

Three Invasive Weed Species: Notes from Alaska

Steven Seefeldt



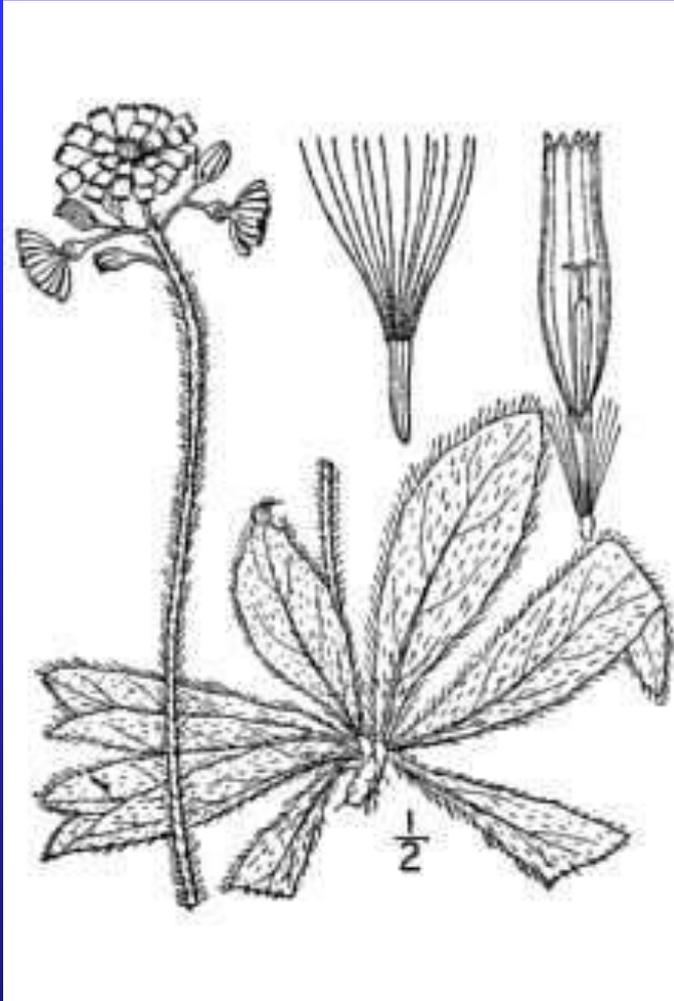
The Weeds

- Orange hawkweed (*Hieracium aurantiacum*)
- White sweetclover (*Melilotus alba*)
- Reed canarygrass (*Phalaris arundinacea*)

Orange hawkweed (*Hieracium aurantiacum*)

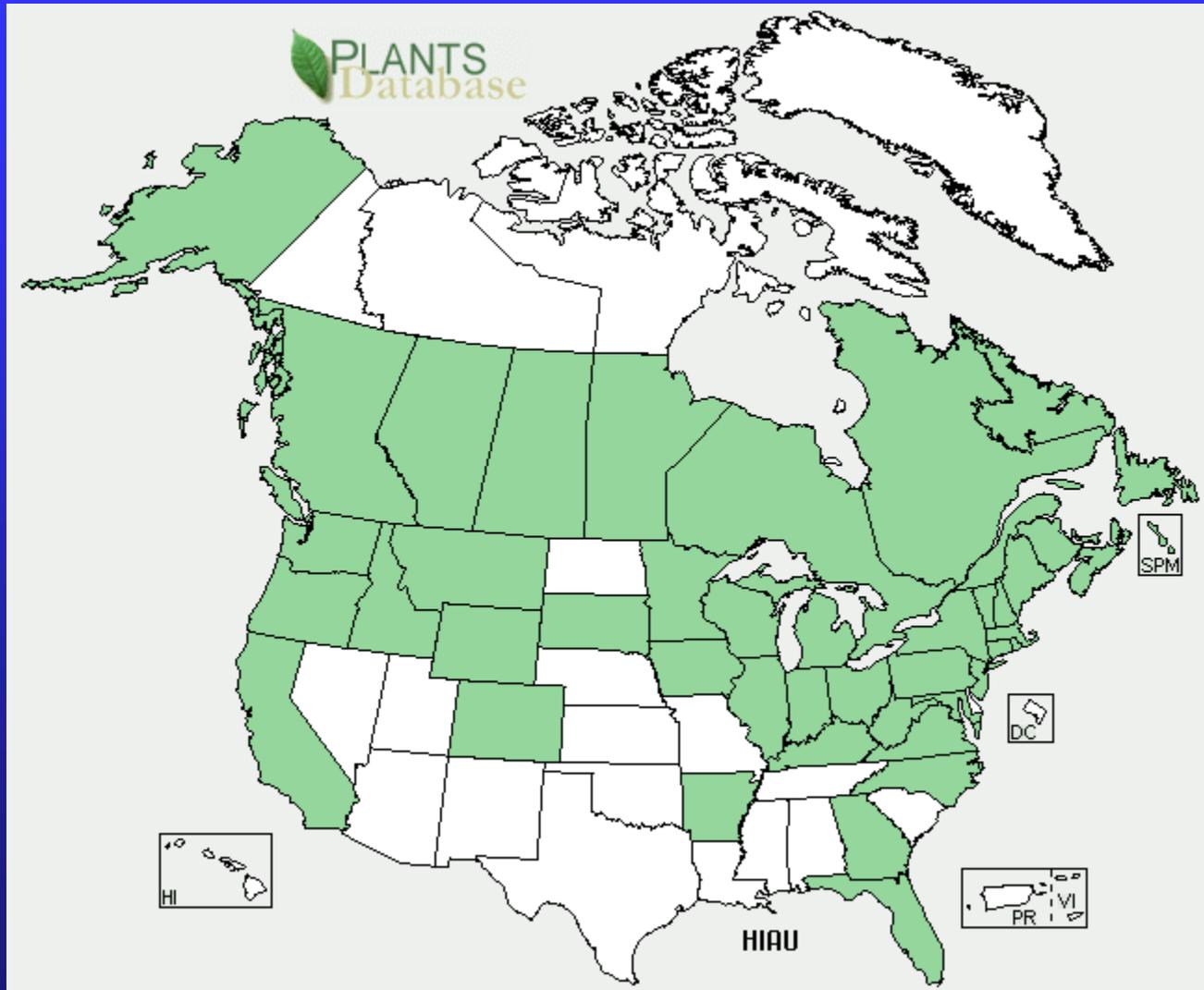
- *Hieracium*
 - About 800 species world wide
 - Hierax = hawk. It was thought that the great vision of hawks was due to their supposed addiction to these plants

Orange Hawkweed

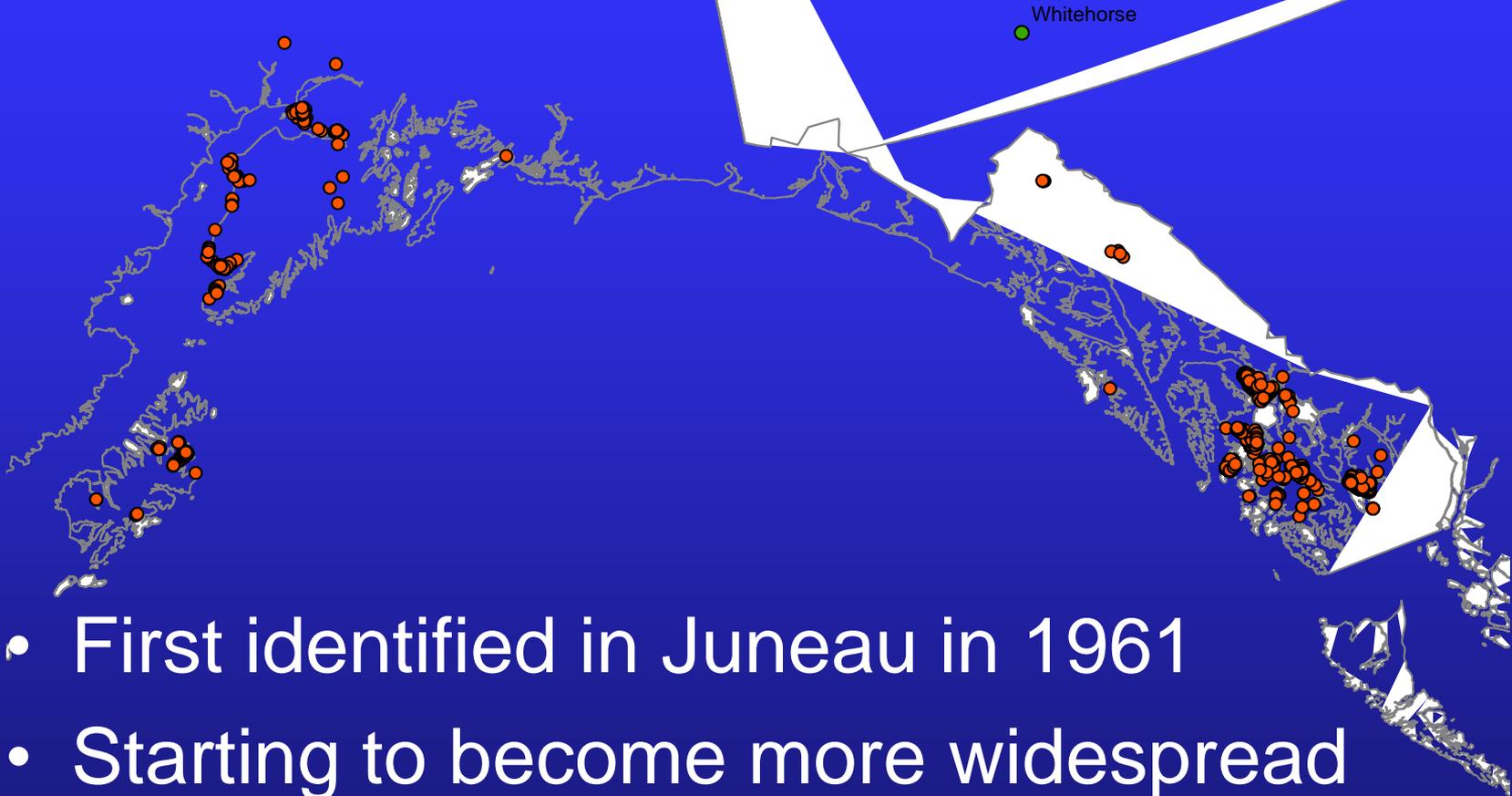


Norman Melvin

Orange Hawkweed



Orange Hawkweed in Alaska



- First identified in Juneau in 1961
- Starting to become more widespread

Warnings

- From the book *Wild Flowers of the Pacific Northwest* by Lewis J. Clark
 - Pg 561 – “Introduce into one’s garden with peril”

Hawkweed reproduction

- Flowers from rosettes, typically get one stalk
- Each stem with multiple flower heads
- Each head with multiple seeds
- Seeds dispersed by wind and easily carried on vehicles, animals and clothes
- Many species have stolons

Orange Hawkweed management

- Information from the south
 - Mechanical methods not effective
 - Mowing increases vegetative spread
 - Plowing spreads
 - Digging difficult

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Orange Hawkweed management

- Information from the south
 - Mechanical methods not effective
 - Mowing increases vegetative spread
 - Plowing spreads
 - Digging difficult
 - No biological agents
 - Herbicides
 - Must have surfactant to get past leaf hairs
 - Must apply during rosette stage

Talkeetna Weed Pull

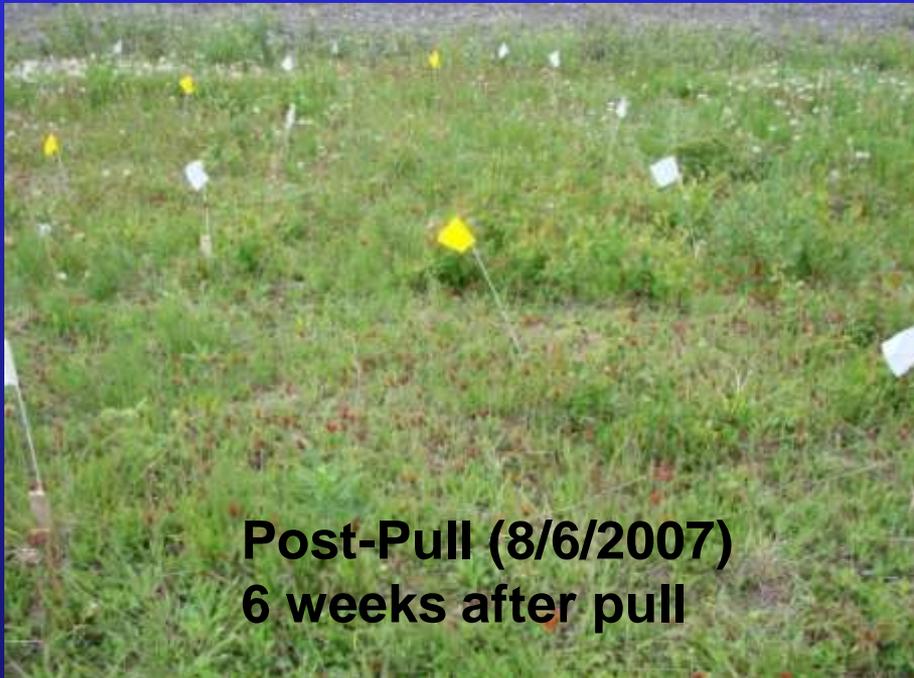


Methods:

- 2 x 2 meter plots
- 8 treated plots, 8 control plots
- Pre-treatment % cover estimates
- Hand pulled each treated plot (biomass of orange hawkweed including roots and stolons)



**Post-Pull (6/25/2007)
End of the day**



**Post-Pull (8/6/2007)
6 weeks after pull**



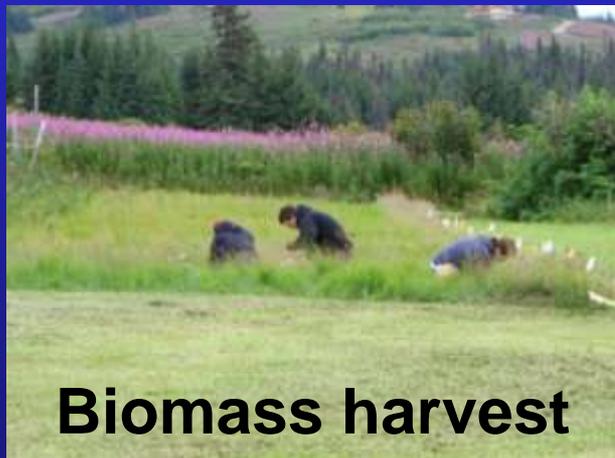
**Post-Pull (8/6/2007)
6 weeks after pull**

Field Trials

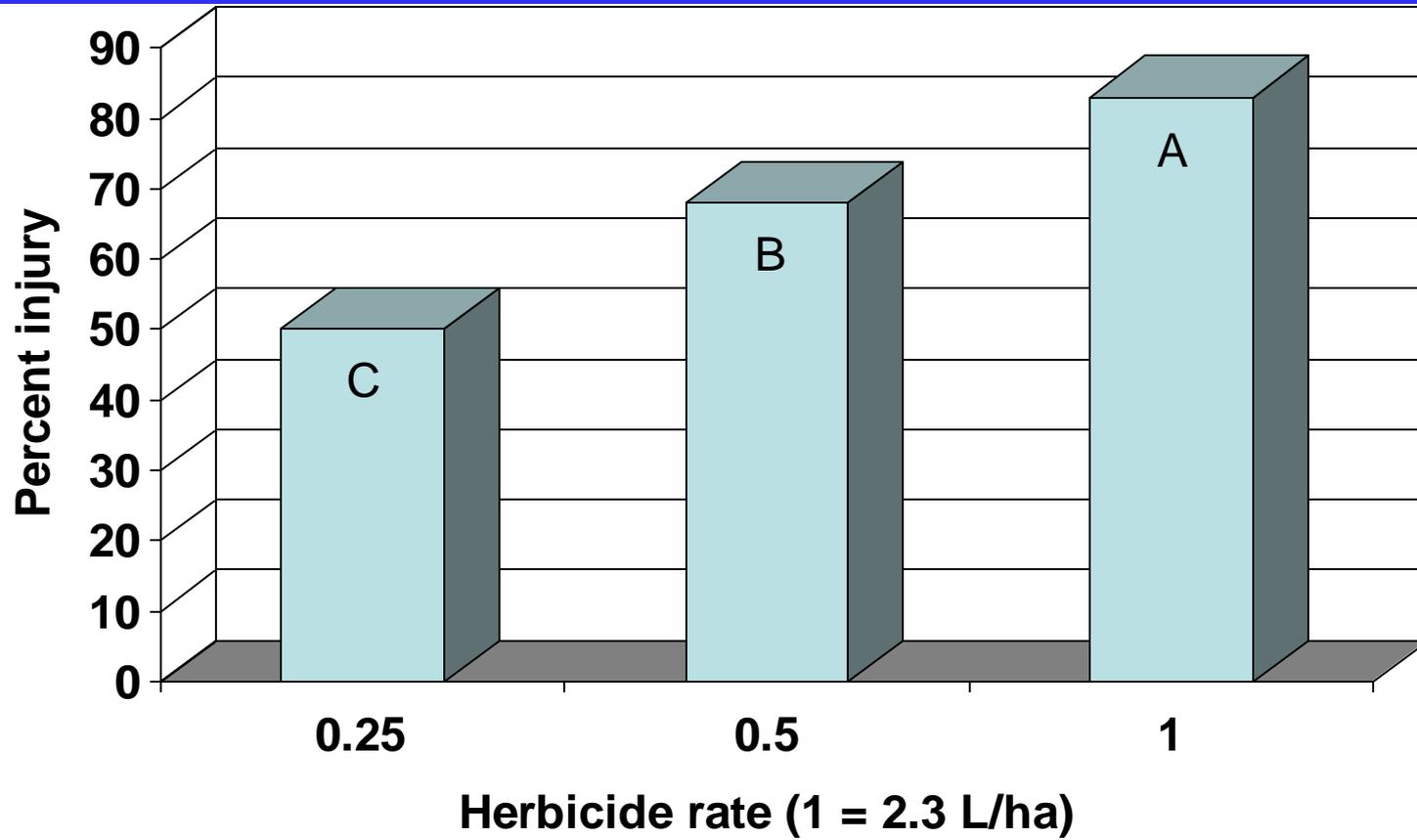
- Five sites, Talkeetna and Homer
- Plots 6 x 30 feet
- Redeem, Transline, and Milestone at three rates (1, $\frac{1}{2}$, and $\frac{1}{4}$ the full rate plus a control)
- Three replications of each of the above treatments
- Randomized complete block



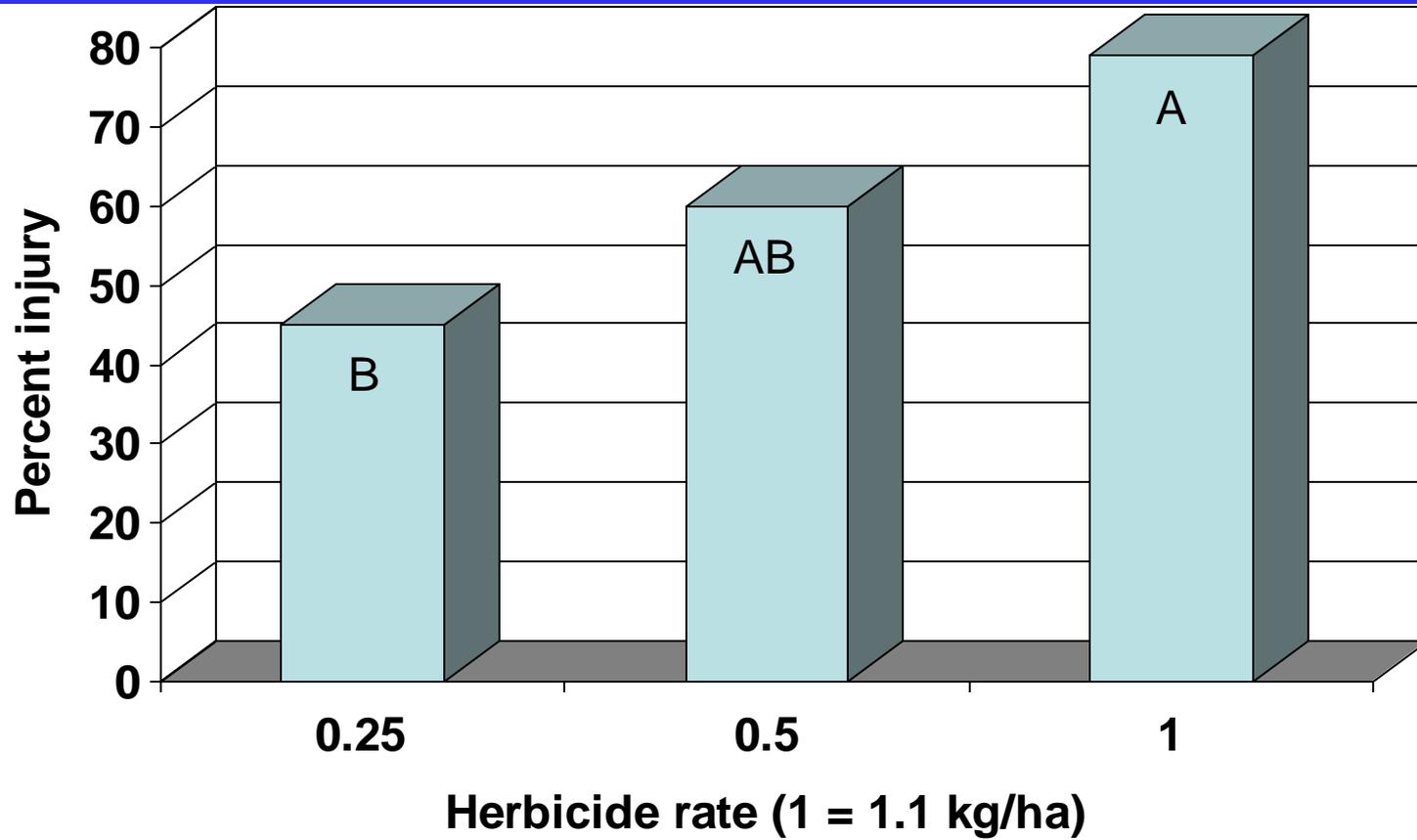
The work in Homer, AK



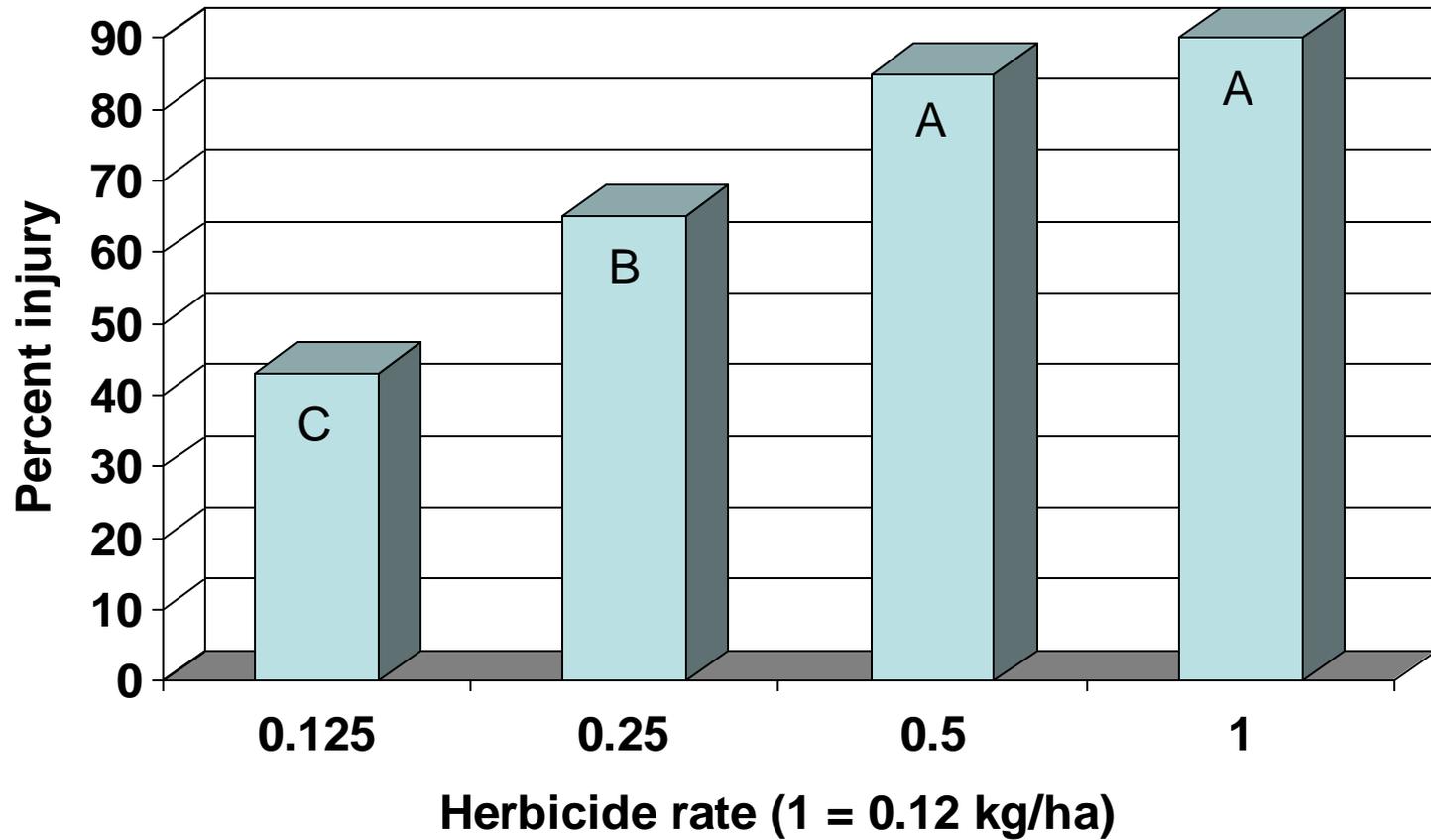
Visual Injury - Redeem



Visual Injury - Transline



Visual Injury - Milestone







Conclusion

- Three herbicides are promising for use on orange hawkweed and one (Milestone) is effective at reduced rates based on greenhouse and field research

Conclusion

- Three herbicides are promising for use on orange hawkweed and one (Milestone) is effective at reduced rates based on greenhouse and field research
- Grasses increased as orange hawkweed decreased

Acknowledgements

- ARS – Jeff Conn, Joseph Kuhl, Dan Hall, Erin Carr, Nan Werdin-Pfisterer, Trista Saunders, Jennifer Kapla, Steve Lillard, Zachary Behr, Katie Mohrmann, and Katie DiCristina
- AK - Caleb Slemmons, Gino Graziano, Steve Hicks, Jen Vaughan, and Emily Perchuzel
- Weed pullers of the Youth Conservation Corps and Talkeeta citizens
- Four land owners

White sweet clover (*Melilotus alba*)



Where is WSC found?

- Road sides
- Braided glacial streams
- Disturbed areas

- How it got there and adapted

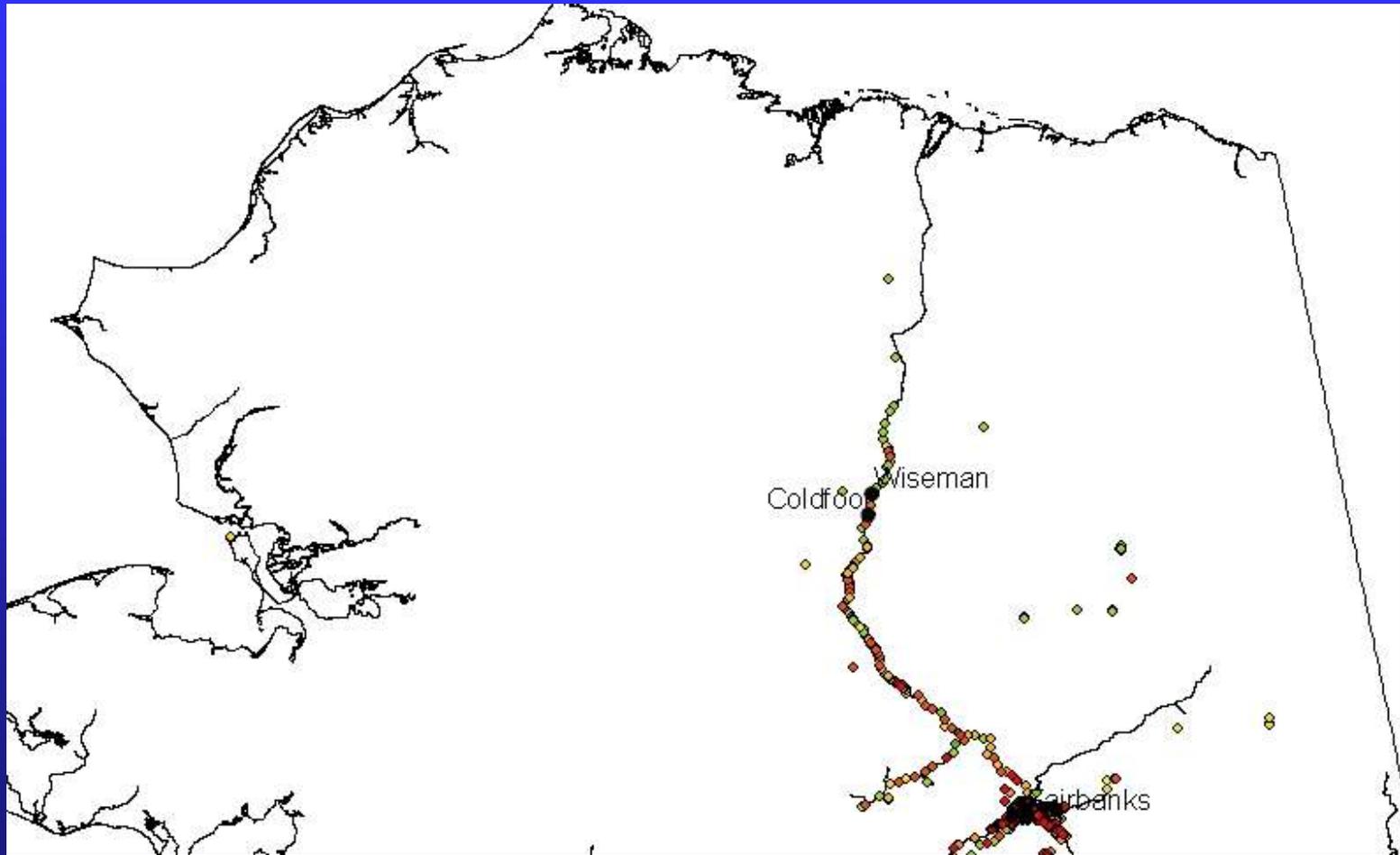
What is WSC doing?

- Establishing in and adapting to the ecosystem
- Altering ecosystem processes
 - Fixing nitrogen
 - Crowding out natives
- Expanding when opportunity arises

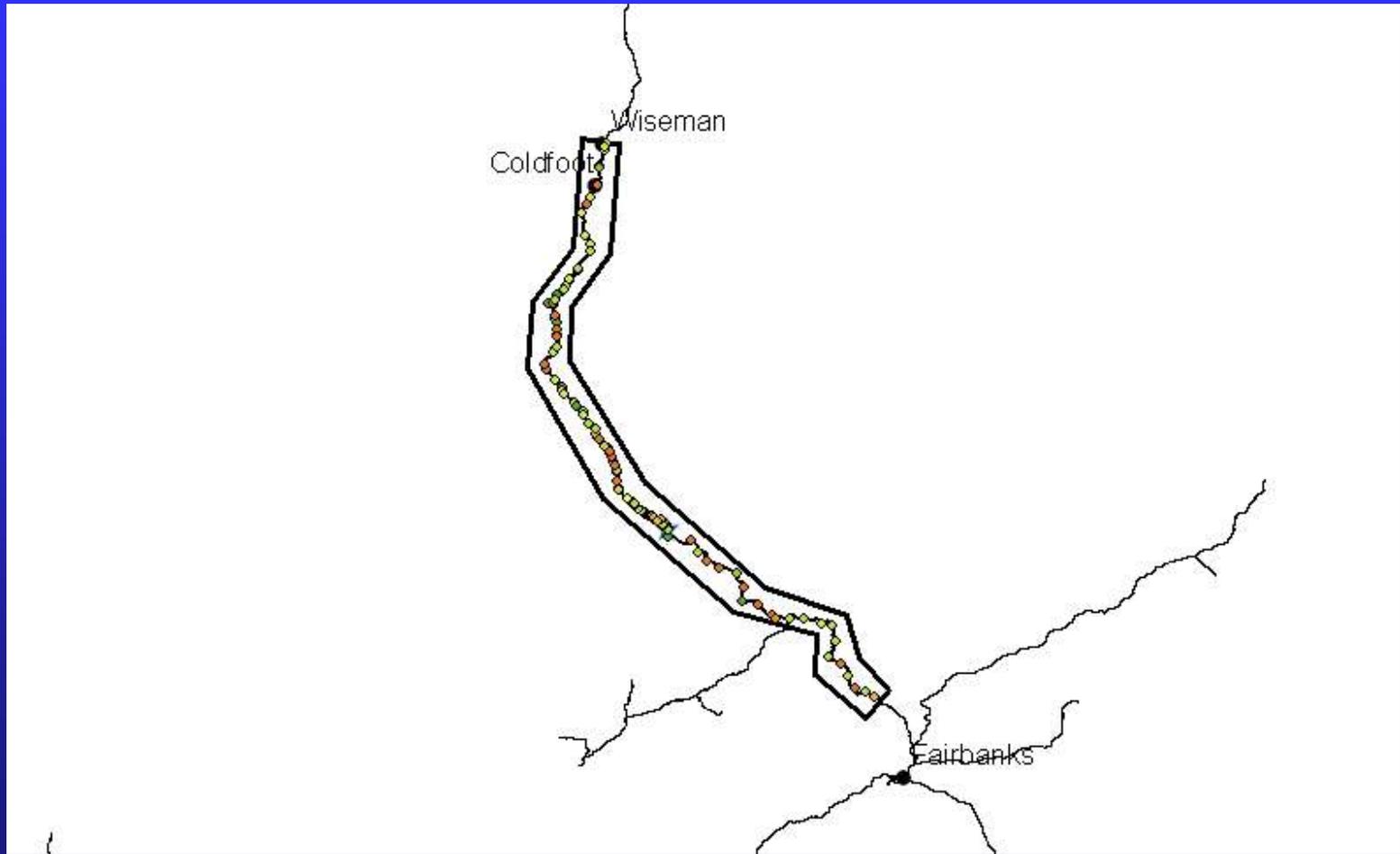
The Dalton Highway example



Northern Alaska



Study Site



Typical patch



Planting white sweet clover



Moving seed around



Preparing the seed bed



Control options

- Mechanical
 - Cultivating, hand weeding, mowing, mulching, burning, flooding, etc
- Cultural
 - Crop selection and planting technique
- Biological
 - Insects, pathogens, and herbivores
- Chemical

The easiest control option

- Prevention



Mechanical control

- Cultivating
 - Do before seed set
 - Enhances seed germination of existing seed bank
 - Can be used with cover crop

Chemical option - broadcast

- Boom-buster from the Salcha Delta Soil and Water Conservation District



Chemical option - selective

- Wet blade mower
- USDA/ARS/SARU
Initial experimentation

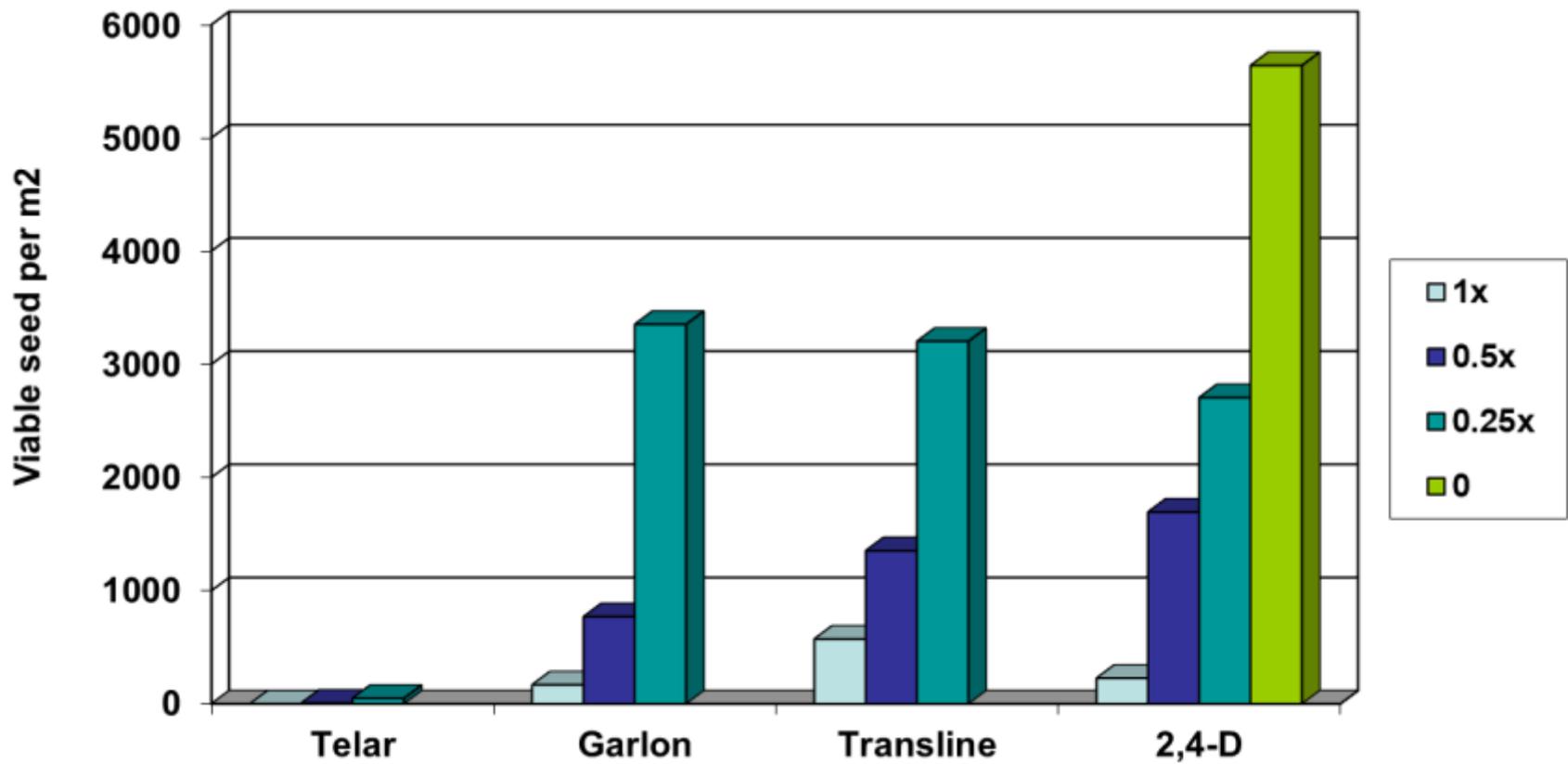


Which herbicides to use?

- Field studies

		g/ha
– Chlorsulfuron	Telar	17.6, 8.8, 4.4
– Triclopyr	Garlon	1,200, 630, 320
– Clopyralid	Transline	210, 105, 53
– 2,4-D	2,4-D	1,600, 800, 400

Field Study Results



Acknowledgements

- ARS – Joseph Kuhl, Dan Hall, Kate Beatie, Elizabeth Andringa, Erin Carr, Nan Werding-Pfisterer, Trista Saunders, Steve Lillard, Katie DiCristina, Zach Behr, Katie Mohrmann
- AK - Caleb Slemmons, and Gino Graziano

Moose as a vector for non-indigenous plant species in Alaska

Steven Seefeldt, Subarctic Agricultural Research Unit, Fairbanks, AK

William Collins, Alaska Department of Fish and Game, Palmer, AK

Joseph Kuhl, Department of Plant, Soil, and Entomological Sciences, University of Idaho, Moscow, ID

Marcus Clauss, Clinic of Zoo Animals, Exotic Pets and Wildlife, Vetsuisse Faculty, University of Zurich



Plant species studied



White sweet clover
(*Melilotus alba* Medik.)



Narrowleaf hawkbeard
(*Crepis tectorum* L.)

Why study these plant species?

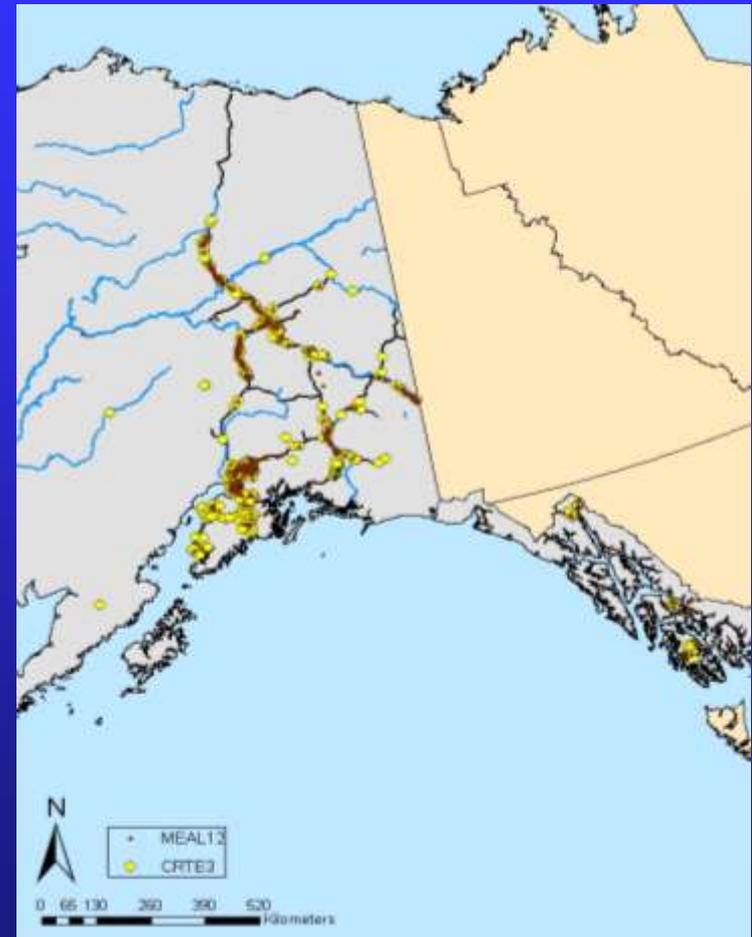
- Moose have been observed grazing on *M. alba* when the plant has mature seed
- *C. tectorum* has been observed growing out of collections of moose feces in the wild



C. McKay 03/15/07

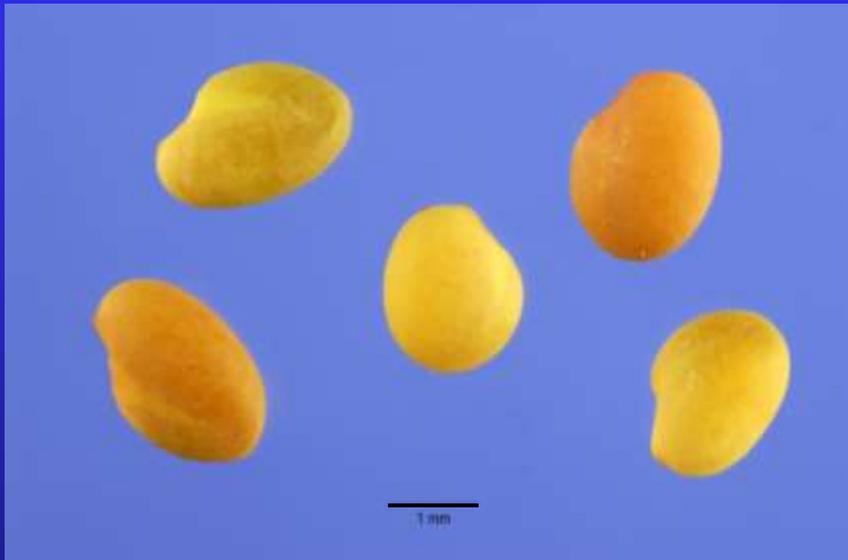
Infestations in Alaska

- Yellow dots are *C. tectorum*
- Red dots are *M. alba*



Seeds

M. alba



C. tectorum



Materials and Methods

- Seeds were collected in the summer of 2008 from plants around the UAF campus
- Germination tests determined 36% and 93% viability of *M. alba* and *C. tectorum*, respectively
- Seeds were divided into four replications of 5,500 *M. alba* and 10,600 *C. tectorum* germinable seeds

Materials and Methods

- Moose used in the study are located at the University of Alaska Fairbanks Agricultural and Forestry Experiment Station, Matanuska Experiment Farm, Palmer, Alaska
- The moose are tame



Materials and Methods

- Moose were fed a diet of brome grass (*Bromus inermis*) silage beginning 21 D before the trial and throughout the feeding trial
- Silage did not contain viable seed



Materials and Methods

- On October 19, 2008 each dose of seeds was mixed with approximately 100ml of canned pumpkin immediately before feeding the moose



Feeding the Moose



Force feeding the Moose



Materials and Methods

- Moose were kept in separate digestion balance stalls
- All fecal material was collected, bagged, and frozen at -10°C each day for the next 11 days



Materials and Methods

- November 17, 2008 all fecal material was placed in the greenhouse (18 C) to thaw
- The following day, fecal material was placed in 28 x 53 x 6 cm plastic trays to a depth of 2 to 4 cm
- 3 to 7 trays were needed for each moose for each day

Setting up greenhouse study



Materials and Methods

- The greenhouse was kept at 18 C with a 13/11 hr day/night cycle
- Trays were watered as needed and covered with plastic domes to reduce evaporation



Materials and Methods

- Before watering, *M. alba*, *C. tectorum* and other species were counted and removed
- Unknown seedlings that were not *M. alba* and *C. tectorum* were transplanted and grown until identified



Materials and Methods

- After 7 wk, when new seedling numbers were quite reduced, fecal material was air dried in the greenhouse for 2 wk, weighed, and combined
- Our observation was that seedlings were mainly coming from the surface of the fecal pellet so a follow-up study was conducted

Materials and Methods

- 4 subsamples (> 1 kg each) were sent to Fairbanks
- Half was weighed, dried at 60 C for 48 hr and weighed
- Half was sieved through a 5.6 mm mesh (No. 3.5) after moistening



Materials and Methods

- The sieved material was placed in trays to a depth of 2 cm and watered
- Trays were placed in a seed germinator set to 15 C with a 12/12 hr day/night cycle
- Emerging seedlings were identified



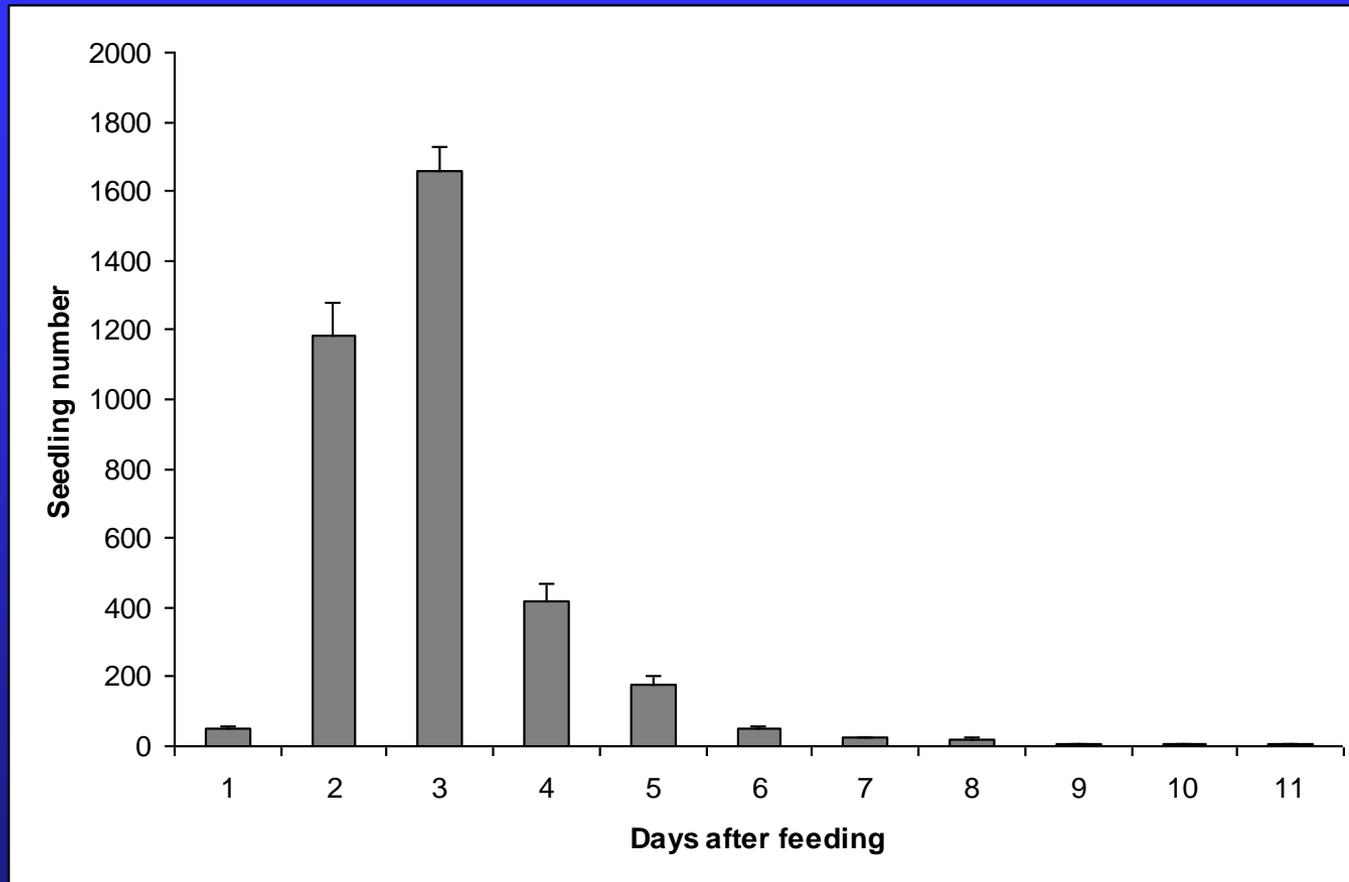
Results

- *C. tectorum*
 - 42,000 germinable seed produced 5 seedlings
 - 4 from one moose 1 DAF (days after feeding)
 - 1 from another 3 DAF

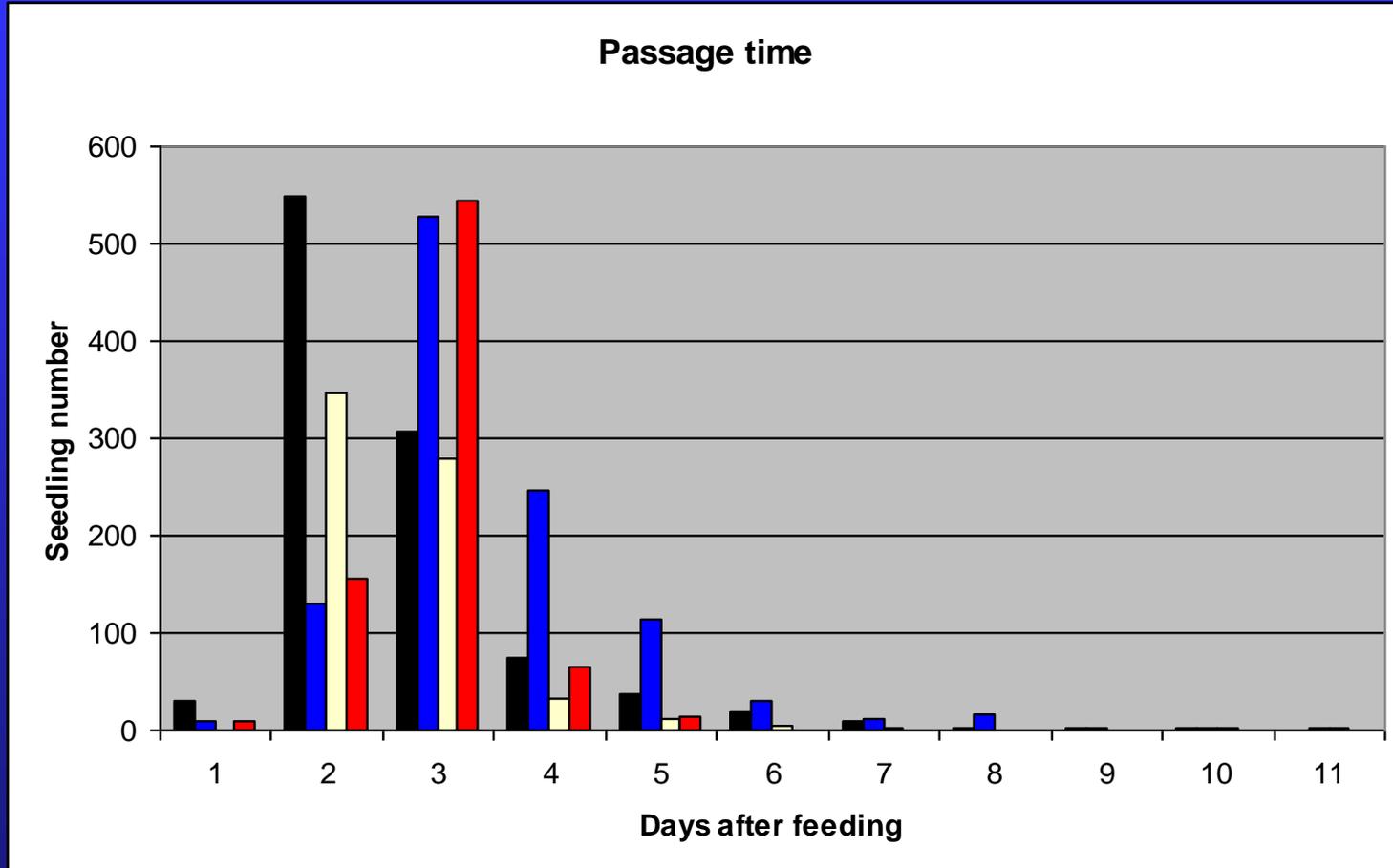
Results

- *C. tectorum*
 - 42,000 germinable seed produced 5 seedlings
 - 4 from one moose 1 DAF (days after feeding)
 - 1 from another 3 DAF
- *M. alba*
 - 22,000 germinable seed produced 3,595 seedlings
 - 16% survived mastication and digestion
 - Of those 39% came from inside the pellet

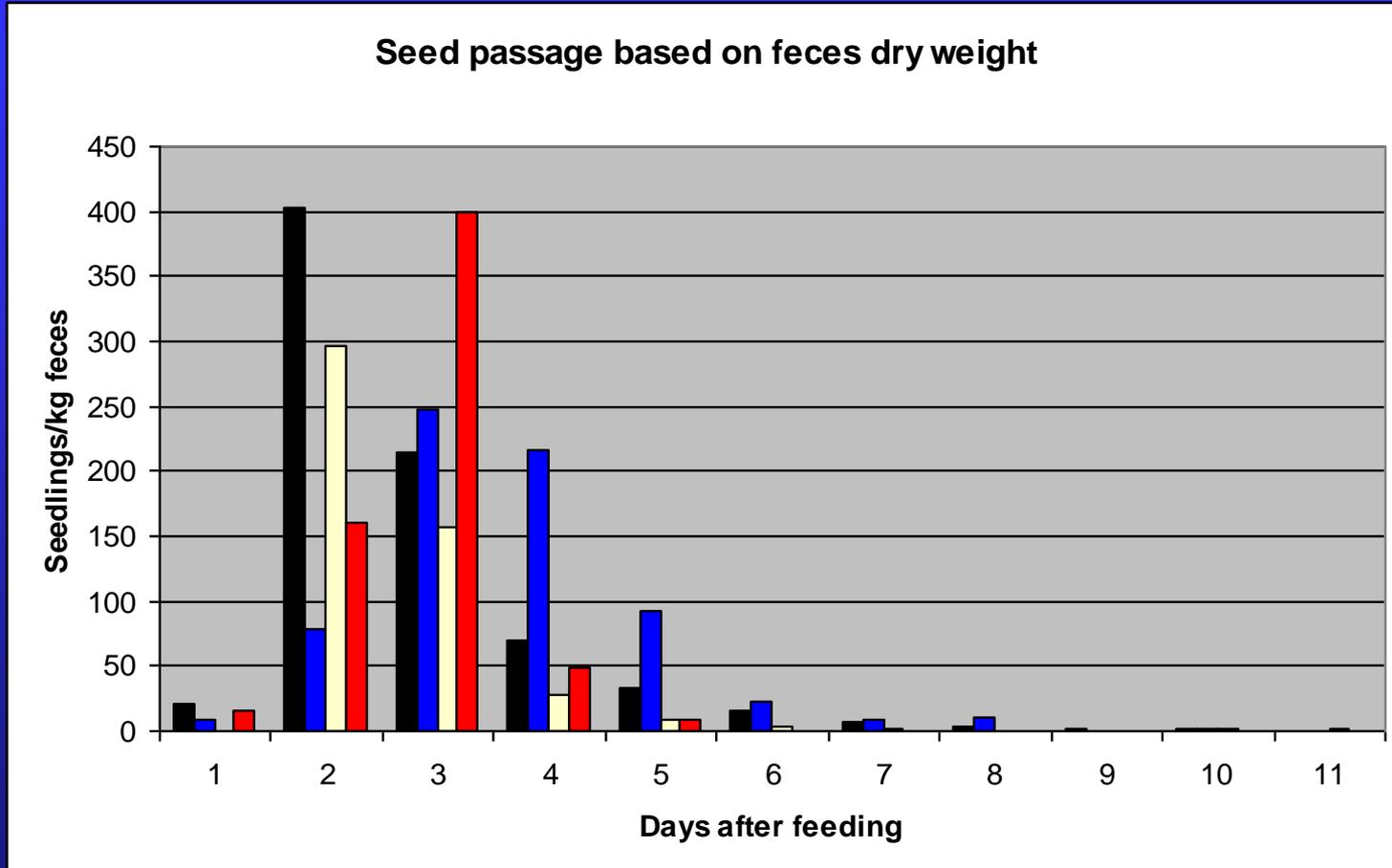
Results – *M. alba*



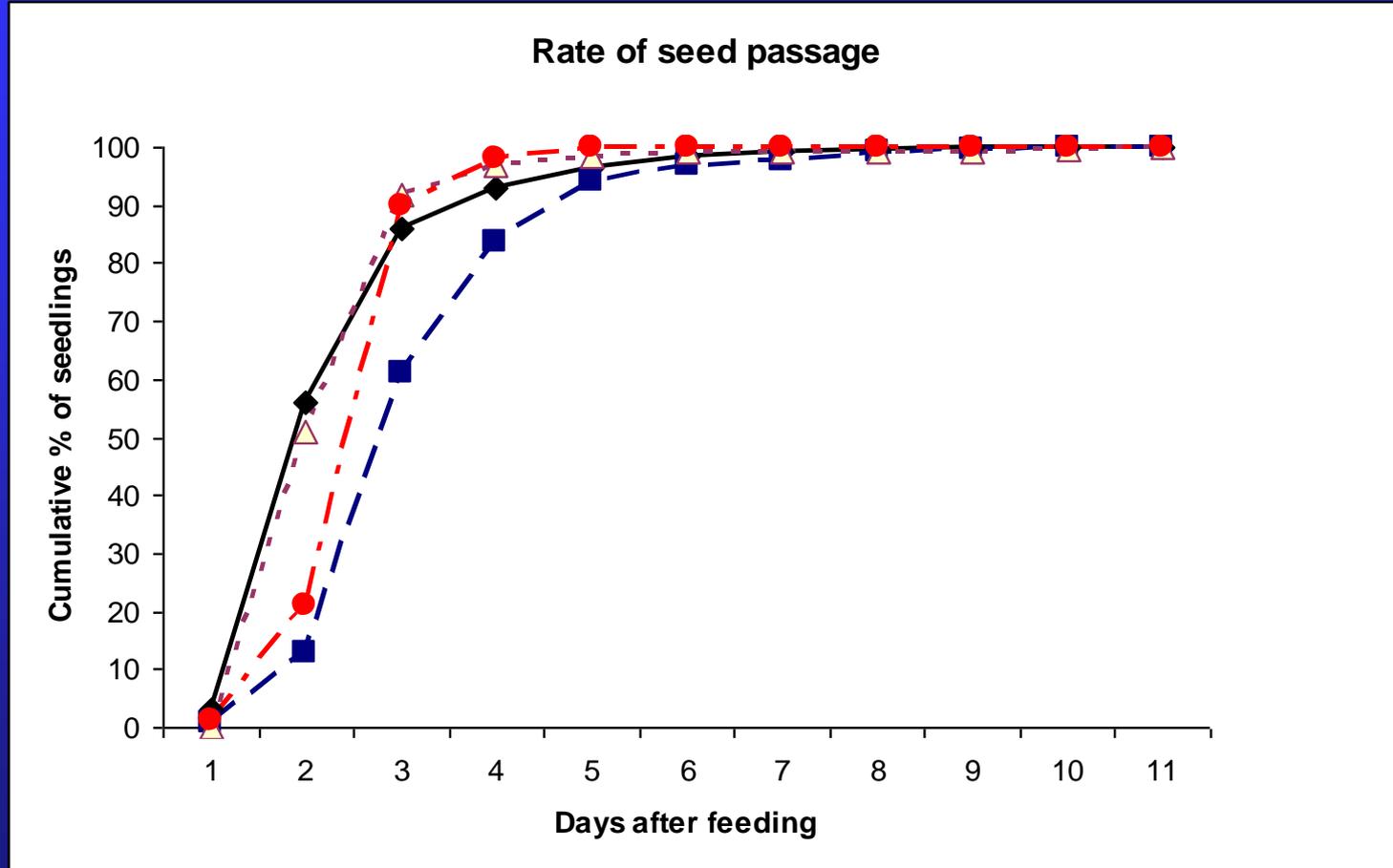
Results – *M. alba*



Results – *M. albus*



Results – *M. alba*



Results

- Other species identified during the study
 - Common lambsquarters (*Chenopodium album* L.)
 - Common chickweed (*Stellaria media* (L.) Vill.)
 - An unknown grass
- Two are common agricultural weeds
- Both were available before moose were penned

Conclusion

- Seed dispersal of non-indigenous plant species is a concern
- *M. alba* seed typically does not fall far from the plant



Conclusion

- Seed dispersal of non-indigenous plant species is a concern
- *M. alba* seed typically does not fall far from the plant
- But things happen



Conclusion

- *M. alba* seed floats
- If it gets to a river the rate of spread can increase



Conclusion

- Blaine Spellman determined that *M. albus* will negatively impact many native pioneer plant species along braided glacial streams



Conclusion

- Endozoochorous dispersal of *M. alba* is a new concern
 - *M. albus* produces up to 300,000 seed/plant
 - Viable seed are on the plant from late summer on into winter
 - Moose can move considerable distances in a day
 - Moose feces are a suitable habitat for seed germination and seedling establishment

Conclusion

- Currently along the Dalton Highway, volunteers try to keep *M. alba* from setting seed within 30 m of river crossings
- Is this enough?



Conclusion

- This is a report of one animal and two plant species
- There are many other wildlife – non-native indigenous species interactions that could result in the enhanced spread of potentially ecosystem altering organisms

Conclusion

- Mule deer have been observed eating *M. alba* in the Yukon
- And deer are known to spread spotted knapweed (*Centaurea stoebe*) and leafy spurge (*Euphorbia esula*) [Wallander, Olson, and Lacey 1995; Olson and Wallander 2002]



C. Domes

Acknowledgements

- Erin Carr, September Martin, and Jennifer Kapla – USDA/ARS
- Committee for Noxious and Invasive Plant Management (CNIPM)
- AKEPIC plant database

Managing Reed Canarygrass on the Kenai Peninsula

Before, Now and the Future



D. Koester



Blaine T. Spellman

Reed Canary Grass (RCG) Biology

- Eurasian variant is aggressive.
- Likely brought to Alaska as a soil stabilizer and forage crop.
- Up to 6+ feet tall.
- Spreads via seed and rhizome.
- Grows well in wetlands.



Barry Rice, bugwood.com

Closed and open panicles

Spreading rhizome makes extensive root mass



T. Miller

RCG Habitat



Grows optimally in wet habitat.

Why worry? RCG Impacts

- RCG populations are near monoculture along hundreds of miles of streams in the Pacific Northwest (Miller 2007).
- RCG is likely displacing native vegetation through competitive exclusion.
- RCG drastically modifies stream flow through sedimentation.
- **RCG alterations** have unknown consequences on stream invertebrates, waterfowl, rodents, and **SALMON**.



B. Spellman

encroaches on active channels

RCG – Scenario 1

reed canary
grass



Displaces native
grass/sedge and clogs
streams!

sockeye



Loss of salmon
spawning beds?

Black Bear



Less food, less
bears?



Less food in the
freezer, need more
\$\$\$

RCG Management Plan

To effectively manage RCG the KP-CWMA decided two components were necessary.

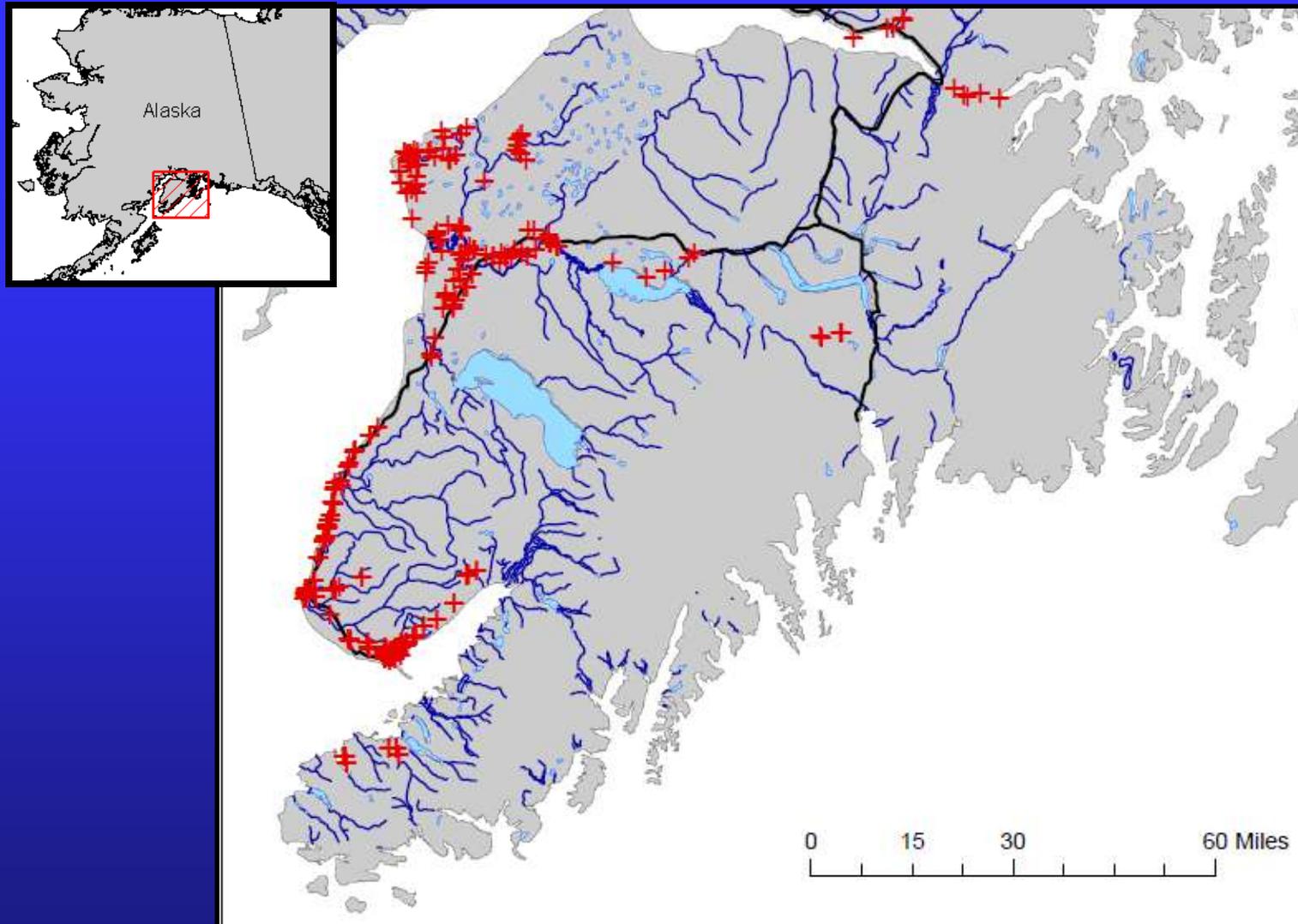
1. RCG Survey

- Need locations of RCG to coordinate control efforts for the future. Maybe EDRR?
- Prioritize infestations for control: Critical habitat vs. non-critical habitat.

2. Best Control Techniques

- Do methods in lower 48 work in Alaska?
- Determine cost-effective and efficient approaches to control RCG in Alaska.

RCG Roadside Distribution (2006 data)



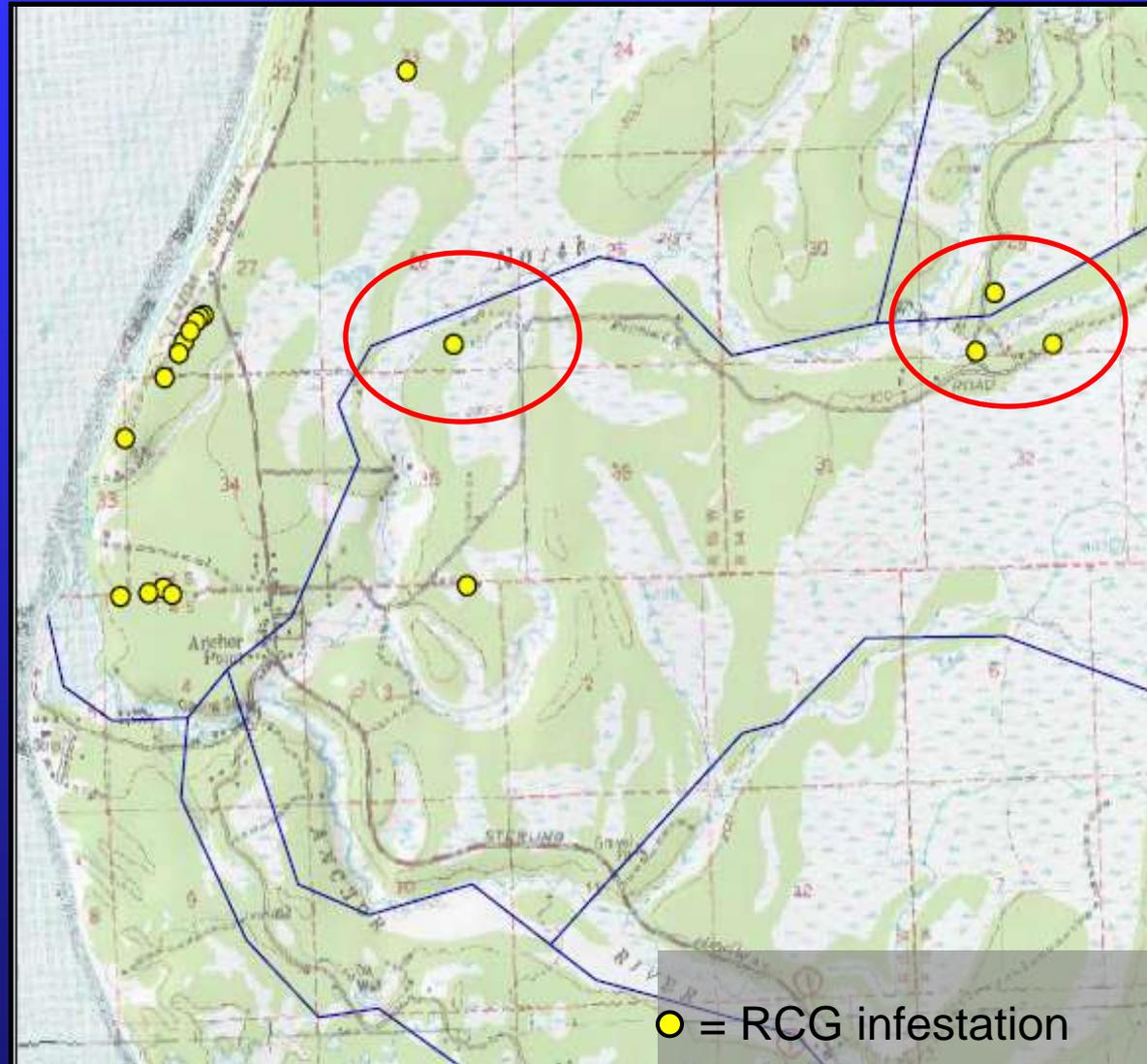
There are currently 259 AKEPIC points for Reed Canary Grass on the Kenai Peninsula.

RCG Watershed Survey - Prioritization

Kenai Peninsula CWMA

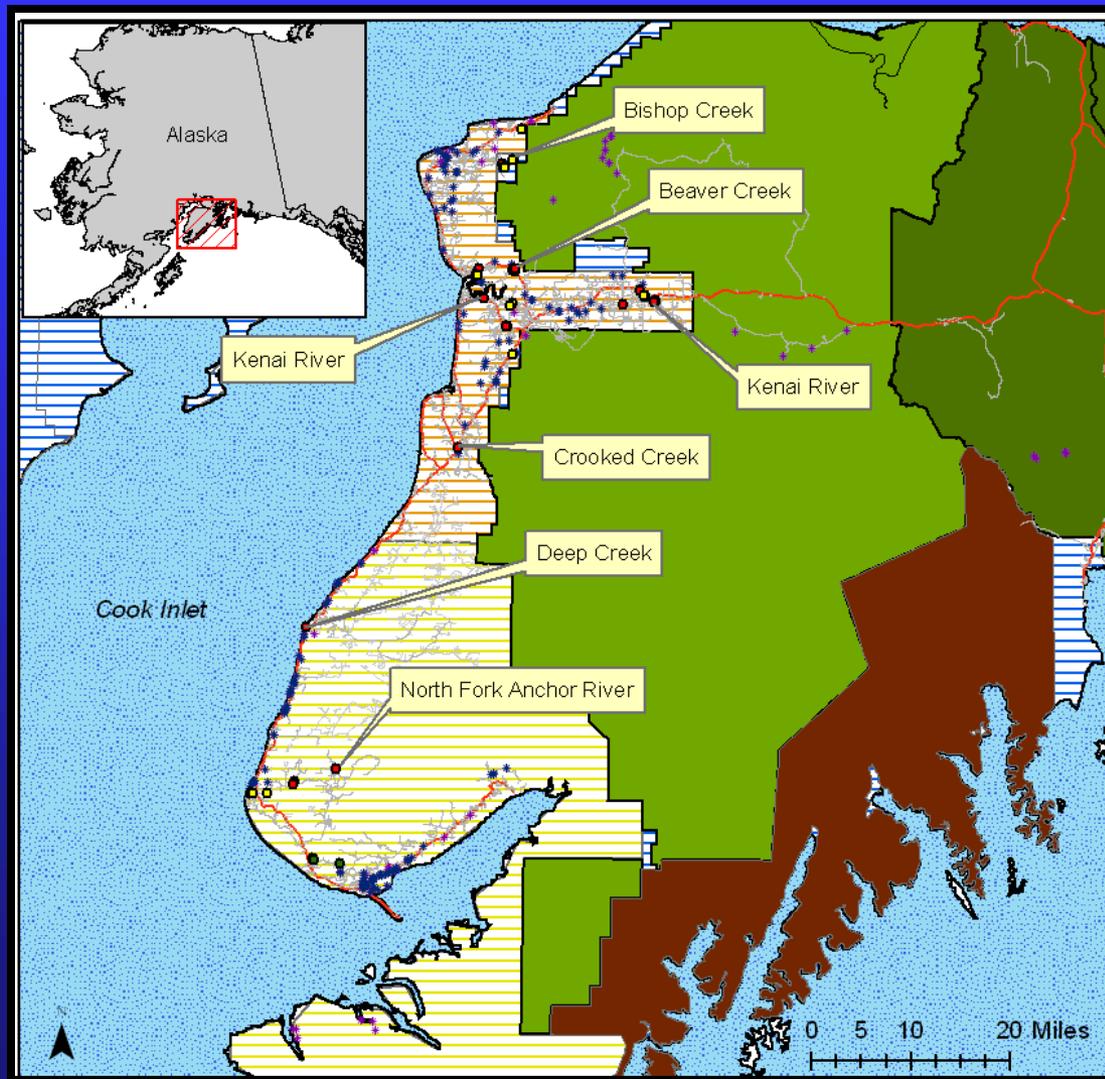
- Understood RCG is beyond eradication on the Kenai Peninsula
- During 2007-2009, shifted focus from roads to sensitive wetland habitat.
- Thousands of water bodies in the Kenai Peninsula.
- **Prioritized survey efforts in wetlands both adjacent to RCG infestations and that support coho salmon.**

North Fork Anchor River



Prioritizing RCG Stream Surveys

- 51 RCG infestations mapped in wetlands.
- 14 of 51 infestations were adjacent to wetlands that support Coho salmon (Kenai Watershed Forum, 2006).
- During 2007-2009, RCG survey of 6 streams took place.



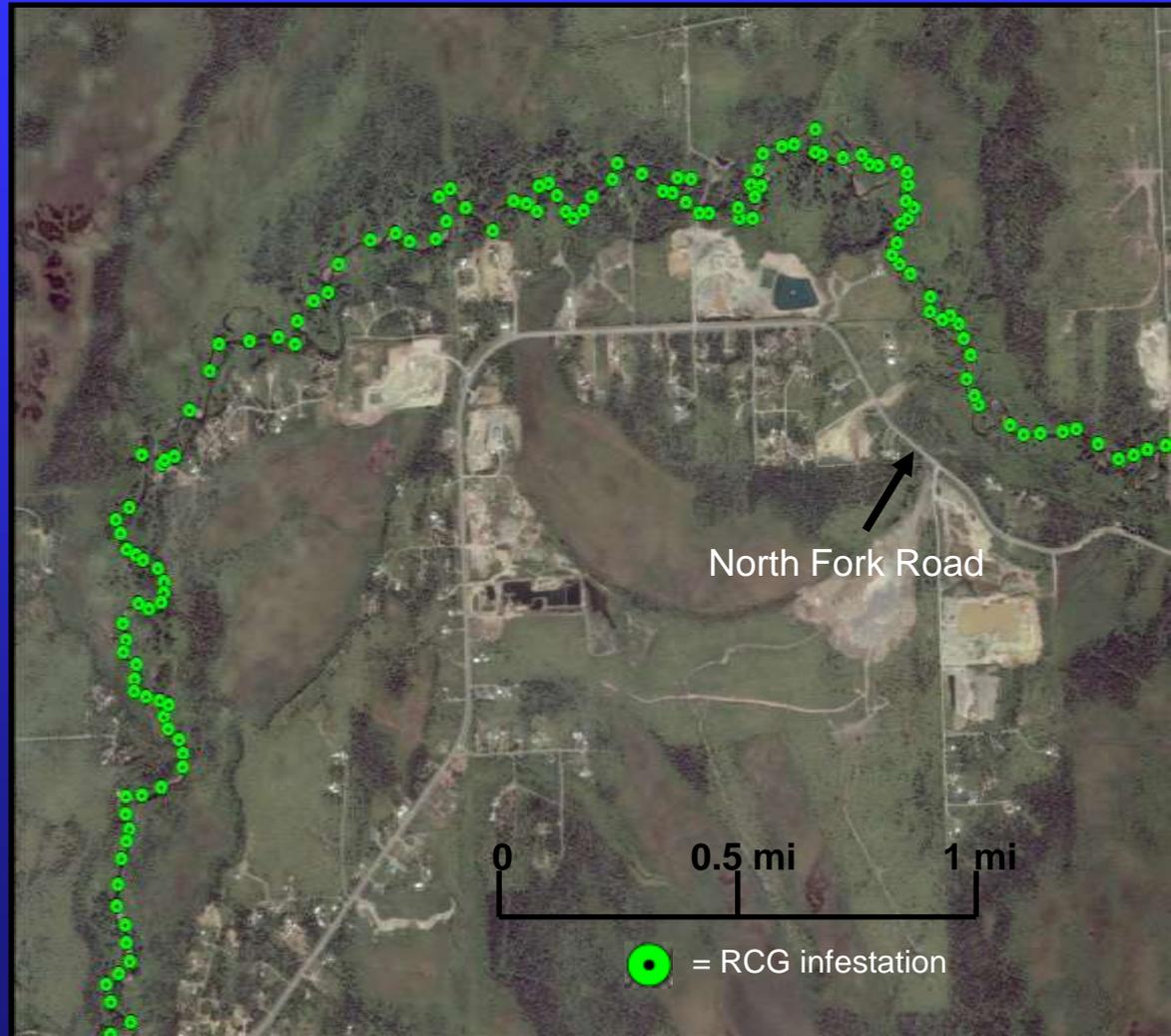
Map made by Kenai Watershed Forum

RCG distribution– North Fork Anchor River



Results – North Fork Anchor River

- Mapped ~ 20 miles of North Fork Anchor River.
- Found 256 RCG infestations along the river.
- RCG growing directly along the active channel.
- **Generally monotypic infestations that stretched for 100+ meters.**



RCG on North Fork Anchor River

4 of the 6 high-priority streams had extensive RCG infestations

Kenai River

Bishop Creek

North Fork Anchor River

Beaver Creek

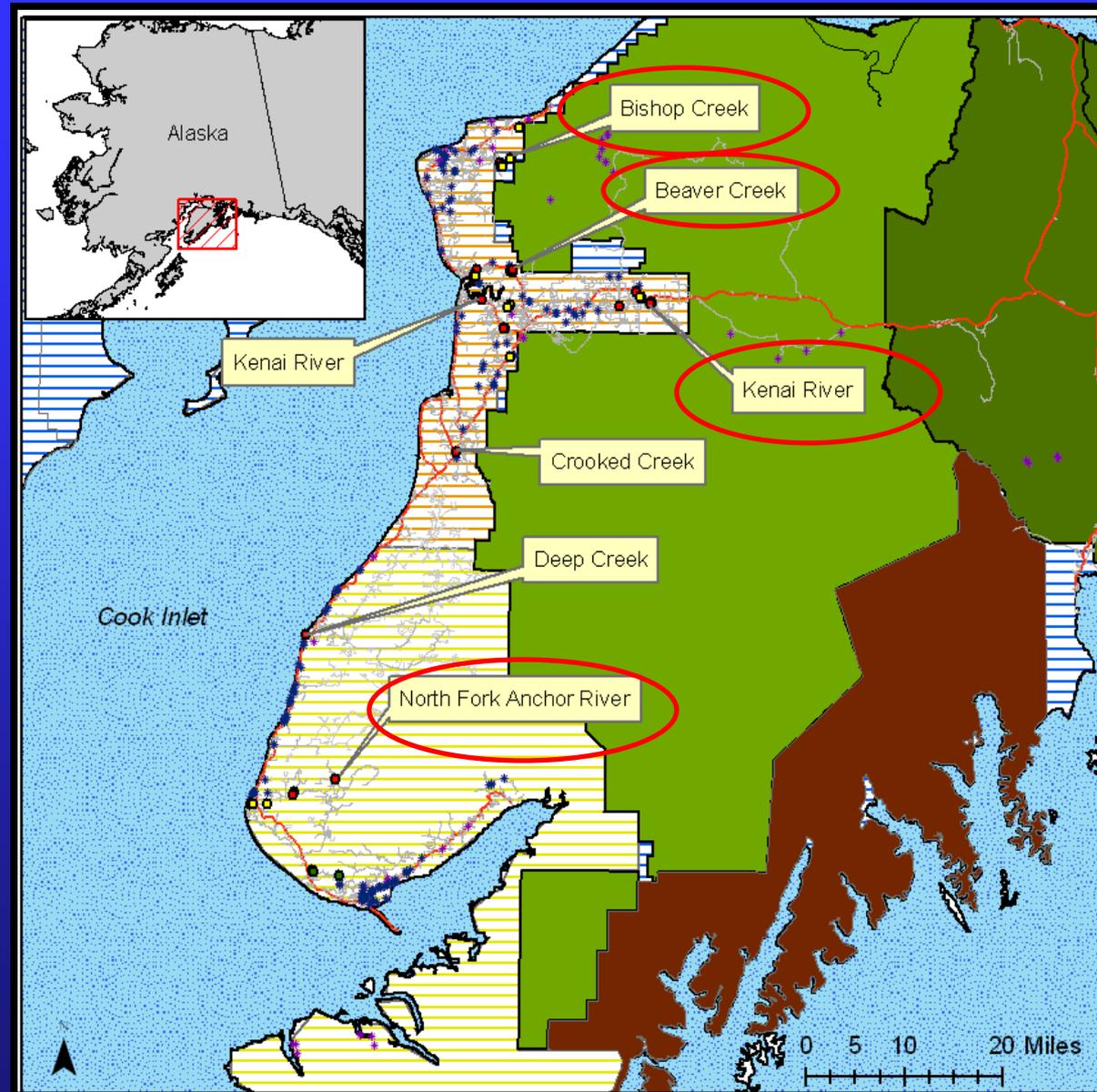
Additional anadromous
RCG Streams:

Anchor River

Slikok Creek

Stariski Creek

Swanson River



What are we going to do?





M.Martin



D. Koester

Mechanical control can be effective for small RCG infestations.



D. Koester

Tarping material might be more feasible for controlling RCG infestations on large and flat sites such as field edges and boat launches.

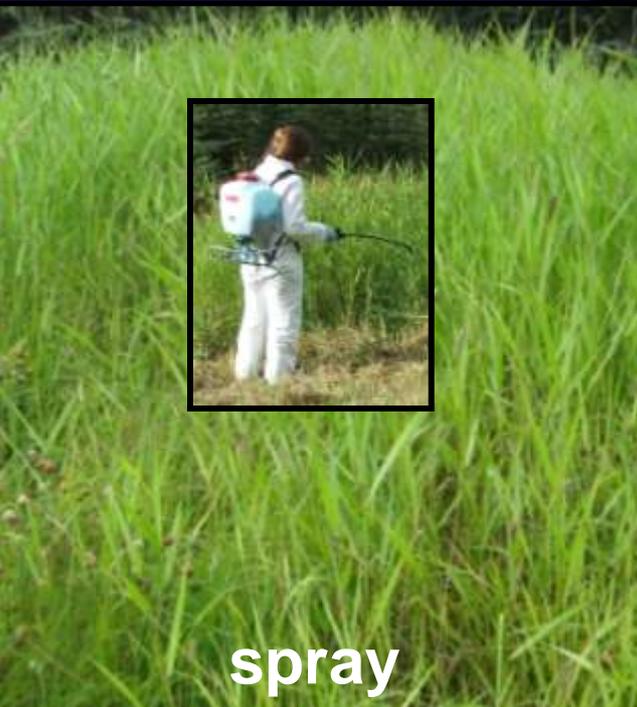


G. Grazziano

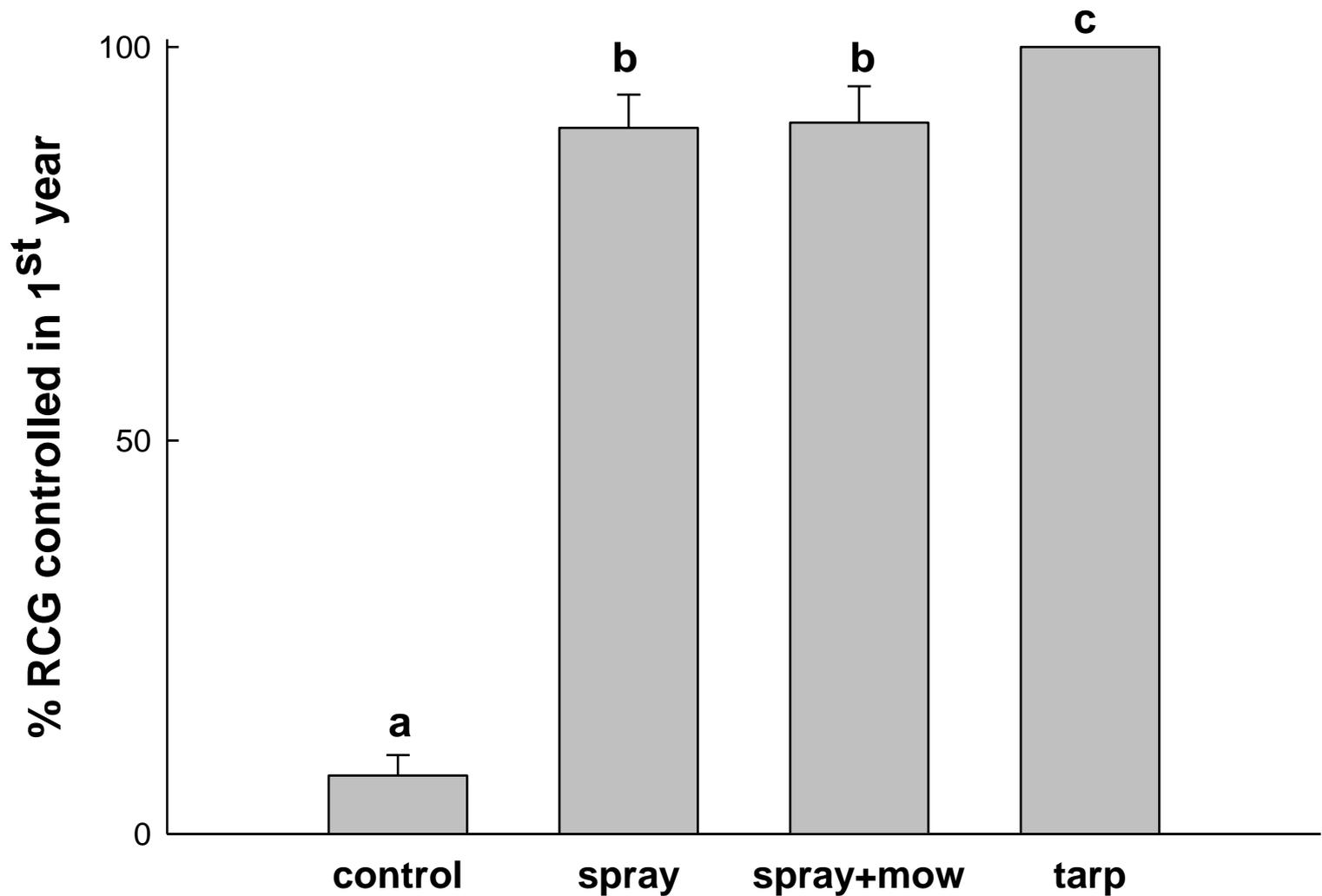
Larger RCG infestations, or those in rough or wet ground, may require applications of herbicide for full control.

RCG Control Experiment Methods

- Two sites (Soldotna & Anchor Point)
- Control and 3 treatments
- 6 replicates per treatment (3 per site)
- Plots are 10' x 20'
- Started 2008 and ends 2010



RCG Control Experiment Results



Different letters indicate statistically significant differences $p > .05$.

Data calculated as follows: $(RCG\% \text{ before} - RCG\% \text{ after}) * 100$.



control

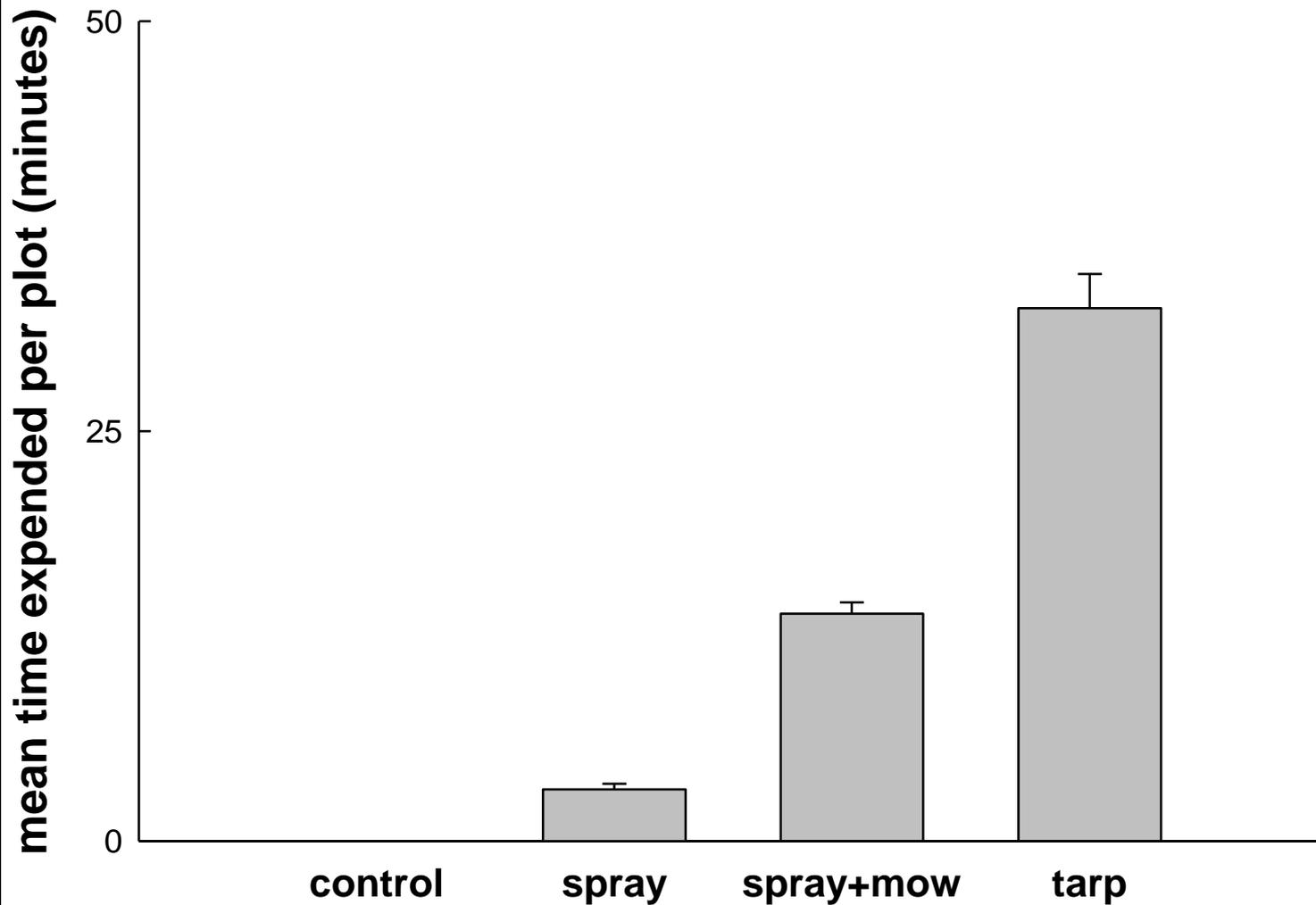


spray & spray + mow



tarp

RCG Control Experiment Results



Plots area is 10' x 20'.

Control Experiment Observations

- In our experiment, most cost-effective treatments was spraying. Time needed is low with 90% control in 1st year.
- Mowing makes herbicide application easier. More feasible along road-river interface.
- In year one, tarping resulted in the highest mortality of RCG. But is most labor intensive.
- Due to legal restrictions, tarping is currently the only treatment option in floodplain habitats.



Control Experiment – RCG Seed Bank

Spraying did not appear to kill RCG seed and RCG began to reinvade plots?



Next year we plan to determine re-growth from seed in tarped plots.



RCG control Experiment - Logistic Feasibility

RCG in remote areas

- Tarping and mowing are not practical in remote areas.
- Of the treatments used in our experiment, shovels and backpack sprayer only feasible option for remote areas.

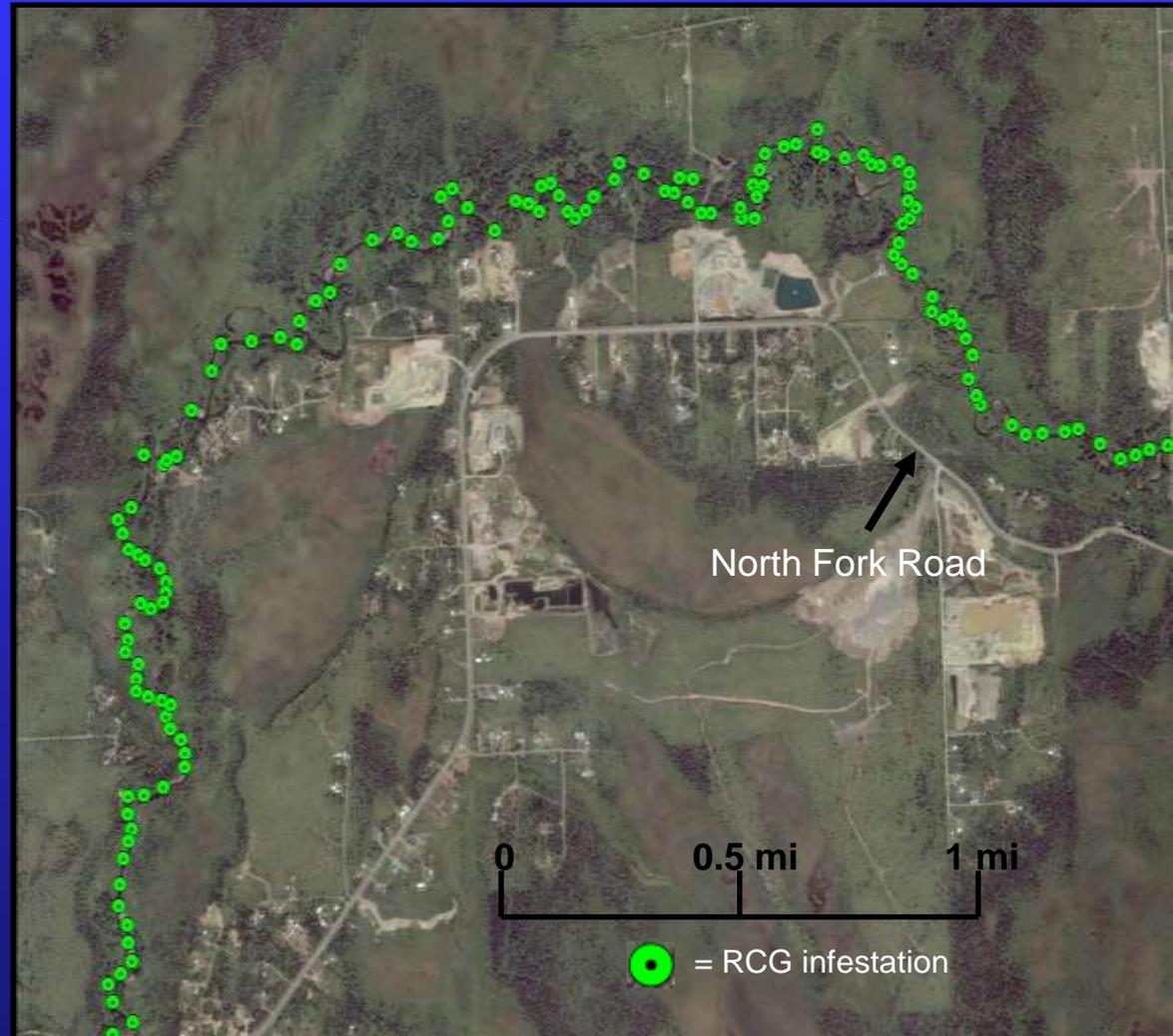


M.Martin

Discussion – Survey Results

- Our RCG management plan needs fine tuning.
- RCG on certain anadromous streams of the Kenai Peninsula are beyond eradication.
- **Prevention** – prevent RCG spreading by controlling road-river interfaces.
- **EDRR** – create a list of salmon streams most likely to be impacted by RCG and survey them routinely.

RCG on North Fork Anchor River



Preventing the Spread

- RCG may still be used to revegetate disturbed soils on the Kenai Peninsula.
- RCG is still being used as a forage and hay crop on the Kenai Peninsula.
- It might be prudent to restrict the use and transport of RCG seed.



Could RCG be an addition to the Alaska State-Listed Noxious Weeds?

Preventing the Spread

- Routinely survey all road crossings that intersect anadromous streams that have none to low abundances of RCG.
- Work with state and borough to use best control methods.
 - Create a 100 m buffer around anadromous stream bridges.

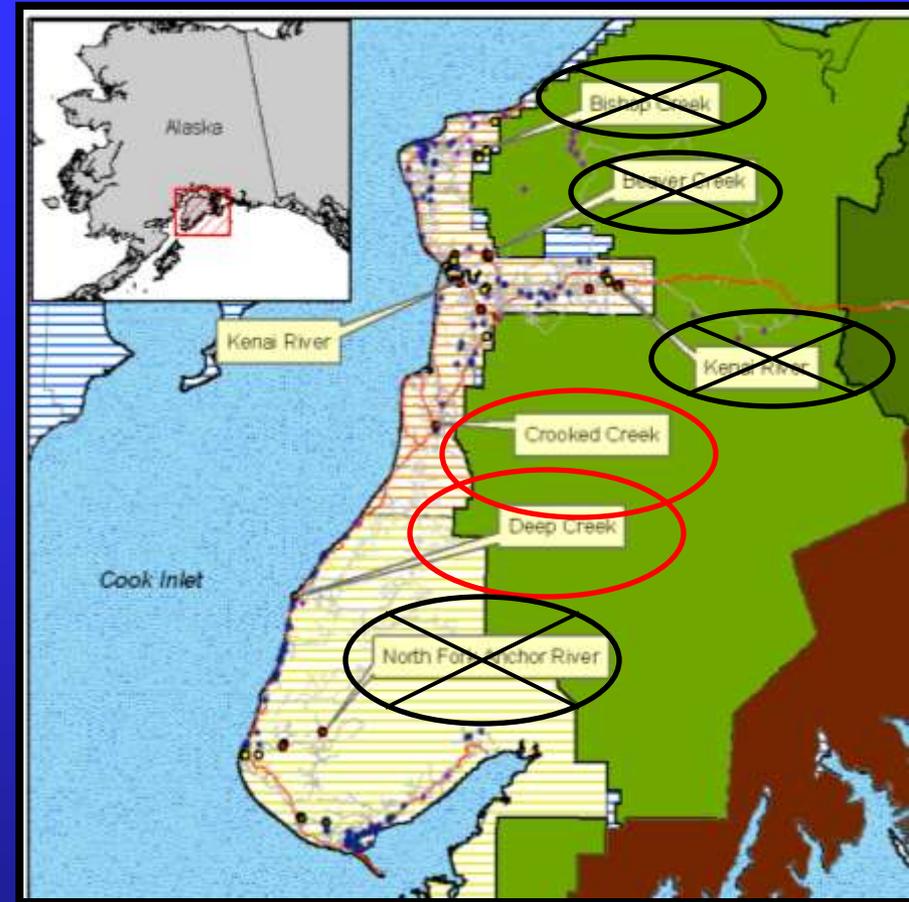


Creating a buffer around the road-river interface may prevent RCG invading other anadromous streams.

EDRR after all

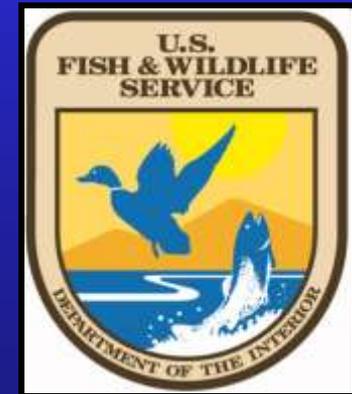
EDRR

- Create a list of critical anadromous streams to monitor (e.g. small streams with large salmon populations).
- Focus on anadromous streams with none to low RCG abundance.
- Develop routine monitoring program. Involve citizen monitors and Kenai Peninsula-CWMA partners.



Through concerted efforts, we feel the Kenai Peninsula CWMA can keep RCG off of many anadromous streams of the Kenai Peninsula!

Acknowledgements



Special Thanks: Hans Klaussner, Gino Grazziano, Caleb Clemmons, Sarah Easton, Doug Koester, Tyler Hass, Dillon Brady, Daren Brady, Kaleb Henderson & family, Janice Chumley, and Phil North.



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