxious Weeds Invading the North). This infestation consisted of a single flowering plant, which was pulled at the time (Table 2). The surrounding area was searched with no other knapweed found.

The infestation location described by Lori Zaumsel is "Near the corner of 88th and Jewel Lake. If you go east on 88th from the corner, past the fire station, it is in the clearing adjacent to the fire station lawn. If you see Canada thistle a few yards back, you are in the right spot." The area was monitored in 2010 by Lori Zaumsel with no regrowth of spotted knapweed observed.

Map of All Recorded Spotted Knapweed Infestations in Alaska, 2010

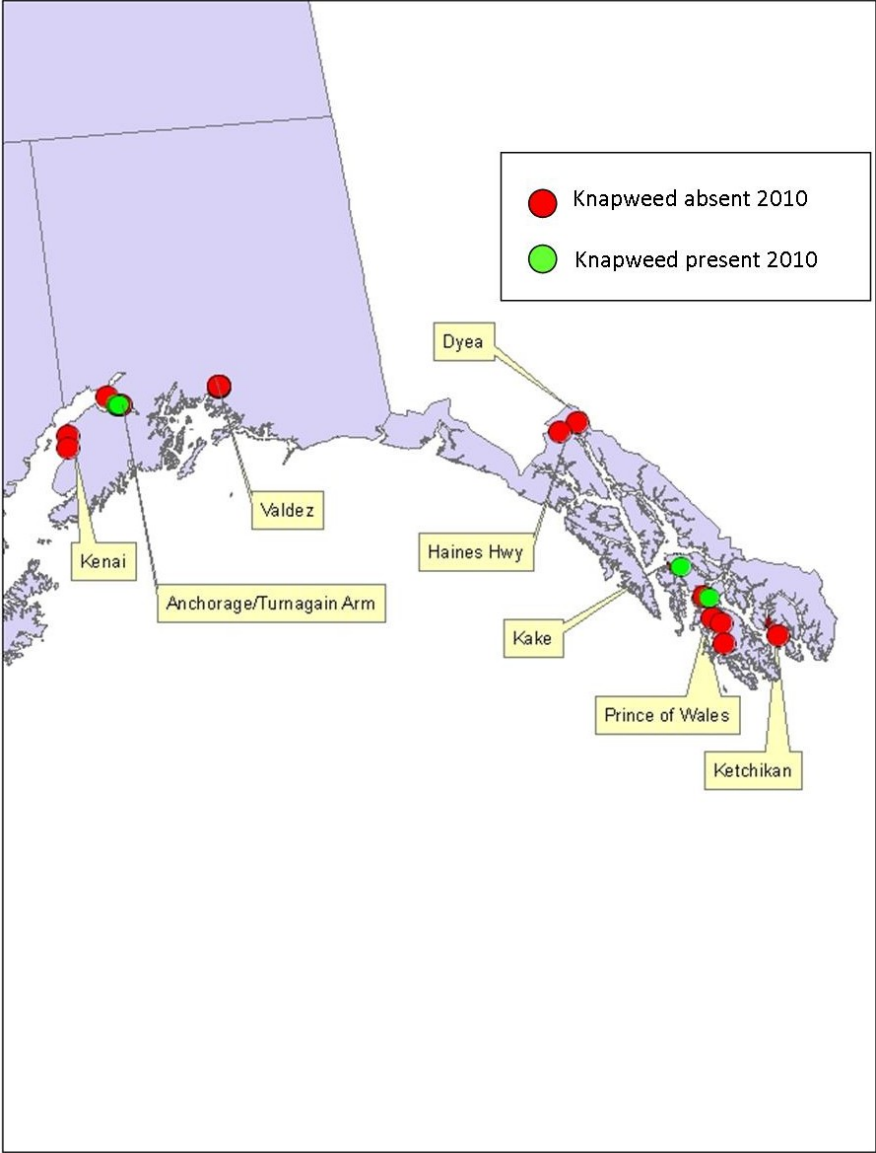


Table 1. Results of the 2009-2010 Inventory of Reported *Centaurea stoebe* Populations in Alaska

SITE	LOCATION	KNAPWEED PRESENT? 2009;2010
TURNAGAIN_01	Beluga Point	YES ; YES
TURNAGAIN_02	Rainbow	NO ; NO
TURNAGAIN_03	Party World	YES ; YES
TURNAGAIN_04	Falls Creek	YES ; YES
TURNAGAIN_05	Indian	NO ; NO
VALDEZ_01	Estuary pull-out (East)	NO ; NA
VALDEZ_02	West of VALDEZ_01	NO ; NA
VALDEZ_03	West of VALDEZ_02	NO ; NA
VALDEZ_04	North Side of Highway	NO ; NA
POW_01	FS Road 20 – Sarkar Lake	NO ; NO
POW_02	FS Road 30 – Salmon Bay	YES ; YES
POW_03	FS Road 2000 - Red Bay	NO ; NO
POW_04	State Road 925 & FS Road 2054	NO ; NO
POW_05	Craig	NO;NA
KENAI_01	Gill Street	NO;NO
KASILOF_01	Ness Street	NO;NO
HAINES_01	Haines Highway Mile 24	YES ; NO
HAINES_02	Haines Highway Mile 11	NO ; NO
KAKE_01	FS Road 6337	YES;YES
KETCHIKAN_01	Revilla Road	NO;NA

DYEA_01	Dyea Townsite Warehouse	NO;NA
DYEA_02	Dyea Flats	NA;NA
ANCHORAGE_01	Jewel Lake	YES;NO

Table 2. Attributes of *Centaurea stoebe* populations found persisting in Alaska during summer field work, 2009 and 2010

Site	Year	Area Infested	% Cover	Stem Count
TURNAGAIN_01 (Beluga Point)	2009	0.5 acre	1%	178
	2010	0.1 acre	1%	155
TURNAGAIN_03 (Party World)	2009	0.01 acre	1%	22
	2010	0.001	1%	14
TURNAGAIN_04 (Falls Creek)	2009	0.1 acre	1%	24
	2010	0.01	1%	4
POW_02 (Salmon Bay)	2009	0.1 acre	50%	2000+
	2010	0.1 acre	25%	1710
HAINES_02 (Mile 24)	2009	0.1 acre	1%	12
	2010	None found	0%	0
KAKE_01 (FS Road 6337)	2009	0.1 acre	1%	102
	2010	0.1 acre	1%	81-180*
ANCHORAGE_01 (Jewel Lake)	2009	0.01 acre	1%	1
	2010	None found	0%	0

*Notes were incomplete for the 2010 site visits. The Second visit reported 30 stems, and the first reported 51-150 stems.

Prevention Efforts

To complement ongoing eradication efforts, it is necessary to engage in management practices that will substantially reduce the occurrence of new *C. stoebe* infestations in Alaska. Successful prevention efforts will require identifying the primary vectors of seed transport, engaging in education and outreach that reduces the quantity of seeds transported, and promoting early detection of and rapid response to new infestations.

Research and speculation have identified several possible vectors responsible for transporting spotted knapweed seeds to Alaska, primarily vehicles and heavy equipment. The occurrence of numerous infestations on remote logging roads in the Tongass National Forest suggests that heavy equipment and other vehicles associated with timber sales, or perhaps even USFS vehicles, may have transported seeds. It is also possible that the seeds arrived on vehicles whose use was unrelated to USFS activities. Infestations near Haines and Dyea likely were introduced on vehicles traveling into Alaska via the Haines and South Klondike Highways, with seeds being transported from roadside infestations in Northwest, or perhaps Southern British Columbia. Infestations in the Valdez and Anchorage areas likely arrived on the mainland via vehicles or equipment shipped in via the Alaska Marine Highway Ferry System or container ships. While overland transport via the US-Canada border crossings is plausible, it seems likely that seeds traveling this route would infest Interior Alaska roadsides as well as the Southcentral region (Valdez, Anchorage, Kenai, Kasilof) far from the initial border crossings. The overland border crossings remain a highly probable route of future transport, especially as spotted knapweed infestations increase in Northwest British Columbia and the Yukon Territory.

Prevention through education

Prevention of new infestations of spotted knapweed from occurring in Alaska should focus primarily on travelers and contractors coming to the state from outside. To this end, the Division of Agriculture placed advertisements in the Milepost, a popular guide to travelling to and within Alaska, which highlighted the need to clean vehicles and equipment before entering Alaska. While cleaning is not required by law, the hope is that readers will voluntarily clean their vehicles and/or gear before entering Alaska, or shortly after arriving.

Milepost advertisement for spotted knapweed prevention

Keep Alaska Knapweed Free



M. Sheehy, U.S.D.A. Forest Service

Spotted Knapweed is an invasive weed of North America, recently found in Alaska.

**Please wash vehicles
before entering Alaska**

Impacts of Knapweed

- Displaces native plants
- Degrades pastures
- Reduces wildlife habitat
- Increases soil erosion
- Control efforts cost millions

Do your part
You may be transporting seeds.
Please clean all vehicles,
bikes, ATVs, camping gear
and shoes thoroughly.



Several thousand rack cards were also developed with the visitor to Alaska as the target audience. These rack cards will be distributed to managers of the Alaska Ferry terminal system for distribution to passengers. Some cards may also be provided to officials at border crossings; however, infestations found in the state seem to be more closely associated with the ferry system.

Rack cards distributed to the Alaska Marine Highway System

Spotted Knapweed
Centaurea stoebe

ON! CAUTION! CA

Invasive Weed

Spotted Knapweed infests 10 million acres in North America, and has degraded wildlife habitat and pastures in Montana, Washington, Idaho, and British Columbia.

Pink to purple flower heads on gray hairy stems

Dark spots below the flower heads

Knapweed degrades wildlife habitat
It provides low quality forage and secretes compounds into soil that inhibit the growth of more nutritious plants.

Knapweed increases soil erosion
Large stands of knapweed increase soil erosion and stream sedimentation, degrading essential spawning and rearing habitat for trout and salmon.

Humans spread knapweed
Humans can spread the seeds long distances when they stick to vehicle undercarriages and heavy equipment.

Help Protect Alaska's Fish and Wildlife
THOROUGHLY CLEAN ALL VEHICLES, HEAVY EQUIPMENT, ATVS, BIKES, SHOES, AND CAMPING GEAR

IF SPOTTED:
Take photos, and report infestations at
www.alaskainvasives.org
1-877-INVASIV

Turnagain Arm, Alaska
Michael Rasy, University of Alaska, Bugwood.org

Finally radio public service announcements were developed and aired by the Division of Agriculture to alert Alaska residents to the spotted knapweed situation in the state. The PSA requested that listeners clean vehicles and equipment, and directed listeners to alaskainvasives.org for more information and free identification materials.

Early detection through education

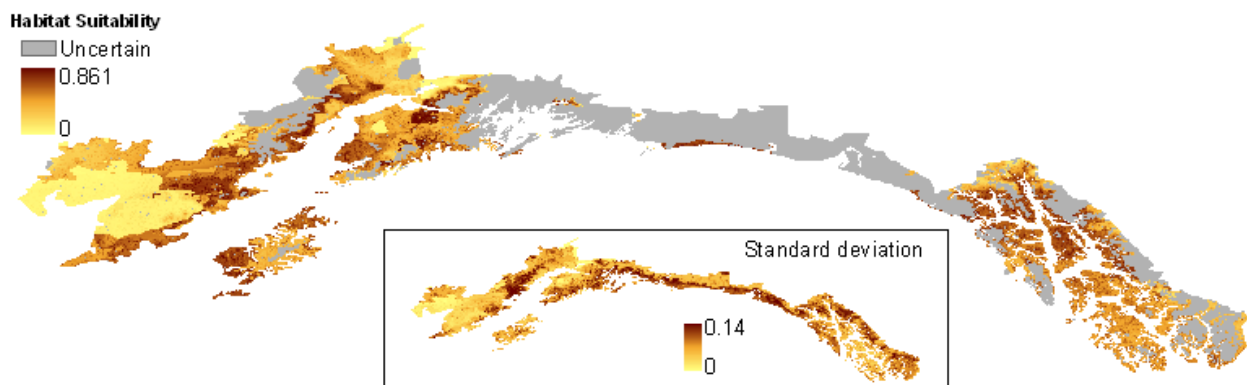
Early detection efforts for spotted knapweed are of critical importance. Many of the infestations discovered in the state were not found during directed surveys. Rather they were found by informed individuals, some with limited or no formal background in botany or weed science. Furthering efforts to encourage this kind of passive detection of spotted knapweed has and should remain a priority.

The early detection efforts through passive survey and reporting by the interested general public are encouraged primarily through presentations about early detection and distribution of an early detection booklet. Both presentations and the booklet highlight spotted knapweed and a few other high priority species for Early Detection and Rapid Response (EDRR). The booklet and presentations include reporting instructions which include e-mail, telephone and online reporting options. The online reporting option is the most sophisticated, yet user friendly. Hosted by EDDMapS, the online reporting function allows for transmittal of necessary information as well as pictures of the infestation, and latitude and longitude location data generated through Google maps (www.eddmaps.org/alaska). While no confirmed infestations of spotted knapweed have been reported through the online system it still has considerable value as a user friendly reporting function.

Early detection through modeling

An effort to use predictive modeling of spotted knapweed is presently underway through a partnership with the USGS Fort Collins Science Center, Invasive Species Forecasting Team. Representatives from the Alaska Division of Agriculture, USDA Agricultural Research Service, Natural Resource Conservation Service, US Forest Service, and Alaska Natural Heritage Program participated in the effort. Modeling areas vulnerable to knapweed infestation proved to be very difficult with the limited number, 18, of presence points available. The USGS team is trying a different approach to modeling with these few presence points, and we should have results by the end of October 2010.

Spotted knapweed habitat suitability as predicted by Max-Ent with 18 recorded locations



Statistical values produced during generation of the habitat suitability model indicate that the model is ok, but not good enough to be considered reliable. The lack of reliability in the model is likely from the low number of locations of spotted knapweed. However, the

output makes sense considering the current locations of the infestations. The present scale at which the model predicts habitat suitability is large providing general utility in identifying regions of the state that are appropriate for survey. Finer scale predictions of where (south facing slopes, soil types, disturbance types, etc.) in those broad geographic regions to look for spotted knapweed is still not accounted for in these modeling programs. The fine scale predictions are at present best accomplished by survey teams familiar with the biology and occurrences of spotted knapweed in Alaska.

Discussion

Spotted knapweed has infested several areas in Alaska. All of the known infestations are located in the Southcoastal ecoregion, except for the infestations along the Seward Highway where it runs adjacent to the Turnagain Arm, which is classified as Interior Boreal (Carlson et al. 2008). Even though the knapweed infestations are in an interior boreal area along the Turnagain arm, the location of the infestations is directly adjacent to the Turnagain arm and thus has substantial maritime influence. This leads to a possible conclusion that spotted knapweed infestations in Alaska are associated with coastal communities and the adjacent upland ecosystems.

Spotted knapweed infestations that are known to exist have been found primarily along roadsides and railroad tracks. One confirmed infestation was reported by a gardener on the Kenai Peninsula where it was found growing at the gardens edge. Another unconfirmed infestation was found growing in a garden in the Anchorage area (Jeff Lowenfels personal communication). Most of the roadside and railroad infestations were found along highways or other busy roadways, and often were adjacent to pull offs. Exceptions to the infestations being found along major travel corridors are present in Southeast Alaska, on both Prince of Wales (POW) and Kupreanof Islands.

The infestations on POW and Kupreanof Islands were located on remote forest service roads in the upland areas. Both infestations were discovered adjacent to wider areas of the roads that would be used as vehicle pull offs or staging areas for heavy equipment.

Discuss potential vectors to Alaska

Humans are the most likely facilitator of spotted knapweed movement to new areas providing both carriers of propagules and habitat disturbances necessary for knapweed establishment. In Alaska the primary way that humans affect knapweed introductions is unknown. However, some speculation from the limited distribution of knapweed in Alaska presents valuable information to develop prevention measures.

Infestations found along major roadsides were generally associated with either roadside pullouts or railroad tracks. Roadside infestations may have been introduced by personal vehicles, particularly those driven by tourists from the lower 48 states or Canada where spotted knapweed is widespread. Many of these roadside infestations that may be associated with tourist vehicles are also in relative close proximity to Ferry terminals where passengers may have offloaded their vehicles.

Locations of spotted knapweed along railroad tracks may have spread from roadside infestations associated with tourist vehicles, or freight. Hay transported from infested areas of North America to Alaska, for example, is a potential freight item that may have introduced spotted knapweed along the railroad. Significant RV traffic also occurs along many of the roads with infestations in Southcentral Alaska.

Spotted knapweed locations in Southeast Alaska on POW and Kupreanof Islands are found on remote Forest Service roads near pullouts. These areas primarily see use from local traffic, the Forest Service or commercial logging. It is unlikely that these infestations were established by seeds on recreational or tourist vehicles because of the limited amount of use these areas see. In these areas the most likely carriers are heavy equipment that may have come from infested areas of North America for use in construction. Most of the small island communities in SE Alaska do not have construction contractors. Thus construction projects are bid on by entities located outside SE Alaska. The equipment shipped to the location to complete the work may have come from an infested area, and if not thoroughly cleaned may infest a new area.

Management effectiveness

Presently infestations of spotted knapweed in Alaska are all managed manually by digging or pulling individual plants. Manual management is implemented primarily because the sizes of the infestations are small (less than 1/10 of an acre) or consist of small clusters of plants scattered over an area. Manual management is also possible because of the biology of spotted knapweed. Spotted knapweed does not creep with its roots, however, anecdotal observations indicate that when manual removal of plants fails to remove the entire taproot the plant will re-sprout. This may become more of an issue for infestations which have well established large plants, growing in soil conditions that make digging difficult. Small plants which appear to be in their first year of growth are still highly manageable with hand pulling.

Knapweed infestations in Alaska managed manually appear to show a general trend of reduction in size over time. Many infestations found while small and manually managed quickly are no longer present. Others that still persist are diminishing in size or number of individuals. These control results indicate that the size of infestations presently being managed in Alaska may not warrant more aggressive management with herbicides.

Herbicides may become a more important component of spotted knapweed management in Alaska in two scenarios. First, if larger dense infestations are found, an acre or more in area for example, significantly more time will be required to manage the infestation. In these situations the cost of manual management may increase while effectiveness may diminish. If such an infestation is found in Alaska use of an appropriate herbicide should be considered. Not having these large infestations in Alaska makes determining a threshold where herbicide use is necessary difficult. If larger or denser infestations are discovered in Alaska, herbicide use should be considered on a case by case basis.

Coordination for lasting project implementation

Prior to implementation of this ARRA funded spotted knapweed eradication effort little to no coordination was in place for management, and monitoring of infestations. The ARRA funded effort established the Division of Agriculture as the coordinating agency for eradication of spotted knapweed. The Division of Agriculture staff was able to contact each land manager to coordinate site visits and involve them in the management of spotted knapweed. This was especially true for infestations on Turnagain Arm located along the railroad tracks. Infestations in the Tongass National Forest were inconsistently visited prior to implementation of this project. Now, however, Forest Service staff accompanied Division of Agriculture staff when managing these infestations each summer.

Coordination through the Division of Agriculture has also resulted in greater efficiency of visiting reported sightings of spotted knapweed. When sightings are found in areas of the state, Division of Ag. staff contact a partner working on weed management in the area of the report. These partners visit the site where the infestation was reported, and send pictures or specimens to Division of Ag. staff to confirm the identity of the plant.

Tasks for the future

Future management efforts for spotted knapweed broadly include prevention, detection, management and monitoring of reported spotted knapweed infestations. Addressing each of these categories will decrease introductions, increase confidence on the locations of infestations and eradicate existing populations.

Prevention is often noted as the primary goal in invasive species management. To adequately prevent introductions of spotted knapweed it is necessary to determine where to focus the majority of efforts. Given the apparent relationship between roads, coastal areas and knapweed infestations it is important to focus prevention efforts on vehicles in those areas. To that end the Division of Agriculture purchased advertising space in the Milepost requesting

travelers clean their vehicles and report spotted knapweed if found. Fliers were developed for distribution by ferry operators on the Alaska Marine Highway system. Additional efforts are needed to prevent introductions that likely came about from heavy equipment, imported for the job, from knapweed infested areas of North America. These additional efforts should include cleaning equipment, and if gravel or fill material is shipped to Alaska, ensure it is certified weed free, or at least the extraction and storage areas are inspected for the presence of spotted knapweed.

Detection of spotted knapweed in the past was completed through surveys for other species and informed persons who happened on infestations. Directed surveys for only spotted knapweed are not likely to be fruitful as modeling does not yet predict knapweed movement in Alaska at a practical scale, and this might result in overlooking other priority species. However, continued survey for invasive plants in general has turned up several knapweed infestations in Southeast and Southcentral Alaska, and those efforts should continue as appropriate. Many knapweed infestations in Alaska were discovered by informed persons who happened on infestations. Statewide early detection efforts have focused on several species including spotted knapweed. These efforts seek to involve citizen scientists and land managers who work in the field but not regularly with invasive species. A reporting system is established through EddMapS (www.eddmaps.org/alaska). Additional materials are being placed on the state web server that will describe priority early detection species, and how to report them. Further efforts are necessary to provide educational events about early detection and reporting.

Management and monitoring of existing knapweed infestations is an ongoing need. Several knapweed infestations appear to no longer be present where they were reported. These sights should still be monitored for some time to ensure that any residual seed does not germinate. These infestations and others with existing plants are currently being managed by local entities. Southeast Alaska infestations are being managed by the Juneau Cooperative Weed Management Area, and the USFS Tongass National Forest. Infestations in Anchorage and along Turnagain Arm, just South of Anchorage, are managed by the Anchorage Cooperative Weed Management Area in partnership with the Alaska Railroad, and the Division of Agriculture. Kenai Peninsula infestations are annually monitored by Janice Chumley of the Kenai Cooperative Weed Management Area. Finally, infestations in Valdez, Dyea, and Ketchikan are no longer present, and may not need any monitoring as they have not been seen in many years.

One new infestation of spotted knapweed was discovered during the time period of this ARRA funded project. This infestation was discovered by a concerned and informed citizen that happened on the plant while taking notice of a Canada thistle infestation. The infestation was reported via e-mail. Unfortunately the individual pulled and disposed of the plant so no

confirmation with GPS coordinates was made. However, the pictures provided were enough to confirm the identity of the plant as spotted knapweed.

Conclusions

Early detection for spotted knapweed infestations appears to be working. New infestations have been discovered by informed citizen scientists and agency staff with job assignments unrelated to weeds. Additional infestations were discovered by general surveys. We can expect that additional infestations will be discovered via these informed persons and general surveys. This notion supports the need for increased education and outreach to citizen scientists and all agency staff in addition to completing regular general surveys.

Control work with spotted knapweed twice per growing season using manual methods appears to work with the size of infestations present in Alaska. While unlikely, if a large (1/2 acre or more) infestation is discovered chemical management will likely be necessary. Some Environmental Analyses are complete for the National Park Service and Refuge lands, however, most agencies have not prepared analyses to allow for chemical management of spotted knapweed if found on the majority of federal lands in the state. If an infestation of substantial size is discovered on state lands, NEPA compliance may not be an issue, however, the state laws for pesticide application may stall the process for implementing effective eradication measures for at least one growing season. Two options exist presently for state pesticide use permits: 1. Get a general pesticide use permit requiring public review and a waiting period before applications (approximately 100 days). 2. Get an emergency exemption from DEC with approval from the Commissioner of DEC which would likely take an equal amount of time as a pesticide use permit. These two options do not lead to rapid response to a large infestation if found.

Prevention measures in Alaska for spotted knapweed are lacking in all areas but education. Current efforts ask travelers to voluntarily wash their vehicles to prevent spreading seeds that may have hitchhiked on their vehicle from infested areas of North America. These efforts could be improved upon with wash stations at border crossings and wash stations at ports outside Alaska where vehicles or equipment are being shipped from infested areas to Alaska. Further measures requiring heavy equipment used in state, borough or federal projects to be washed, and fill material to be certified weed free before imported into Alaska would address other potential pathways for introduction.

Coordination for management of the spotted knapweed infestations was largely the reason this project was initiated. In many instances infestations were discovered in areas such as Valdez and Haines where an entity was not identified as responsible or willing to carry out management of these infestations. In other instances, such as infestations on the Tongass National Forest, control work was sporadic because of diverging priorities. Presently the

remaining infestations in Alaska have entities identified for management and monitoring to ensure eradication. In the future, as new infestations of priority species are discovered efforts should be made to initiate coordination between agencies and identify funds for management immediately. Point in case is the giant hogweed infestation discovered in Kake. The Division of Agriculture immediately secured funds from APHIS to initiate inventory and control work. This was relatively easy considering giant hogweed is a federally regulated weed, however, spotted knapweed and other important EDRR species do not fall into that category. For such weeds it may be necessary to identify rapid response funds that are made available quickly received to address new infestations.

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