U.S. FISH AND WILDLIFE SERVICE
Kodiak National Wildlife Refuge

2016 Invasive Plant Management Activity Report

Orange Hawkweed in the Vicinity of Camp Island, Alaska

Bill Pyle

Summary

I review management of highly-invasive orange hawkweed (*Hieracium aurantiacum*) in the Camp Island vicinity and describe general results from 2016 field operations. Our goal has been to consistently and cooperatively apply an adaptive, integrated pest management (IPM) approach to control, and to eventually eradicate, this orange hawkweed infestation. In 2016, we completed six missions between mid-May and late September. In May a crew of three Refuge staff surveyed about 37 ha (92 ac) of the Island Point vicinity but did not document any new infestations. Between mid-May and late September, we applied a total of 15.1 ml (0.51 fl oz, equivalent to one tablespoon) of aminopyralid, the active herbicide agent, to 0.08 ha (0.21 ac) of infestation sites primarily on Camp Island. Herbicide use has generally declined coincident with hawkweed decline since 2003. However, herbicide use increased slightly in 2015-16 in response to slight increase in hawkweed resulting from missed application of flowing/seeding hawkweed plants in August 2015. This trend should reverse in 2017 if survey and control operations consistently include all sites where hawkweed has been historically observed on Refuge and non-Refuge lands.

Introduction

Over the years the Refuge gained considerable experience with management of orange hawkweed in the Camp Island vicinity. We periodically modified our approach to increase management effectiveness. Examples included follow-up missions conducted between herbicide applications to assess management response; removal and disposal of hawkweed flowers; adjustment of the survey area scope; and labor-intensive preparation of sites for herbicide application. Field operations have been funded primarily by the Refuge except for labor contributed by partnering individuals, such as Kodiak-based volunteers, and partnering organizations, such as the Kodiak Soil and Water Conservation District and Koniag, Inc. The success of management has been contingent on the ongoing cooperation of partnering organizations, as well as the instrumental field support provided by many Refuge staff and volunteers, mostly Kodiak-based citizens. For additional details refer to the 2014 report.

Methods

Land Access

The infestation areas encompass private lands owned by Koniag, Inc. and federal public lands administered by the Refuge. In spring 2016 we requested and received approval by Koniag, Inc. to access its lands for IPM operations. Project staff carried permits whenever they accessed

Koniag, Inc. lands. As required, we visited with its personnel at Camp Island before starting monthly fieldwork. Between July and September, field operations were restricted to Camp Island, the two small islands to the immediate north, and Refuge land on Island Point.

Survey & Site Preparation

A total of six monthly missions were conducted between mid-May and late September. I continued to lead the project and coordinate logistical support. Danny Hernandez (Refuge Biological Technician), Laura Kromrey (Refuge Biological Aid), and Josh Blouin (Refuge Volunteer) assisted IPM missions between May and August. In September we received field support from Deb Engvall (Refuge Volunteer), Tessa Johrehnt (Service's Regional Office), Tim Knudson (Refuge Biological Technician), Katie Stoner (Refuge Biological Technician), and Aimee Van Tatenhove (Refuge Volunteer).

Three fieldworkers surveyed the Island Point vicinity on 14 and 17 May 2015. Fieldworkers hiked roughly parallel courses about 10-25 meters apart to cover the survey area and one worker recorded the route traversed using a recreational-grade GPS unit (Garmin® GPSmap 64). Estimation of area searched was based on the distance traversed multiplied by an effective lateral observation width of 10 m per observer. If hawkweed was observed, protocol prescribed searching the surrounding 50-meter area for additional plants, flagging the infestation site, recording site coordinates, and returning as soon as logistics and suitable weather permitted herbicide application.

Monthly field mission averaging three days duration usually began with a survey of status of previously documented infestation sites. Equipment and materials included:

- Minimum field team of three with one person outfitted with a .12-guage shotgun and certified by the Refuge as a "designated shooter";
- Recreational-grade global positioning unit (GPS) loaded with the coordinate data (waypoints) of documented, uniquely-numbered infestation sites;
- Weather-proof maps showing updated locations of infestation sites overlaid on high-resolution imagery;
- Survey form on waterproof paper, clipboard, pencil, sharpie pen; and
- Biodegradable flagging, gloves, head-nets, water, shotgun, ammo, bear spray, etc.

We navigated to coordinates (waypoints) of historic infestation sites with GPS units. Upon arrival at an infestation site, we searched for hawkweed in an area of about 10-m^2 radius and recorded presence/absence of hawkweed on a standard form. When hawkweed was encountered, the site was marked with a sharpie pen on a field map followed by a series of follow-up actions.

- Searching the area surrounding visible hawkweed for additional plants;
- Cutting or pulling dead and/or live above-ground vegetation to fully expose hawkweed foliage;
- Marking the apparent perimeter of the infestation site with sticks adorned with biodegradeable flagging; and
- Removal, bagging, and disposal of hawkweed flower buds, flowers, and seed heads.

These actions were performed for two main reasons: to assess the extent of infestation, and to prepare sites for herbicide application. On occasion, undocumented infestations have been

encountered while traversing among documented infestations. In such cases, a new waypoint was recorded, databased, mapped, and revisited in follow-up control missions.

Herbicide Application

A multi-year Pesticide Use Proposal (PUP) was prepared, peer-reviewed, and approved by the Service in April 2016 (Appendix A). The PUP detailed treatment area characteristics, IPM tactics and strategy, best management practices, supporting documents, and review/approval officials. Additionally, IPM actions involving the Service in the Kodiak area, including multi-jurisdictional lands and the project area, were programmatically addressed in an approved Environmental Assessment (USFWS 2010) and supplemental Environmental Assessment (USFWS 2014). As required by the Service, all herbicide applications were supervised by at least one Certified Pesticide Applicator (Pyle, Hernandez).

In general, we applied two tactics for IPM with herbicide in 2016. Selection of the monthly survey and treatment interval was based primarily on the need for sufficient time to elapse for both additional growth of hawkweed (e.g., seedlings grow to height where they may be visually detected) and for accurate assessment of hawkweed mortality in response to the most recent previous application. In no case was herbicide applied to a site where it was previously applied that year, as dictated by the herbicide label. The action of the herbicide facilitated accomplishment of this requirement because it killed plants whose foliage was sprayed and, because residual herbicide activity continued to kill any plants at the site of application for the remainder of the growing season.

Scheduling of application missions was based on the availability of crew, forecasted weather, phenology of hawkweed growth, and occurrence of previous within-year application missions. Applications were scheduled to coincide with forecasted dry weather and, on the day of application, following dissipation of morning dew, usually by 1100. In cases where wet weather was encountered, such as mid-August and mid-September 2016, herbicide application was deferred to the next mission. Prior to herbicide application, we selected a herbicide mixing site, the mixer donned personal protection equipment (i.e., rubber boots, nitrile gloves, Tyvek® coveralls, safety glasses); transported mixture components to this site; estimated total quantity of components needed; and formulated the mixture in standard 18 l (4 gal) backpack tanks and/or handheld quart-size spray bottles. Choice of application method (backpack, handheld bottle, or combination) was based mainly on estimated size of the job and number of available crew consisting of a minimum ratio of one applicator and one hawkweed spotter/bear guard. The initial May application was conducted after surveys were completed of historic infestation sites. Subsequent applications during June-September operated concurrent with the survey.

The herbicide formulation (i.e., tank mix) consisted of water, the main component; Milestone™, an aminopyralid-based herbicide; Agri-Dex®, a non-ionic water soluble spray adjuvant; and Hi-Light® blue, a water soluble dye. Whereas the adjuvant was included to improve deposition and retention of herbicide on hawkweed foliage, the dye displayed the location and volume of application, improved application accuracy, and increased application efficiency. Milestone was applied at a label-allowed rate of 0.29 ml/ha (6 oz/ac). Formulation of tank mix per 3.8 l (1 gal) of water consisted of 4.1 ml (0.1 fl oz), Milestone, 19 ml (0.6 fl oz) of Agri-Dex, and 15 ml (0.5 fl oz) of Hi-Light. Following preparation of the formulation, fieldworkers systematically navigated to active infestation sites marked on the field survey map, and applied the formulation

directly to exposed hawkweed foliage. The hawkweed spotter served key IPM functions including: safety monitoring for leaks and applicator exposure; navigation by map and GPS unit to infestation sites; searching for hawkweed at, and in the vicinity of, the GPS-recorded infestation site; ensuring thoroughness of the application, and recording progress of the application effort (e.g., hashmark made with sharpie pen on infestation site map). An application mission was considered complete when all active infestation sites had been treated. Following completion, application equipment and boots were cleaned with diluted dish soap in the mixing area, and Tyvek coveralls and gloves were bagged and transported to Kodiak for disposal.

Monitoring

We applied standard methods for annual monitoring of response of hawkweed and native vegetation to IPM practices. These included repeat photography at photopoint sites; recurrent monthly survey of hawkweed occurrence (i.e., absent, present) at documented infestation sites; semi-annual monitoring of frequency of occurrence of hawkweed and native forb species at permanent plots; and evaluation of annual trend in volume of herbicide application and application area.

In late July-early August we re-photographed scenes at one of two sites originally photographed in late July 2002 before IPM was initiated in the Camp Island vicinity (Figure 1). Following conclusion of a survey, data acquired from each survey of infestation sites were inputted to a spreadsheet (MS Excel) back in the office. Before the next survey, a new field survey form was generated to display the most recent history of hawkweed occurrence at infestation sites. Assessment of current status was based on summary of occurrence records for a survey. Assessment of trend was based mainly on comparison among years of results from the last survey of the year.

In accordance with procedures described in the 2014 report, we sampled plant taxa frequency of occurrence near start and peak of the annual growing season (e.g., mid-May, mid-July) at three treatment plots and one control plot established in May 2003 (Figure 1). In the office data were databased (MS Access) and processed to generate summary results.

For each application, we recorded the amount of applied herbicide on a standard form. In the office, usage data were entered into a spreadsheet, checked for accuracy, and analyzed to generate summary statistics such as total annual volume of active herbicide agent (i.e., aminopyralid) and total area of application.

Results and Discussion

We surveyed 37 ha (92 ac) of the Island Point vicinity in May but did not identify any new hawkweed infestations (Figure 2). Consequently the footprint of the total infestation did not change since 2015 (Figure 3). Herbicide was applied where hawkweed was observed at 9 of 22 historic infestation sites during May-June. No surveys or applications occurred on Koniag, Inc. land on Island Point during July-September.

Comparison of September surveys indicated more infestations in 2016 (35%) than 2015 (27%), both of which were considerably greater than the low observed in 2014 (22%) (Table 1, Figure 4). This trend of recent increase is attributed simply to the missed survey and treatment of active infestation sites on Koniag, Inc. lands in August 2015. Moreover, it is highly likely that some of

the infestations treated in 2016 represented plants that established from seed disseminated in August 2015. This outcome underscores the importance of consistent adherence to the Refuge's operation plan. In 2017 we expect fewer active infestations if the operation plan is fully implemented.

A total of 34 liters (9 gal) of herbicide formulation was applied to 0.08 ha (0.21 ac) of infestation sites in 2016. Total annual volume of active herbicide agent (i.e., aminopyralid) applied was 15.1 ml (0.51 fl. oz, equivalent to one tablespoon). Evaluation of trend indicated slight increase in annual usage in 2016 compared to 2015 (Figure 5). We attributed this increase to the increase in number of infestations in response to missed August 2015 surveys and applications as explained previously. Usage is expected to decline in 2017 if the full scope of planned survey and treatments is implemented.

Photopoint sites and plot-based monitoring was completed. Results from comparison of visual aspect of vegetation in 2002 and 2016 photopoint scenes is indicative of the magnitude of the original infestation and the extent of recovery of native vegetation, respectively (Figure 6 & 7).

In 2016, no hawkweed was observed in permanent plots annually sampled since 2003 on Camp Island (Figure 8). Evaluation of trend revealed a major decrease in frequency during 2003-2009; a slight increase in response to temporary cessation of herbicide application in 2010; and gradual decline to trace levels exhibited during 2013-2014. This pattern of trend—major decline in hawkweed density in response to management—was supported by extensive field observations across the Camp Island area.

Since 2014, the last year of complete sampling, richness of forbs has markedly increased (Figure 9). Expectation is that richness will continue to vary between treatments and years; however, trend should generally exhibit a pattern of post-treatment increase followed stabilization indicative of recovery.

References

[USFWS] U.S. Fish and Wildlife Service. 2010. Environmental assessment: Integrated pest management of invasive plants on Kodiak National Wildlife Refuge. Kodiak, Alaska: U.S. Fish and Wildlife Service, Kodiak National Wildlife Refuge.

[USFWS] U.S. Fish and Wildlife Service. 2014. Supplemental environmental assessment: Integrated pest management of invasive plants on Kodiak National Wildlife Refuge. Kodiak, Alaska: U.S. Fish and Wildlife Service, Kodiak National Wildlife Refuge.

Figure 1. Location of monitoring plots and and photopoint sites for gauging response of orange hawkweed and native herbs to integrated pest management, Camp Island, Kodiak Island, Alaska.

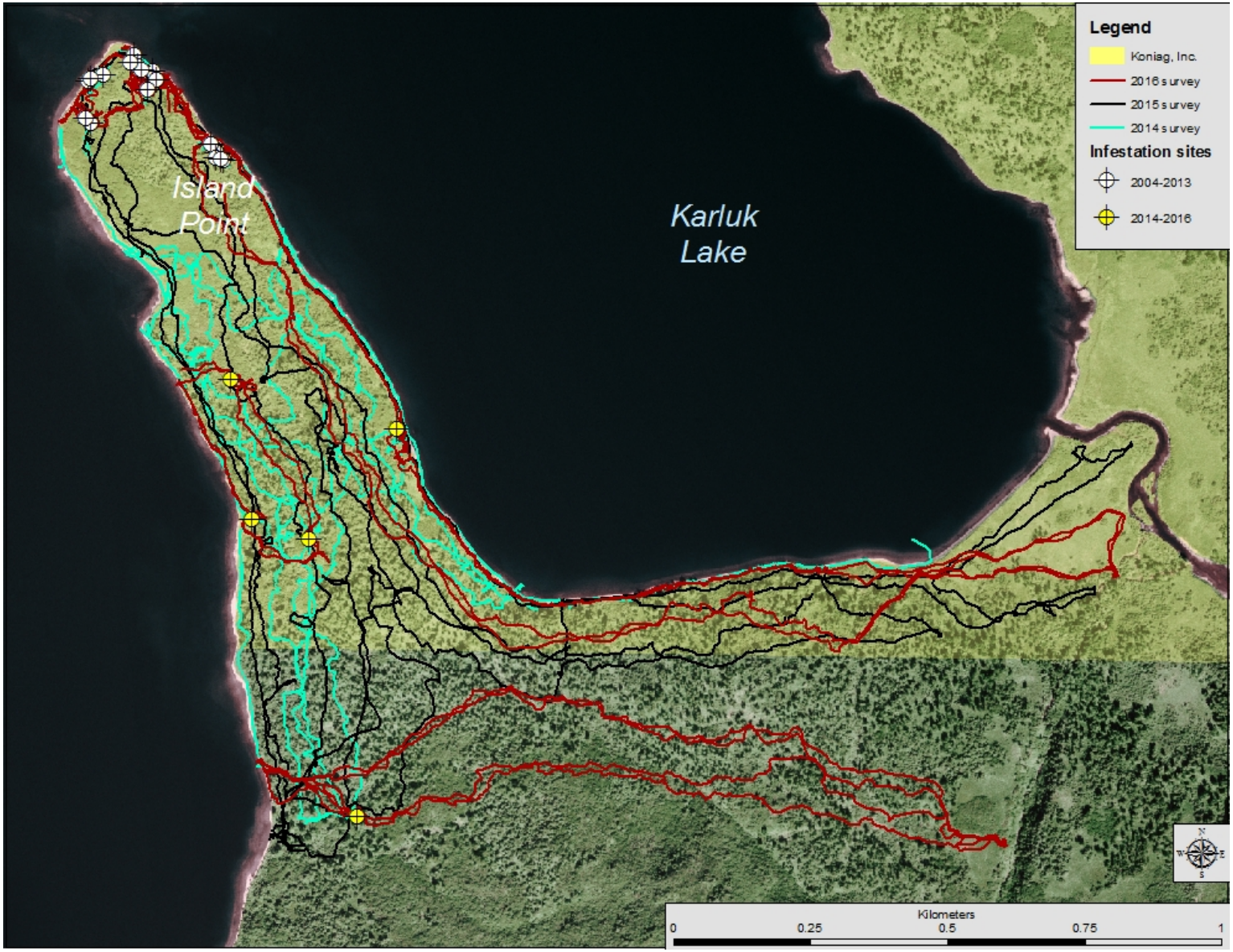

Figure 2. Sites of orange hawkweed infestation and GPS track record of hawkweed survey of Island Point vicinity, Kodiak Island, Alaska.

Figure 3. Known extent of orange hawkweed infestation 2003-2013 and 2014-2016 in the Camp Island vicinity of Kodiak Island, Alaska.

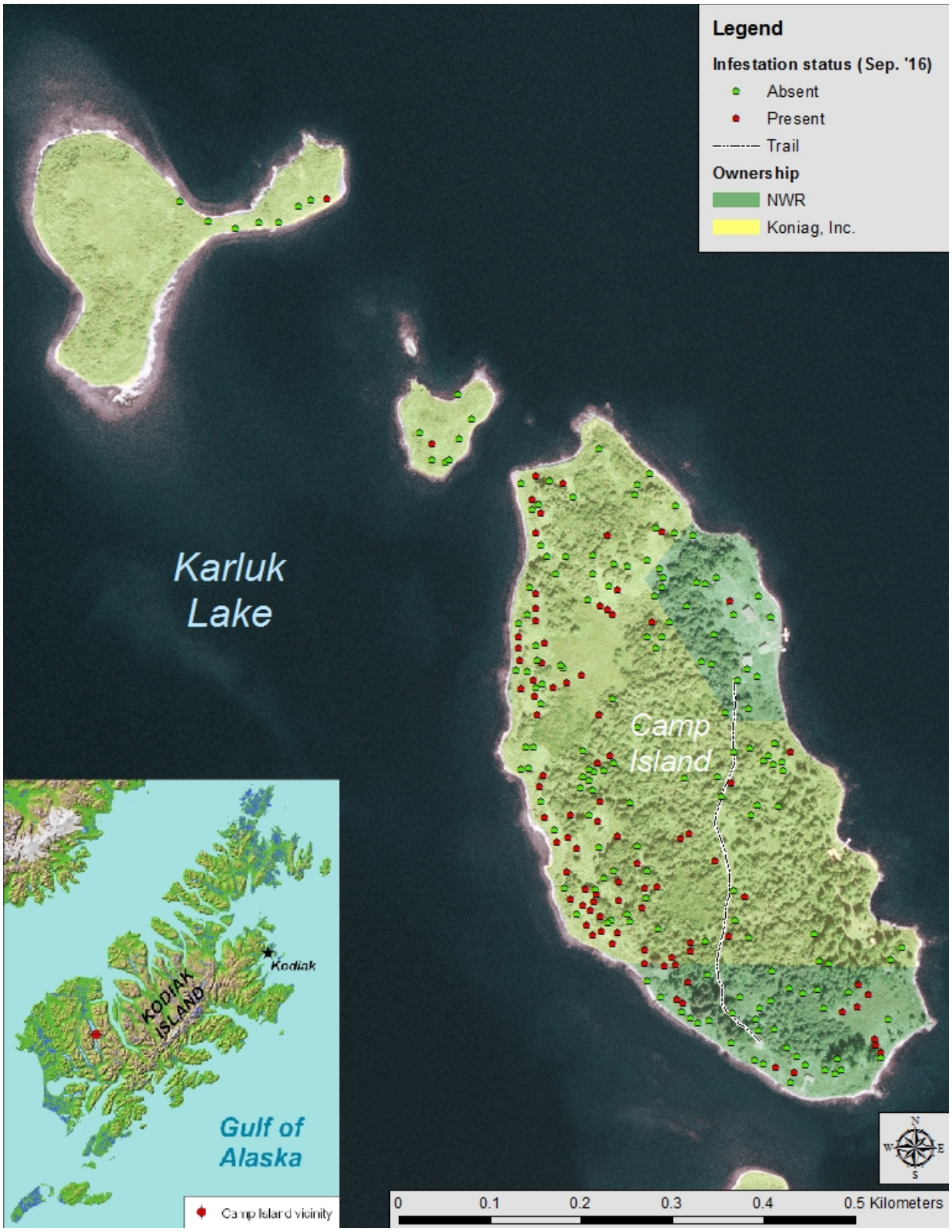

Figure 4. Status of orange hawkweed following four applications of herbicide between mid-May and late September 2016 at documented infestation sites in the Camp Island vicinity, Kodiak Island, Alaska. Note that herbicide was applied to hawkweed at sites labeled "present" in late September 2016.

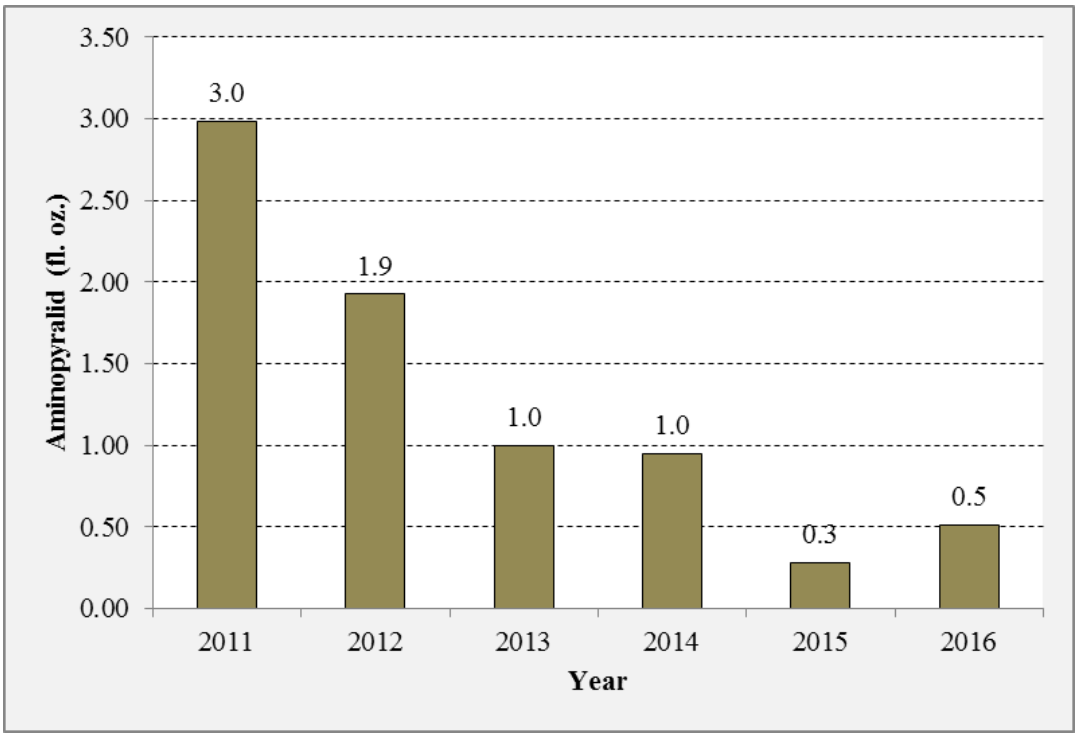

Figure 5. Total annual herbicide use (fl oz aminopyralid) between 2011 and 2016, Camp Island vicinity, Kodiak Island, Alaska.

Figure 6. Orange hawkweed infestation, photopoint site, W. Camp Island, Karluk Lake, July 2002.

Figure 7. Photo retake at scene in figure 8, July 2016. Note the extent of restoration of native plants compared to 2002.

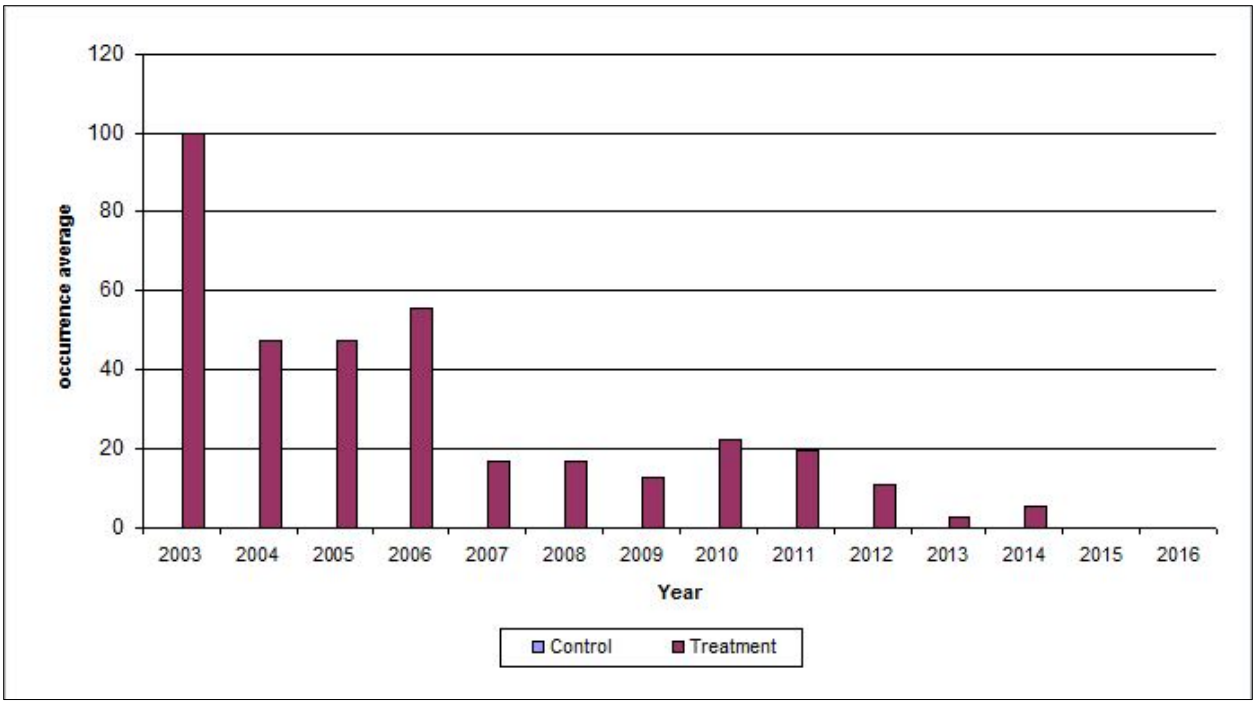

Figure 8. Average frequency of occurrence (%) of orange hawkweed on treatment (herbicide application) plots during late July-early August at Camp Island, Kodiak Island, Alaska.

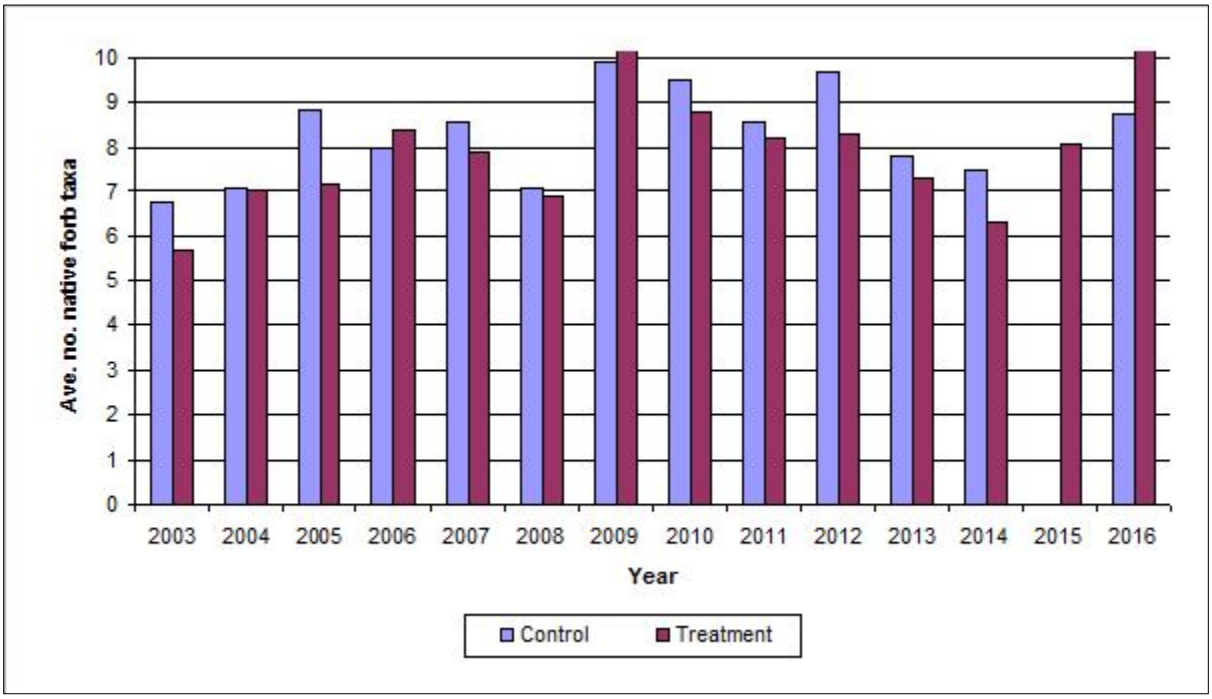

Figure 9. Response of forb taxa richness on treatment (herbicide application) and control plots at Camp Island, Kodiak Island, Alaska. Herbicide consisted of Transline® (clopyralid) between 2003-2008 and Milestone™ (aminopyralid) between 2011-2016.

Table 1. Results of last-of-year survey of orange hawkweed infestation sites, 2010-2015, in the Camp Island vicinity, Kodiak Island, Alaska.[1]

Category	Year						
	2010	2011	2012	2013	2014	2015	2016
Total surveyed sites (no.)	153	142	194	184	261	247	255
Sites with hawkweed (no.)	103	82	93	74	57	67	89
Sites with hawkweed (%)	67	58	48	40	22	27	35

2015-16 results for Island Point based on early July surveys (n=22).

Appendix A. Service approved pesticide use proposal for control of orange hawkweed in the vicinity of Camp Island, Kodiak Island, 2016.

	U.S. Fish and Wildlife Service Pesticide Use Proposal	Date: 04/08/2016

PUP Number: R7-16-74530-001

Treatment Site: Kodiak National Wildlife Refuge

Product Trade Name: Milestone Specialty

Region: 7 **Org Code:** 74530 **Year:** 2016

State/County: AK/KODIAK ISLAND BOROUGH

Field Station: Kodiak National Wildlife Refuge

Management Unit(s): Infestation occurs on both Kodiak NWR federal land and adjacent Koniag, Inc. (Regional Native Corp.) private lands.

Map Attached: Yes

Status: Approved by RO (Dis)Approver

Pesticide Use Pattern:

Need for Treatment: Invasive Species, State/Federal Listed Noxious Species, Native Habitat Restoration

Treatment Site: Terrestrial

Treatment Site Land Type: range, meadow or pasture

Is the crop being treated a genetically modified organism(GMO) (Y/N): N

Management Action/Economic Threshold:

As defined by Kodiak NWR's approved Invasive Plant Management EA (USFWS 2010) and Supplemental EA (USFWS 2014): (1) control action on invasives initiated when one or more plants of any highly invasive species is detected on Refuge land and Service-classified critical control points on non-Refuge land; (2) herbicide control considered where an area of infestation of a highly invasive species contains more than 10 plants per infestation area, and (3) absence of alternative methods for effective and cost-efficient control.

How does this pest(s) interfere with achieving habitat and/or wildlife management objectives?:

Orange hawkweed is considered a highly invasive species in Alaska (Carlson et al. 2008) and in the Kodiak Archipelaogo (USFWS 2010). Highly invasive species are considered to have high potential to replace native plants and plant communities, disrupt ecosystem function, and degrade fish and wildlife habitat. Consequently, they have high potential to interfere, in general, with accomplishment of refuge purposes, the Service's Biological Integrity policy, and a goal of Kodiak NWR's Revised CCP (USFWS 2008): "...maintain and restore native plant populations, communities, and habitats."

Target Pest(s): orange hawkweed (Hieracium aurantiacum)

Pesticides:

Trade Name: Milestone Specialty

Common Name: aminopyralid

U.S. EPA Registration Number: 62719-519

Manufacturer: Dow AgroSciences LLC

Label URL: http://www.cdms.net/ldat/ld77N015.pdf

MSDS URL: http://www.cdms.net/ldat/mp77N002.pdf

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Appendix A. (continued)

	U.S. Fish and Wildlife Service Pesticide Use Proposal	Date: 04/08/2016

Pesticide Details:

Restricted Use Pesticide (Y/N): N

Is the treatment site type listed on the label (Y/N): Y

Is pest listed on label: Y

If the crop, type of vegetation, or site type is not listed, is there a current Section 18 exemption under which you are proposing to operate (Y/N): N

If the crop, type of vegetation, or site type is not listed, is there a current Section 24c exemption under which you are proposing to operate (Y/N): N

Supplemental Label for Proposed Use (Y/N): N

Tank Mix (Y/N): N

Adjuvants: Agridex, Hi-Light

Other Ingredients: N/A

Number of Applications: 1

Application Period: May - September

Application(s):

Note: Proposed pesticide applications in this PUP may not reflect actual on-the-ground pesticide applications. Specifically, PUPs may include different application scenarios (e.g., spray equipment and rate combinations) to capture the breadth of application options that could be used to treat target species. Actual pesticide applications must be compliant with the pesticide label(s). The completed pesticide usage report will contain actual usage information associated with this PUP.

Trade Name	Rate & Unit	Method	Equipment
Milestone Specialty	6 oz/acre	Foliar (low volume)	Backpack

Size of Treatment Area: 50.00 acres

REI (Restricted Entry Interval): 12 Hour

Applicator Information: Cooperator, FWS

Name of FWS Lead Certified Pesticide Applicator: Bill Pyle

Approved IPM Plan (Y/N): N

IPM Plan Year:

Non-Chemical Controls Considered (Y/N): Y

IPM Strategy:

(1) Map infestation sites with GPS,orthoimagery, and GIS technology; (2) prior to herbicide treatment thoroughly search each infestation site for hawkweed to delineate infestation perimiter, mark perimeter with biodegradeable flagging, and hand-remove dead standing herbaceous vegetation to expose hawkweed; (3) following treatment, systematically survey infestation areas at least twice during growing season, map and flag new infestation sites, and hand-pull any hawkweed encountered budding or flowering; and (4) conduct pre- and post-treatment monitoring on permanently established treatment monitoring plots (established in May 2003).

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Appendix A. (continued)

	U.S. Fish and Wildlife Service Pesticide Use Proposal	Date: 04/08/2016

Best Management Practices:

Application at wind speeds less than 10 mph (but not inversion conditions) - must follow label.
Calibrate application equipment.
Field scouting/monitoring before pesticide application.
Pesticide application buffers around sensitive areas.
Use lowest effective application rate.

Additional Best Management Practices:

(1) Herbicide application supervised by Certified Pesticide Applicator; (2) applicators use Tyvek, exceeding PPE requirements on specimen label; (3) mixer wears glasses; (4) re-entry into application area prohibited for 12 hours; (5) no application unless weather information indicates no rain before, during and at least 2 hours post-application; (6) herbicide applicator maintain tips of application nozzle near ground and adjacent to targeted plants to minimize drift potential; (7) dye used to increase herbicide application efficacy, signal potential mechanical malfunction of equipment, and to maintain applicator safety by indicating exposure.

Treatment Site Conditions:

Topography (Degree Slope): Less than 3.0 Degrees
Soil Texture: Sandy Loam
Soil pH: 6.8
Soil Organic Matter: 5.0
Surface Water Type(s): Lake
Distance to nearest: Within 25 ft
Depth to Groundwater: 2+ to 5 ft
Distance to nearest potable water: Less than 1/4 Mile
If Spot Treatment, Estimated % Cover to be Treated: 2
Is the Treated Area Naturally Flooded or Irrigated (Y/N): N
Irrigation Method: N/A

Non-Target Species At/Near Treatment Area during or immediately after treatment (taxonomic groups):

Mammals, Native Lepidopterans, Native Pollinating Insects, Passerines, Sensitive Plants, Other terrestrial invertebrates

Are Impacts to Non-Target Species Expected? (Y/N): Y

Federally Listed Species and Critical Habitat(s):

Key:
NE = No Effect
NLAA = Not Likely to Adversely Affect
LAA = Likely to Adversely Affect
JAM = Jeopardy/Adverse Modification
NJNAM = No Jeopardy/No Adverse Modification

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Appendix A. (continued)

	U.S. Fish and Wildlife Service Pesticide Use Proposal	Date: 04/08/2016

Note: ESA Documentation is required for NE, NLAA, LAA, JAM and NJNAM Effects Determinations. Please ensure you are in compliance with the current Endangered Species consultation procedures.
N/A

Are there any other federally listed, proposed or candidate species or critical habitat(s) that occur (or may occur) at or near the site that are not listed above? (Y/N): N

Other Federally Listed, Proposed, Candidate Species, or Critical Habitat(s):

Are there any state listed, proposed or candidate species or their habitats or other species of concern that may be affected by the proposed activity? (Y/N): N

Other Species of Concern:

Note: If State listed species are in/near your treatment area, it is recommended that you contact the appropriate state agency for consultation procedures.

Contact Person: Bill Pyle
Phone: 907-487-0228
Fax: 907-487-2144

Project Leader: Tevis Underwood
Phone: 907-487-0225
Fax: 907-487-2144

Alternate Contact: Anne Marie La Rosa
Phone: 907-487-0226
Fax: 907-487-2144

Submitter Comments:

(1) Primary treatment will occur during late MayJune. (2) Starting on or about July 1, and continuing through late August-early September, follow-up treatments will be conducted at 10-21 day intervals of previously untreated infestation sites.

Reviewer Information:

Date: 03/30/2016
Reviewer: Tevis_Underwood@fws.gov
Reviewer Type: Field (Dis)Approver
Action Taken: Reviewed by Field (Dis)Approver and forwarded to RO

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Appendix A. (continued)

	U.S. Fish and Wildlife Service Pesticide Use Proposal	Date: 04/08/2016

Comments:
To the best of the Field Approver's knowledge, this PUP is accurate, complete, and the information provided is in compliance with the pesticide label(s), with Service Policy, and with any pertinent local and State laws, regulations, and restrictions concerning each pesticide's use.

Date: 04/07/2016
Reviewer: lori_verbrugge@fws.gov
Reviewer Type: Regional (Dis)Approver
Action Taken: Approved by RO (Dis)Approver
Comments: Only one application is allowed, per label directions, for any particular site. The label states re-entry is prohibited "until dry" and the PUP proposes a 12 hour re-entry period, which should be sufficient to allow pesticide to dry. Extend re-entry period in the unlikely event the spray has not dried within 12 hours, to meet label requirements. Continued approval of this multi-year PUP is granted, given the preparation of both a detailed IPM plan and the Environmental Assessment/FONSI. This action is consistent with Service policy (569 FW 1 Integrated Pest Management).

Approval Period: 1 year **Approval Expires:** 12/31/2016

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