

**Eradicating the first submersed freshwater  
invasive plant (Elodea) in Alaska:  
Do the ends justify the means?**



**John Morton, PhD**





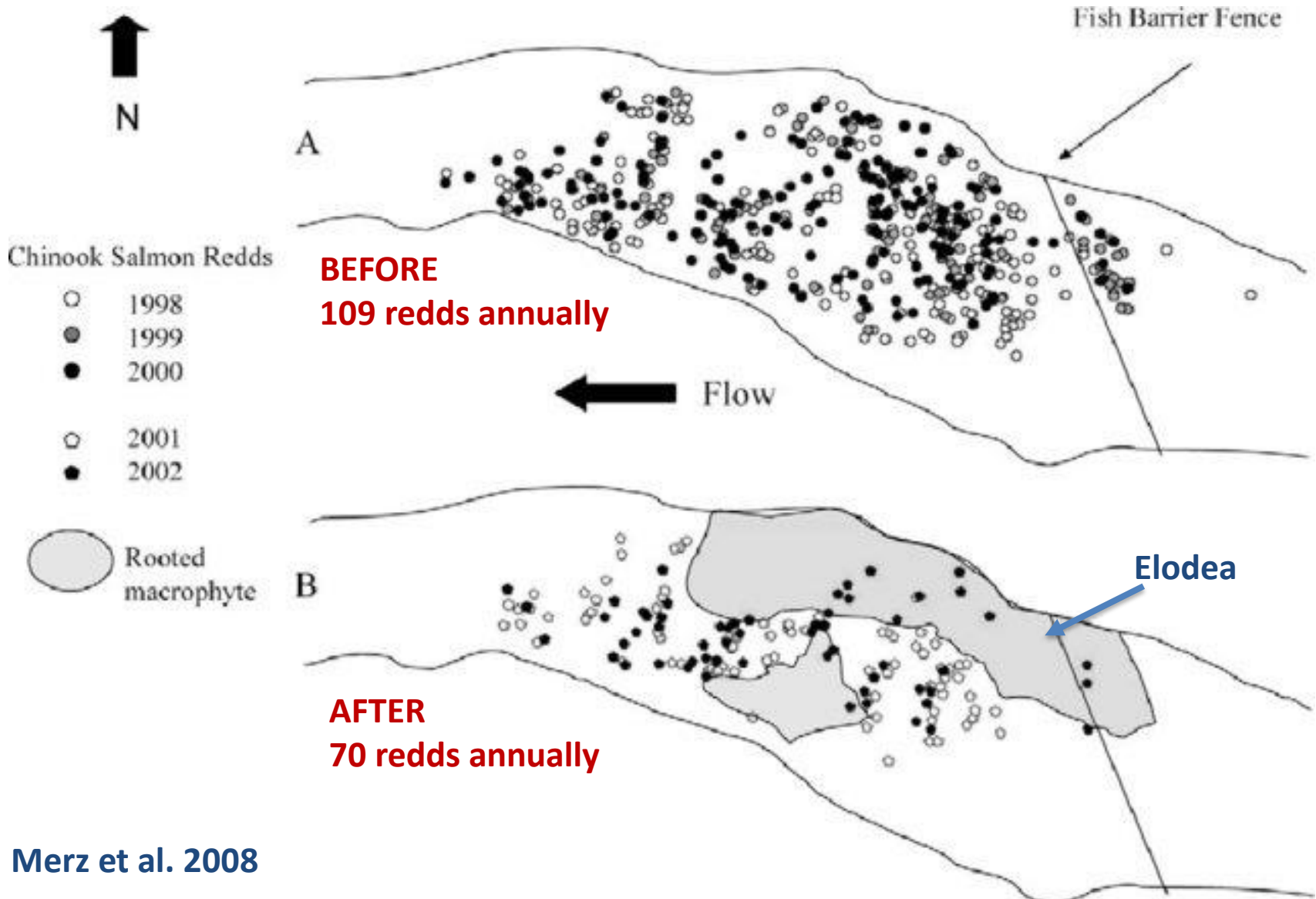


# Elodea was recognized early as bad...

- ✓ It's prolific!
- ✓ Reproduces vegetatively
- ✓ Spreads easily
- ✓ Grows under the ice
- ✓ Impedes boat traffic
- ✓ Reduces property values
- ✓ Anoxic conditions in extreme cases
- ✓ Severely impairs fish habitat



# 35% reduction in Chinook spawning due to colonization by elodea





**Invasive elodea threatens remote  
ecosystem services in Alaska:  
A spatially-explicit bioeconomic risk analysis**

By

Tobias Schwoerer, M.S.

A Dissertation Submitted in Partial Fulfillment of the Requirements

for the Degree of

Doctor of Philosophy

in

Interdisciplinary Sciences: Socio-bioeconomics

University of Alaska Fairbanks

May 2017

APPROVED:

Dr. Joseph Little, Committee Chair  
Dr. Milo Adkison, Committee Member  
Dr. Jungho Baek, Committee Member  
Dr. Greg Hayward, Committee Member  
Dr. John Morton, Committee Member  
Dr. Joseph Little, Chair  
*Department of Economics*  
Dr. Mark Hermann, Dean  
*School of Management*  
Dr. Michael Castellini, Dean  
*Graduate School*

**Salmon habitat  
degradation will likely cost  
statewide commercial  
sockeye industry ~\$100  
million annually**





1982

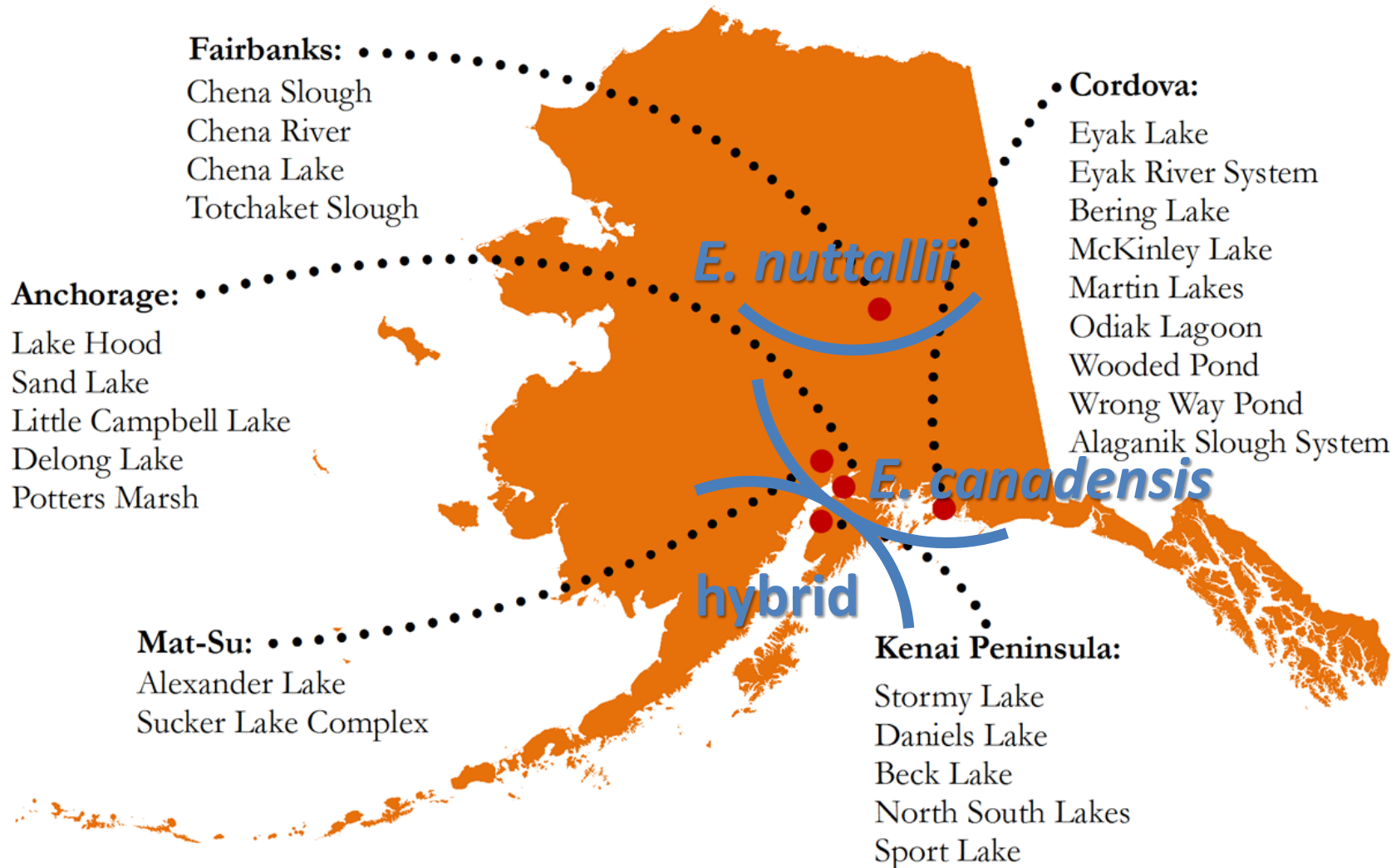
## Eyak Lake, Cordova



2015



# Known Locations of Elodea in Alaska





10195727





# Community Elodea Information Meeting

Nikiski Community Recreation Center  
Mile 23.4 Kenai Spur Highway

Tuesday February 19<sup>th</sup>, 2013  
6 - 8:30PM

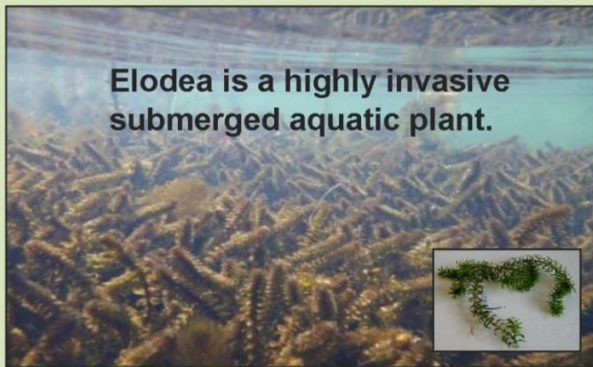


Please join us for a community meeting to discuss what to do about the discovery of Elodea in Stormy & Daniels Lakes.

Dr. Lars Anderson (USDA Agricultural Research Service and University of California-Davis), an aquatic invasive plant expert, will be at the meeting to provide information about Elodea, discuss options for management, and share his experiences in coping with aquatic infestations.

Elodea is not native to the Kenai Peninsula, and can cause serious, irreversible harm to fish and aquatic habitats if allowed to spread unchecked.

Elodea presence has recently been confirmed in Stormy and Daniels Lake on the Kenai Peninsula, and in some slow-moving waters in Anchorage, Fairbanks, and Cordova.



**Meeting Open to the Public**  
For more information, please contact Janice Chumley at UAF-Cooperative Extensive Service, 907-262-5824

## Why we don't want Elodea

**Nuisance:** impedes boat and float plane launching, navigation, and fishing

**Ecological:** degrades salmon spawning habitat

**Safety:** fouls float plane rudders and boat propellers

**Economic:** reduces property values by fouling launch sites and shore habitats





# INTEGRATED PEST MANAGEMENT PLAN FOR ERADICATING ELODEA FROM THE KENAI PENINSULA

April 2014

Prepared by

Elodea Subcommittee of the Kenai Peninsula Cooperative Weed Management Area

John M. Morton (USFWS Kenai National Wildlife Refuge, Soldotna)  
Brianna N. Blackburn (AK Department of Natural Resources, Palmer)  
Elizabeth Bella (USFWS Kenai National Wildlife Refuge, Soldotna)  
Matt Steffy (Homer Soil & Water Conservation District, Homer)  
Cheryl Anderson (USFWS Kenai Fish & Wildlife Field Office, Soldotna)  
Rob Massengill (Alaska Department of Fish and Game, Soldotna)  
Jack Blackwell (AK State Parks, Soldotna)  
Lisa Ka'aihue (Cook Inlet Aquaculture Association, Kenai)  
Rebecca Zulueta (Kenai Watershed Forum, Soldotna)  
Janice Chumley (UAF Cooperative Extension Service, Soldotna)  
Michele Aranquiz (Kenai Peninsula Borough Mayor's Office, Soldotna)  
Cecil Rich (USFWS Regional Office, Anchorage)

#### In consultation with:

Lars Anderson (Waterweed Solutions, Davis)  
Donald H. Les (University of Connecticut, Storrs)  
Scott Schuler (SePRO Corporation, Carmel, IN)  
Andrew Skibo (SePRO Corporation, Fort Collins, CO)



Cooperative Weed  
Management Area

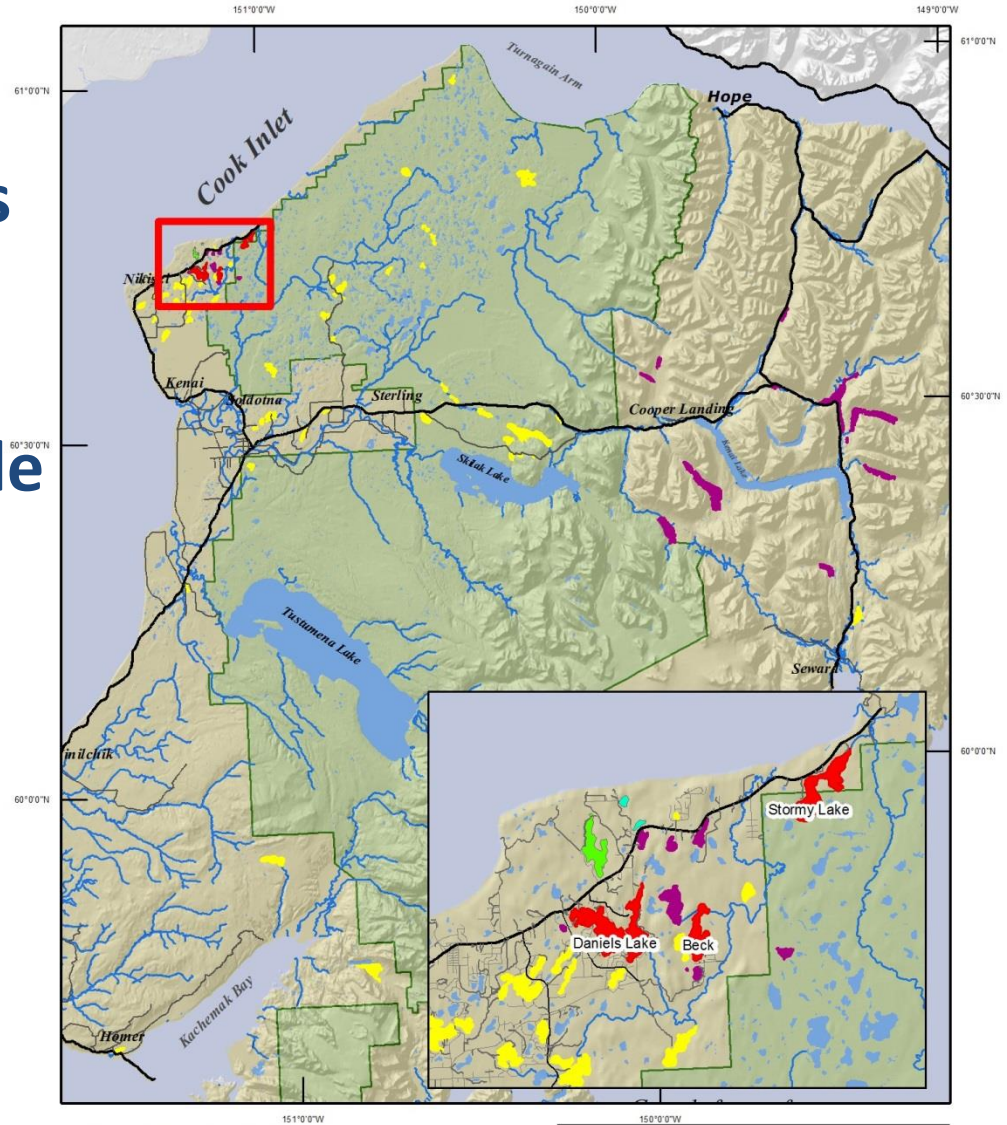


Kenai Watershed Forum

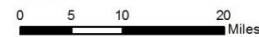




Surveyed 100+ at-risk lakes before (and during) treatments to assess feasibility of peninsula-wide eradication...

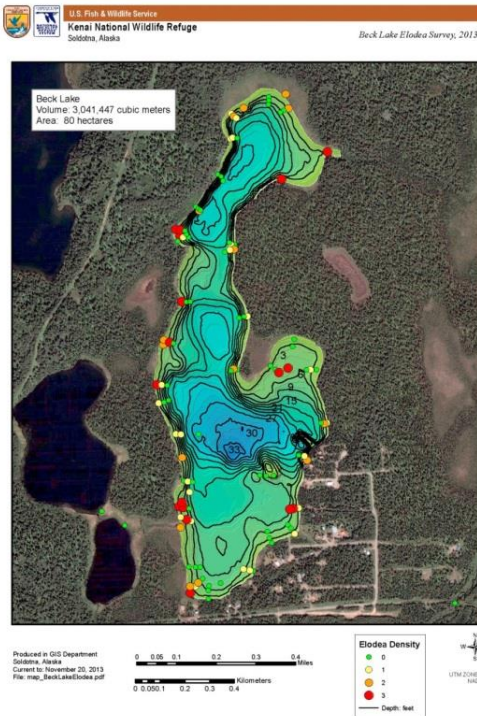


Produced in GIS Department  
 Soldotna, Alaska  
 Current to: 08/11/2016



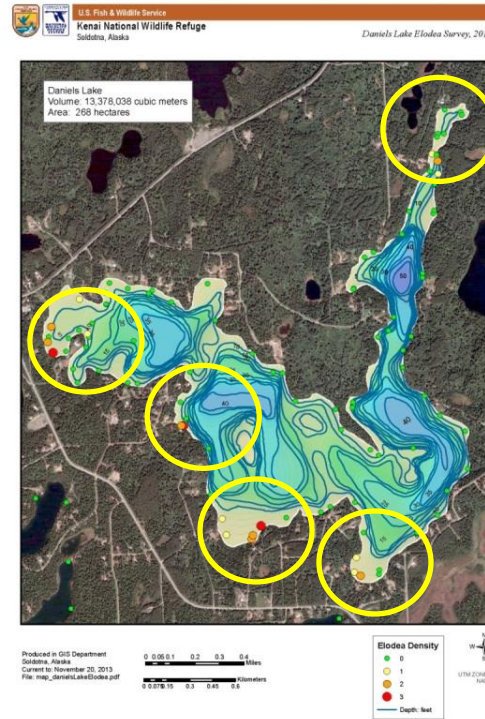


## Beck Lake (200 ac) whole treatment



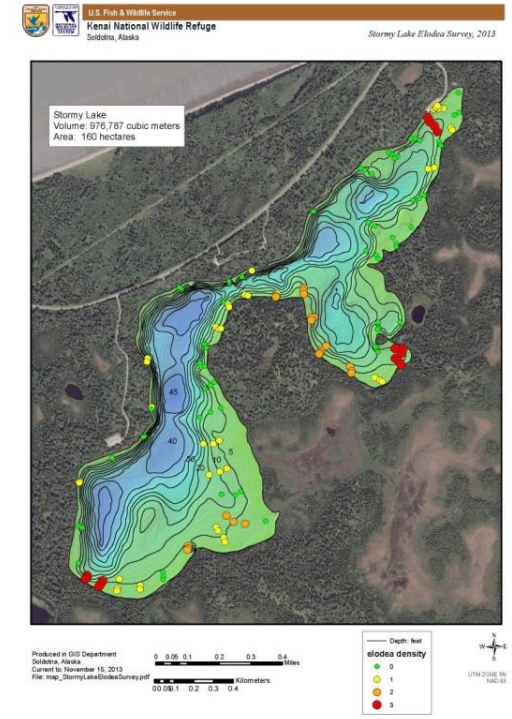
- Some private landowners
- Floatplanes
- NO public access
- Flows into Bishop Creek
- Rainbow trout

## Daniels Lake (640 ac) partial treatment



- All private landowners
- Floatplanes
- 1 community boat launch
- Flows into Bishop Creek
- Sockeye salmon

## Stormy Lake (400 ac) whole treatment



- State Parks/KENWR
- 1 public boat launch
- Flows into Swanson River
- Arctic char

# Fluridone (Sonar®)

- Systemic herbicide
- Liquid, pellets
- Selective @  $\leq 10$  ppb 45-90 days
- Absorbed thru roots, shoots
- Inhibits carotenoid synthesis
- No restrictions on swimming, potable, fishing
- Greenhouse (tomatoes)
- $Kd$  3-16
- $DT_{50}$  aquatic environments (anaerobic):  $\pm 9$  months
- Gradual desorbtion and photolysis





# Diquat bromide (Littora<sup>®</sup>, Reward<sup>®</sup>)



- Contact herbicide
- Liquid
- Nonselective
- Absorbed thru shoots, leaves
- Disrupts cell membrane, plant desiccation
- No restrictions on swimming, fishing
- 2 day drinking water restrictions
- 3-5 days irrigation
- Kd 1200-92000
- DT<sub>50</sub> aquatic environments (anaerobic): <48 hours
- Microbial degradation, photolysis

## PRESCRIBED: 4 herbicide treatments over 3 years (2014-16) to eradicate elodea

	Beck	Stormy	Daniels	Cost
acres	200	400	660 (100)	
approach	WHOLE	WHOLE	PARTIAL	
June 2014	liquid/pellet fluridone	liquid/pellet fluridone	<b>diquat</b> fluridone	\$360k
Sept 2014	pellet	pellet	pellet	
June 2015	pellet	pellet	pellet	\$144k
June 2016	pellet	pellet	pellet	\$116k
cost	\$113K	\$320K	\$197K	<b>\$620K</b>



## ACTUAL: 2+ herbicide treatments over 2 years (2014-15) to eradicate elodea

	Beck	Stormy	Daniels	Cost
acres	200	400	660 (100)	
approach	WHOLE	WHOLE	PARTIAL	
June 2014	liquid/pellet fluridone	liquid/pellet fluridone	diquat fluridone	\$360k
Sept 2014	pellet	pellet	pellet	
June 2015	pellet	pellet*	pellet*	\$144k
June 2016	pellet	pellet	pellet	<del>\$116k</del>

# Nets at lake outlets





# Application equipment



**Pellet blower for SonarONE**



**Pump for Sonar Genesis, Diquat**











SOG

mph

5.0



MOB

ZOUT

ZIN

EXIT

ENTER

MENU

PAGE

WPT  
FIND

LIGHT  
POWER



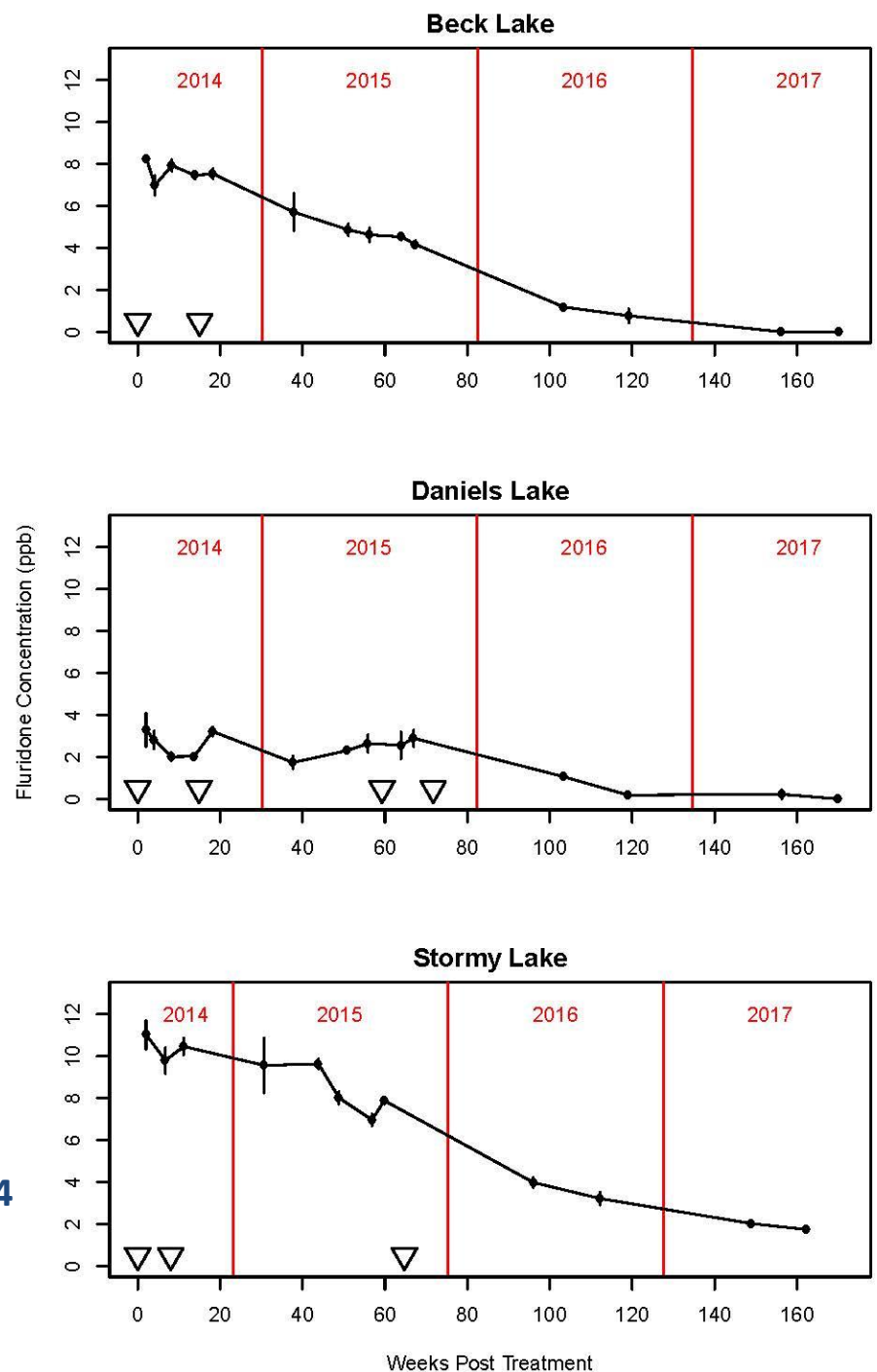
# Sampling design to assess fluridone concentrations in water column

Lake	FasTEST Site	15-Jun	1-Jul	1-Aug	1-Sep	1-Oct	Latitude	Longitude
		2 WAT	4 WAT	8 WAT	12 WAT	16 WAT		
Daniels Lake	1	X	X	X	X	X	60.7516372	-151.167864
Daniels Lake	2	X	X				60.7489173	-151.169602
Daniels Lake	3	X	X	X	X	X	60.7255421	-151.1783782
Daniels Lake	4	X	X				60.7256261	-151.1806742
Daniels Lake	5	X	X				60.727812	-151.1953083
Daniels Lake	6	X	X	X	X	X	60.7291887	-151.1959735
Daniels Lake	7	X	X				60.728905	-151.1919609
Daniels Lake	8	X	X				60.7336754	-151.1994711
Daniels Lake	9	X	X	X	X	X	60.7350518	-151.2011555
Daniels Lake	10	X	X				60.7362653	-151.199675
Daniels Lake	11	X	X				60.7377676	-151.2136654
Daniels Lake	12	X	X	X	X	X	60.7389127	-151.2107042
Daniels Lake	13	X	X				60.7408561	-151.2110261
Daniels Lake	14	X	X				60.7397951	-151.2160472
Daniels Lake	15	X	X	X	X	X	60.7413813	-151.2151459
Daniels Lake	16	X	X				60.733263	-151.1874602
Daniels Lake	17	X	X	X	X	X	60.7314558	-151.1717532
Daniels Lake	18	X	X				60.742802	-151.1744997
Daniels Lake	19	X	X				60.7393565	-151.2018797
Beck Lake	1	X	X	X	X	X	60.7408472	-151.1300189
Beck Lake	2	X	X				60.7378211	-151.1344396
Beck Lake	3	X	X	X	X	X	60.7336602	-151.1353409
Beck Lake	4	X	X				60.7325465	-151.128903
Beck Lake	5	X	X				60.7300037	-151.1332379
Beck Lake	6	X	X	X	X	X	60.7263682	-151.134783
Stormy Lake	1	X	X				60.7874167	-151.0327008
Stormy Lake	2	X	X	X	X	X	60.7840311	-151.0400868
Stormy Lake	3	X	X				60.7797427	-151.0402846
Stormy Lake	4	X	X	X	X	X	60.7794847	-151.0560459
Stormy Lake	5	X	X				60.7716495	-151.0532762
Stormy Lake	6	X	X	X	X	X	60.7696181	-151.0627725
<b>Total Samples</b>		<b>31</b>	<b>31</b>	<b>13</b>	<b>13</b>	<b>13</b>		
<b>Grand Total</b>		<b>101</b>						

# Did it work?



- 1<sup>st</sup> application (Beck, Daniels) 3-4 Jun 2014
- 1<sup>st</sup> application (Stormy) 23 Jul 2014
- 2<sup>nd</sup> application (Beck, Daniels, Stormy) 16-17 Sep 2014
- 3<sup>rd</sup> application (Daniels) 24 Jul 2015
- 4<sup>th</sup> application (Daniels) 19 Oct 2015





# Did it work?



2 weeks (Stormy)



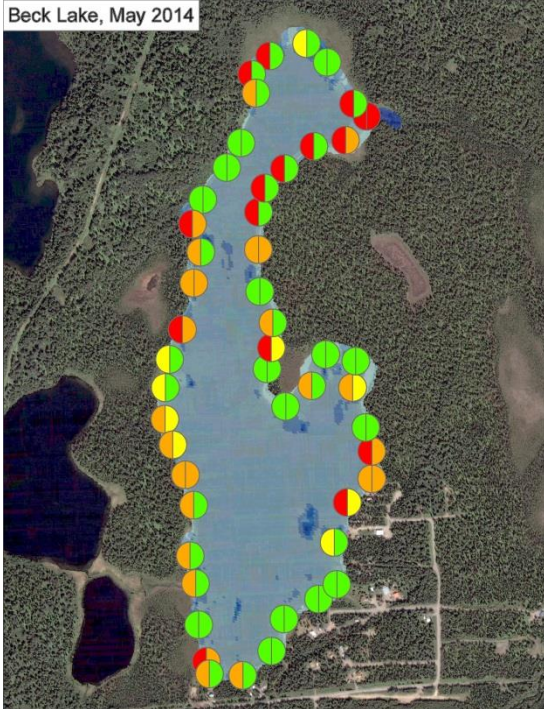
8 weeks (Beck)



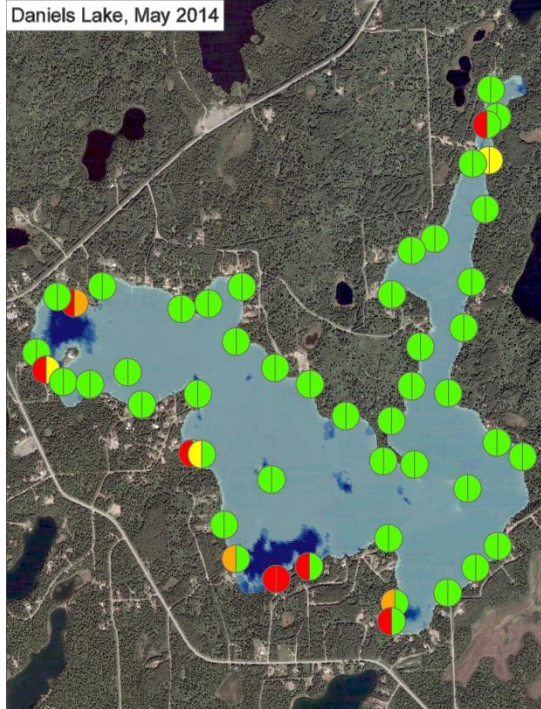
14 weeks (Beck)

# Did it work?

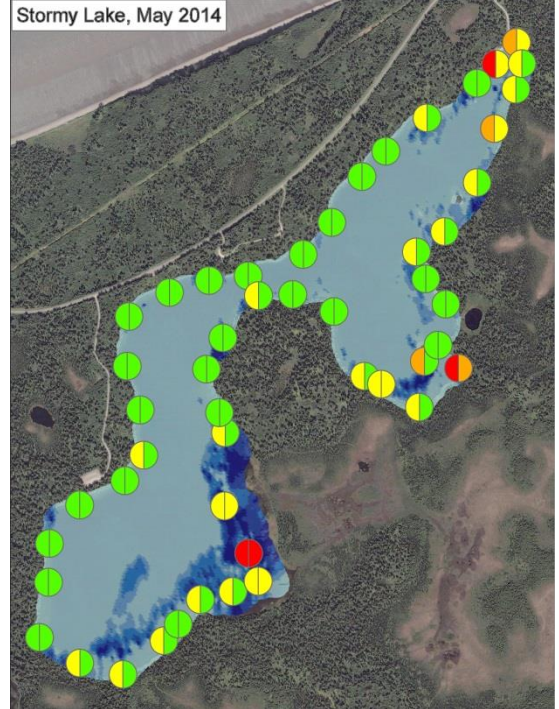
Beck Lake, May 2014



Daniels Lake, May 2014



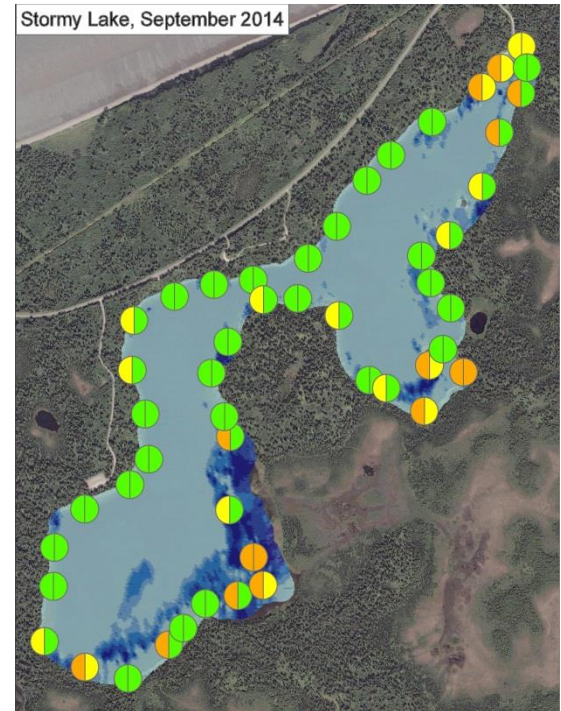
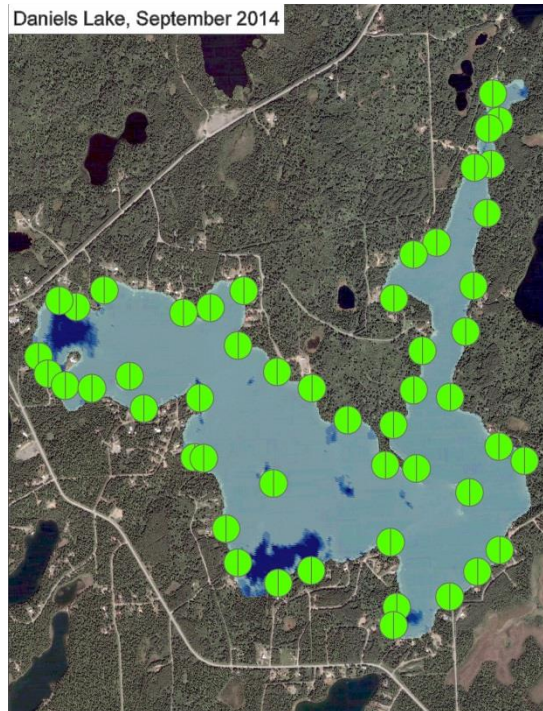
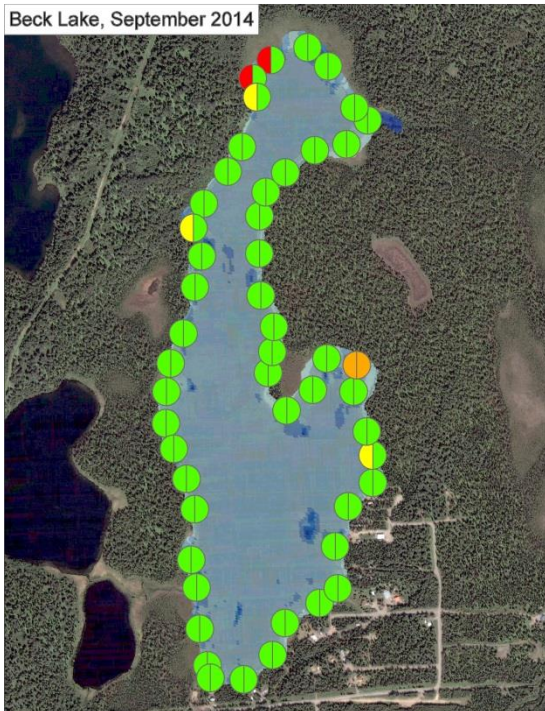
Stormy Lake, May 2014



SURVEY	LAKE		
	Beck	Daniels	Stormy
May 2014 (pre-trmt )	<b>70</b>	<b>22</b>	<b>50</b>



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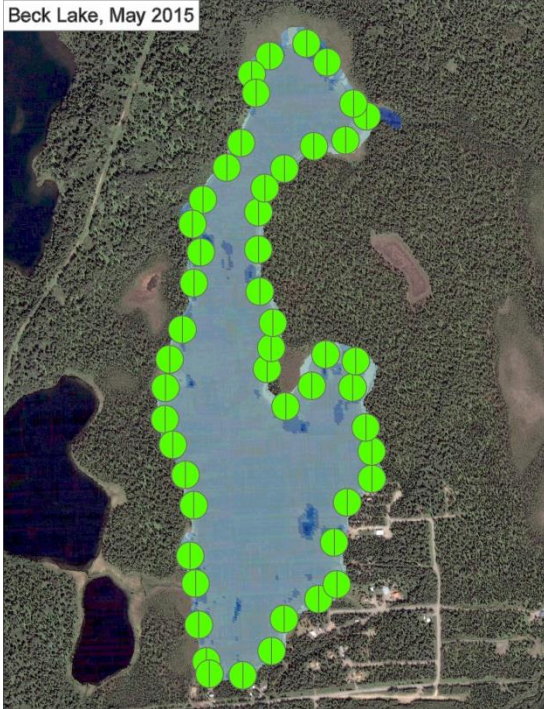


SURVEY	LAKE		
	Beck	Daniels	Stormy
May 2014 (pre-trmt )	70	22	50
Sept 2014 (post)	<b>12</b>	<b>0</b>	<b>46</b>

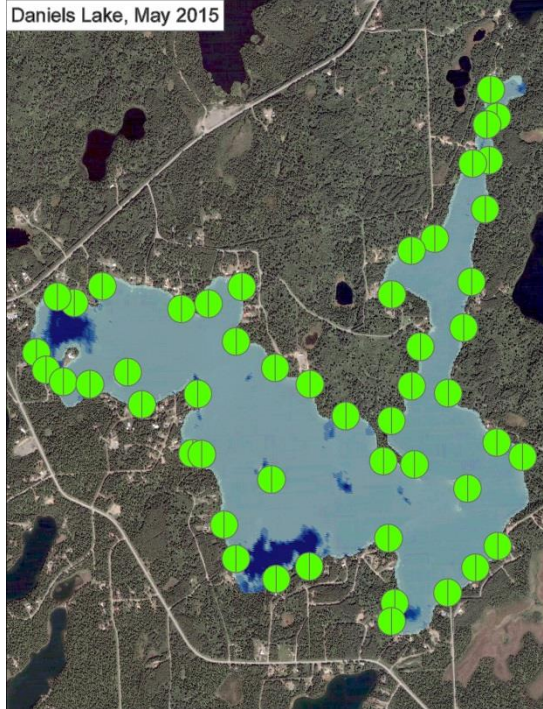


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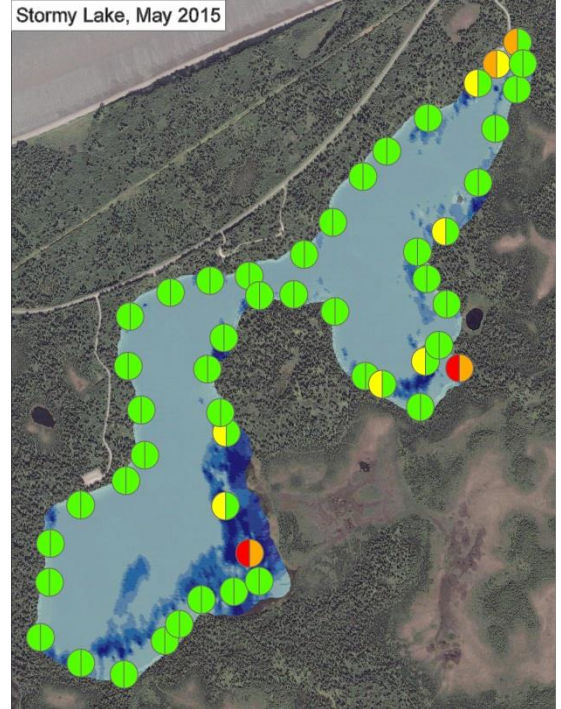
Beck Lake, May 2015



Daniels Lake, May 2015



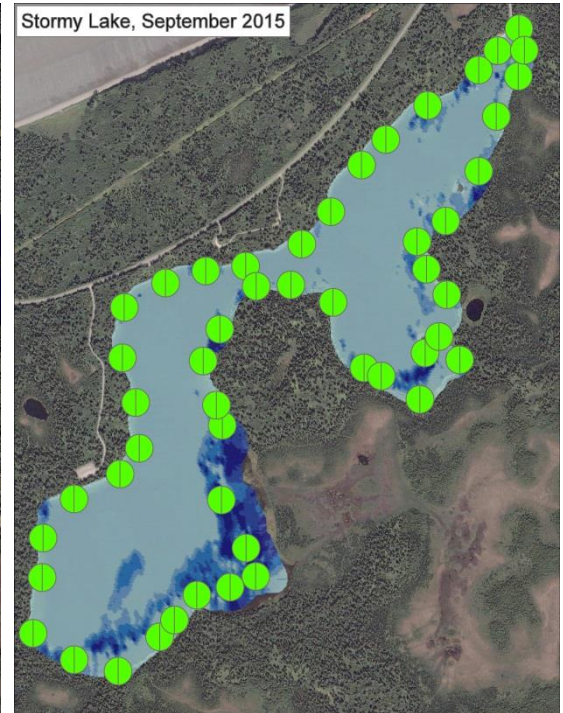
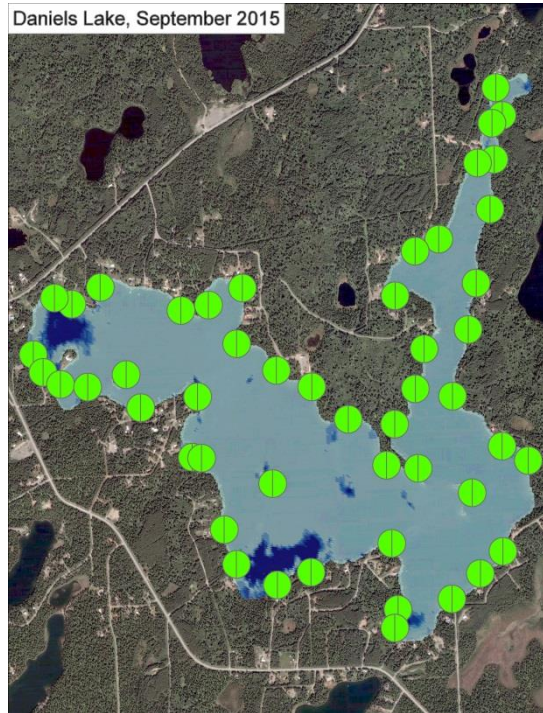
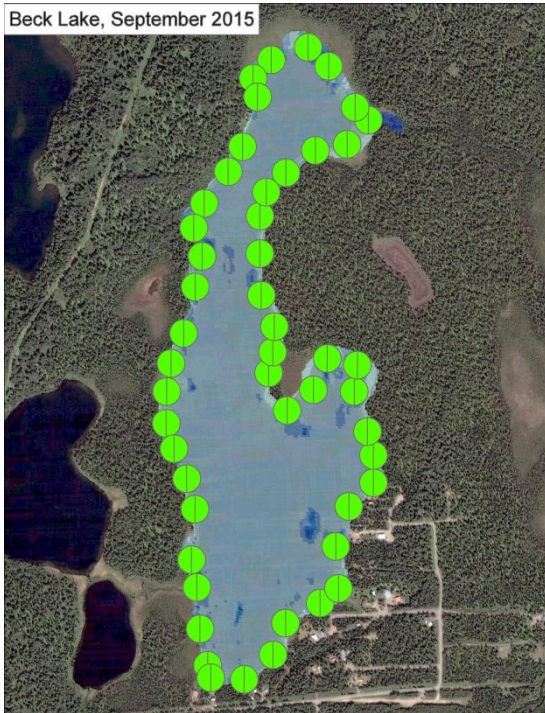
Stormy Lake, May 2015



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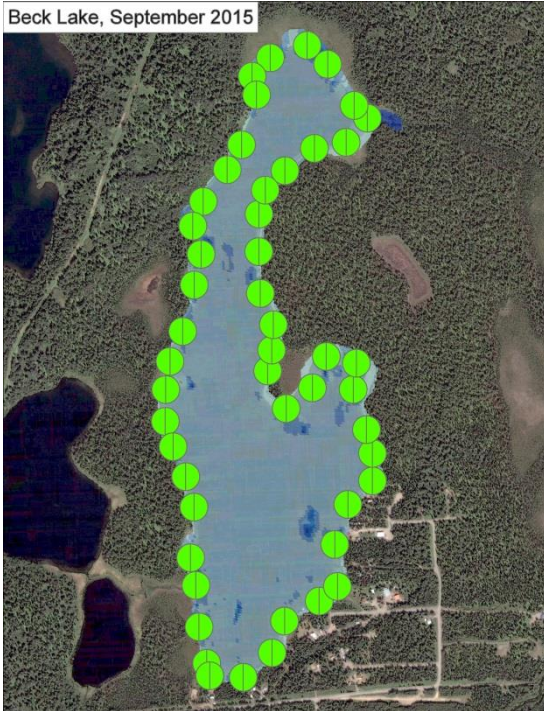


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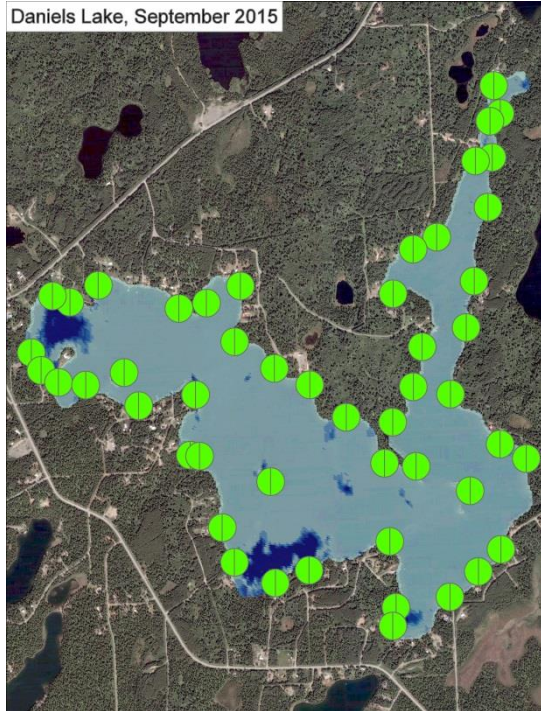


# Did it work?

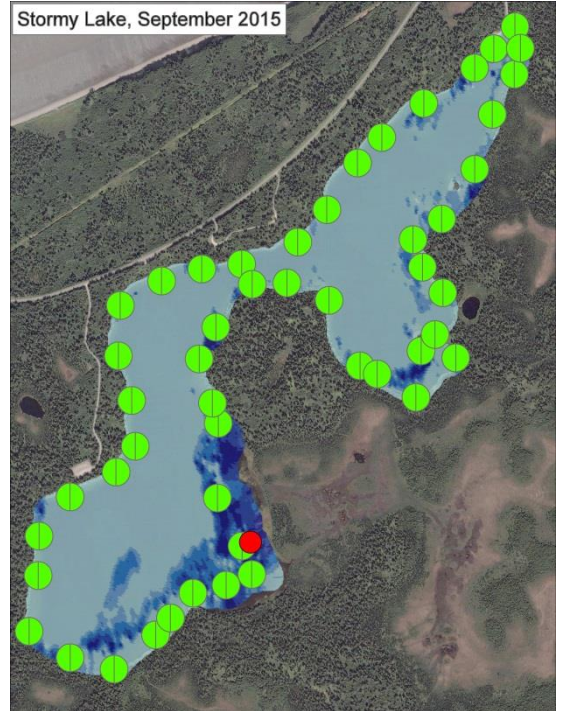
Beck Lake, September 2015



Daniels Lake, September 2015



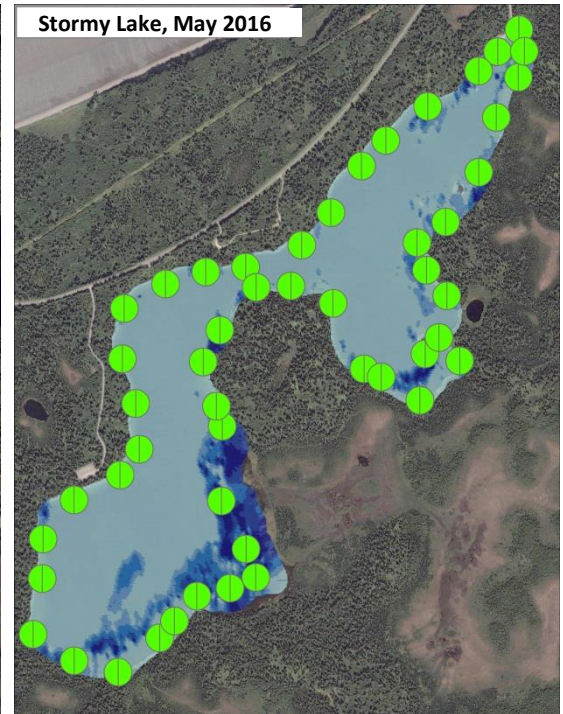
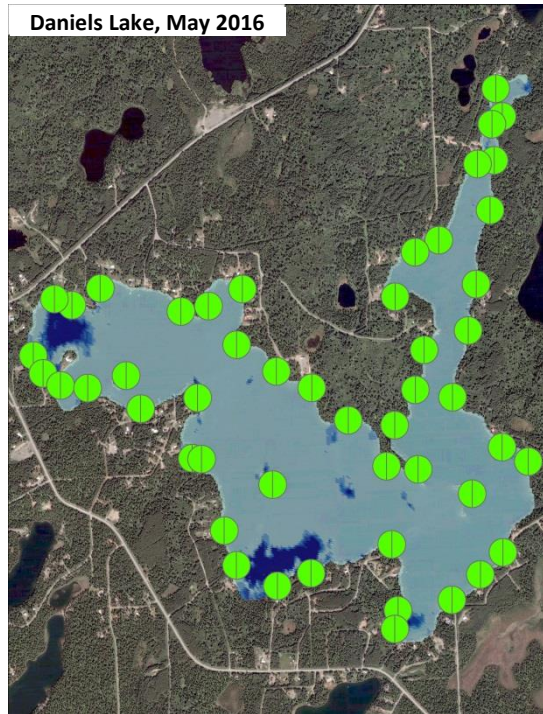
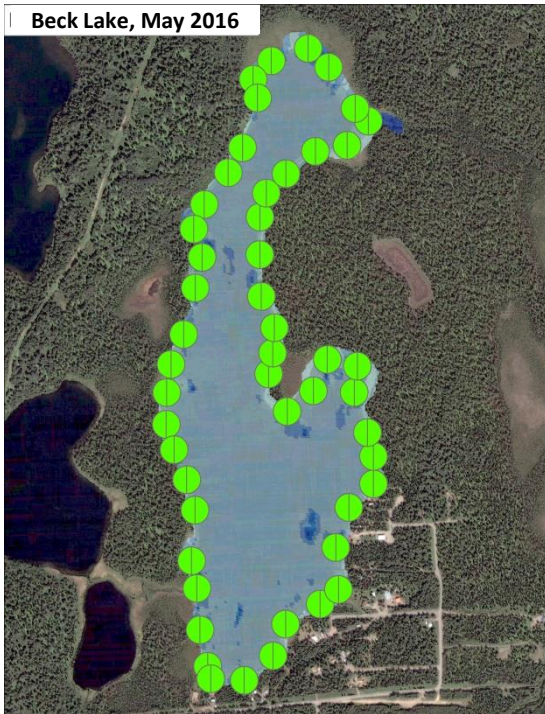
Stormy Lake, September 2015



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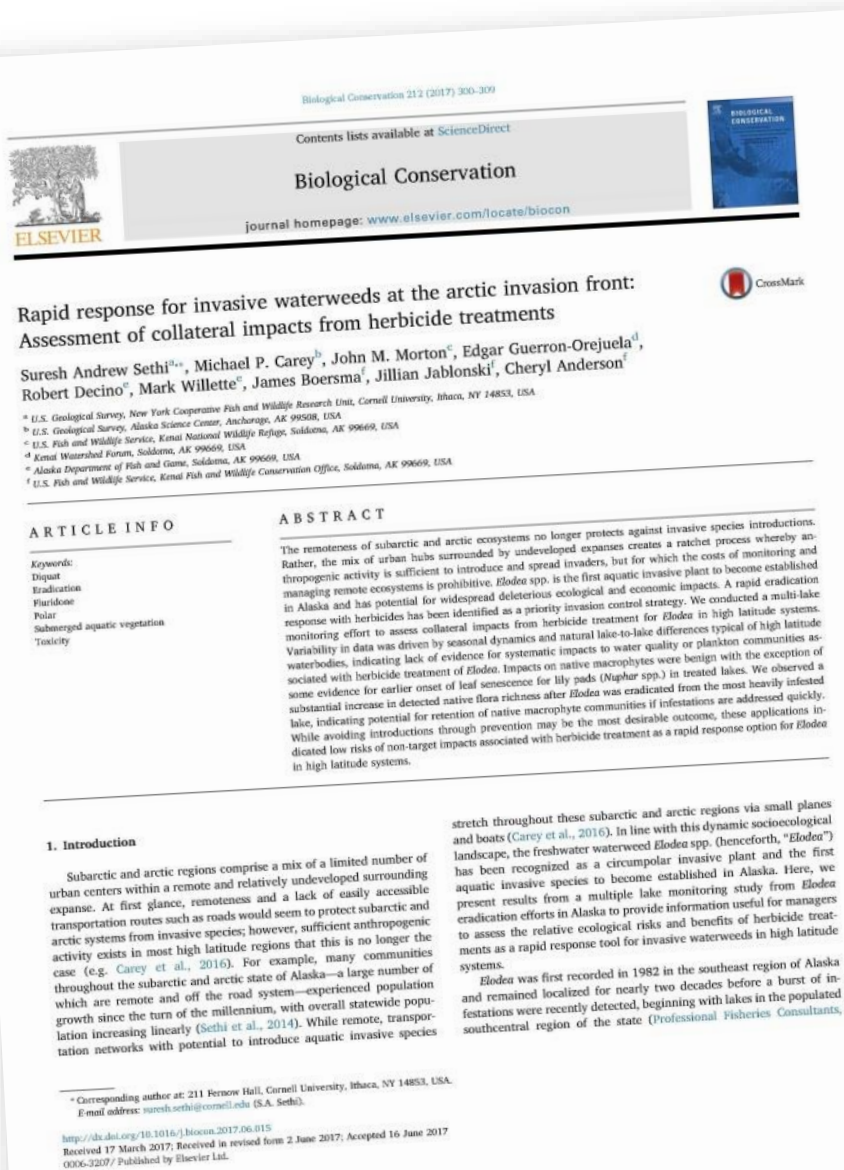


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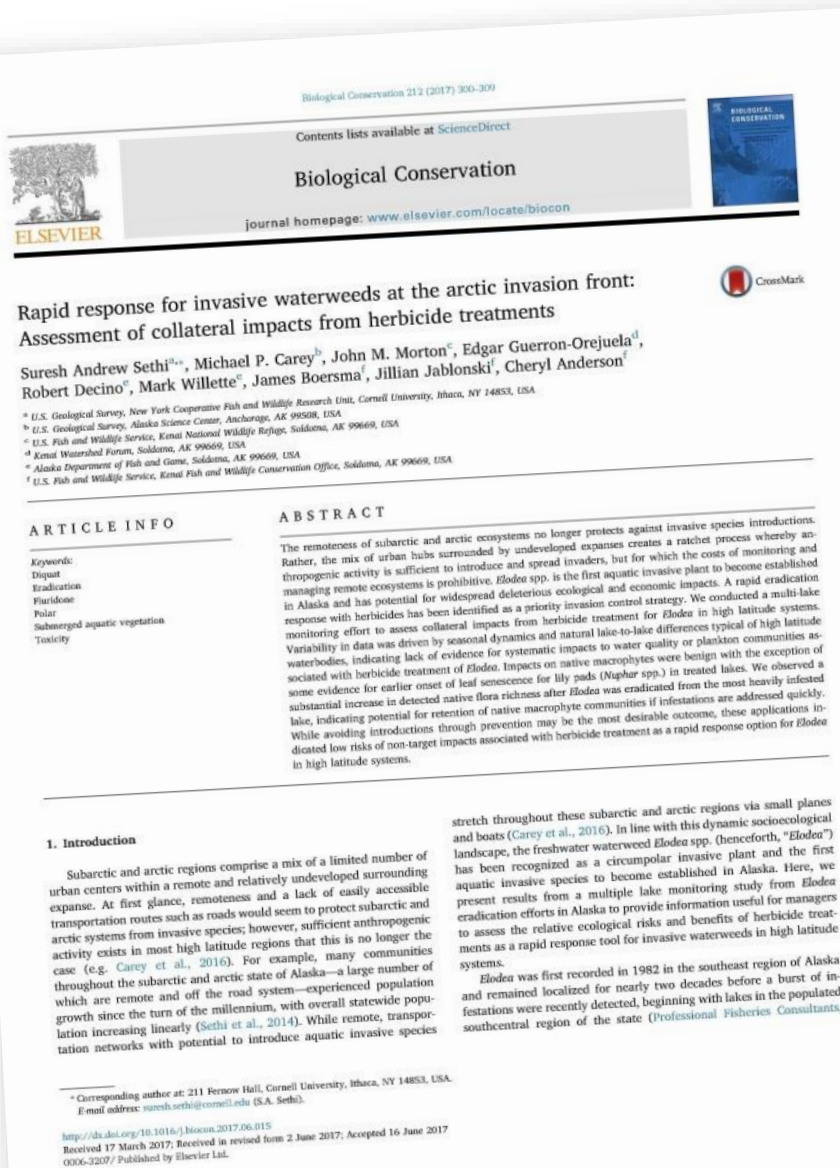
# Secondary effects of fluridone



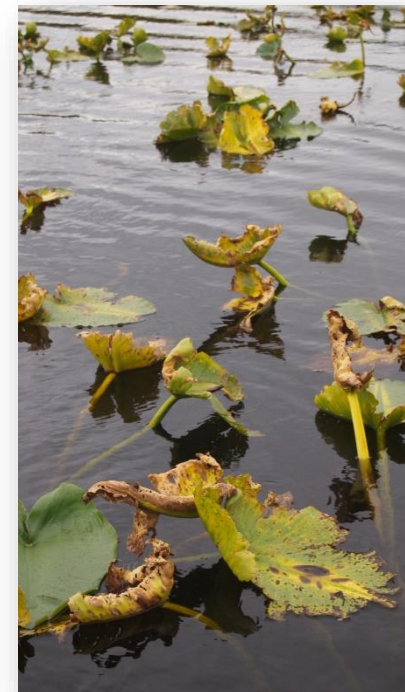
- No systemic effects on zooplankton (biomass, density, richness)
- No systemic effects on water quality (DO, pH, chlorophyll *a*, conductivity, turbidity)
- Some necrosis, loss of non-target plants



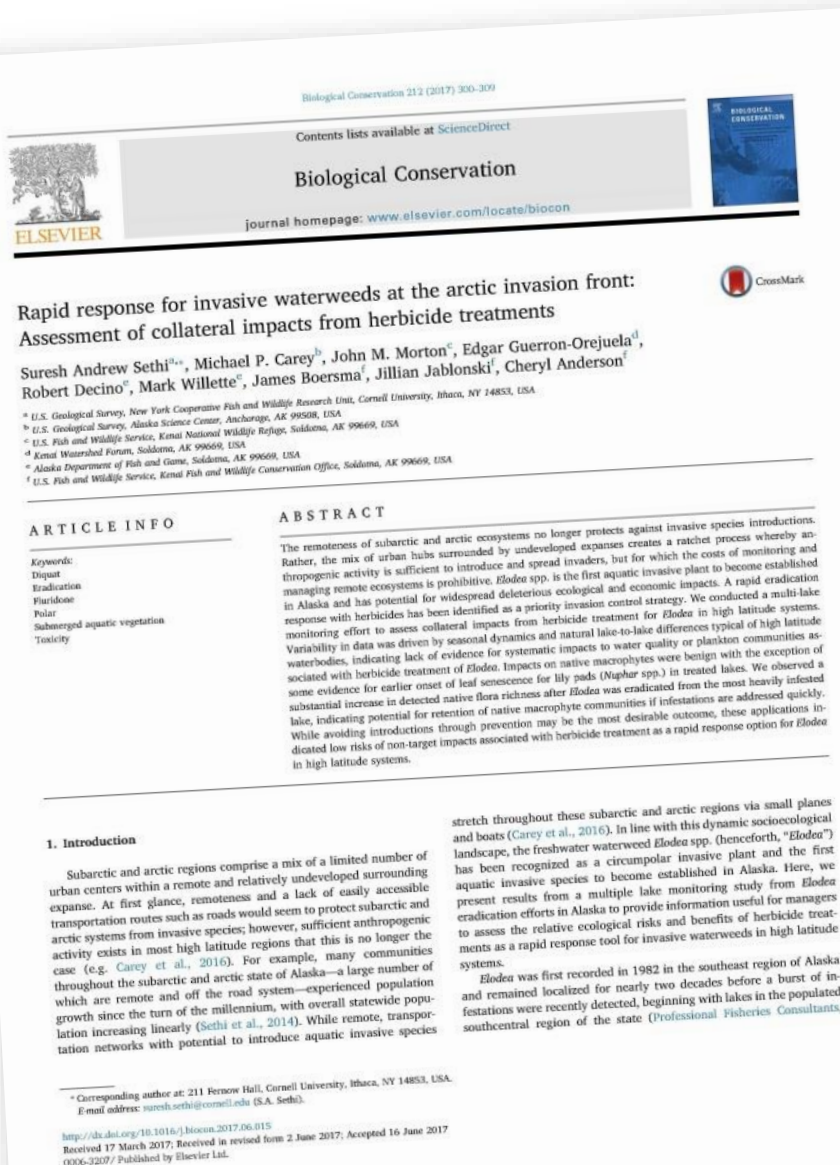
# Secondary effects of fluridone



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# Secondary effects of fluridone



- No systemic effects on zooplankton
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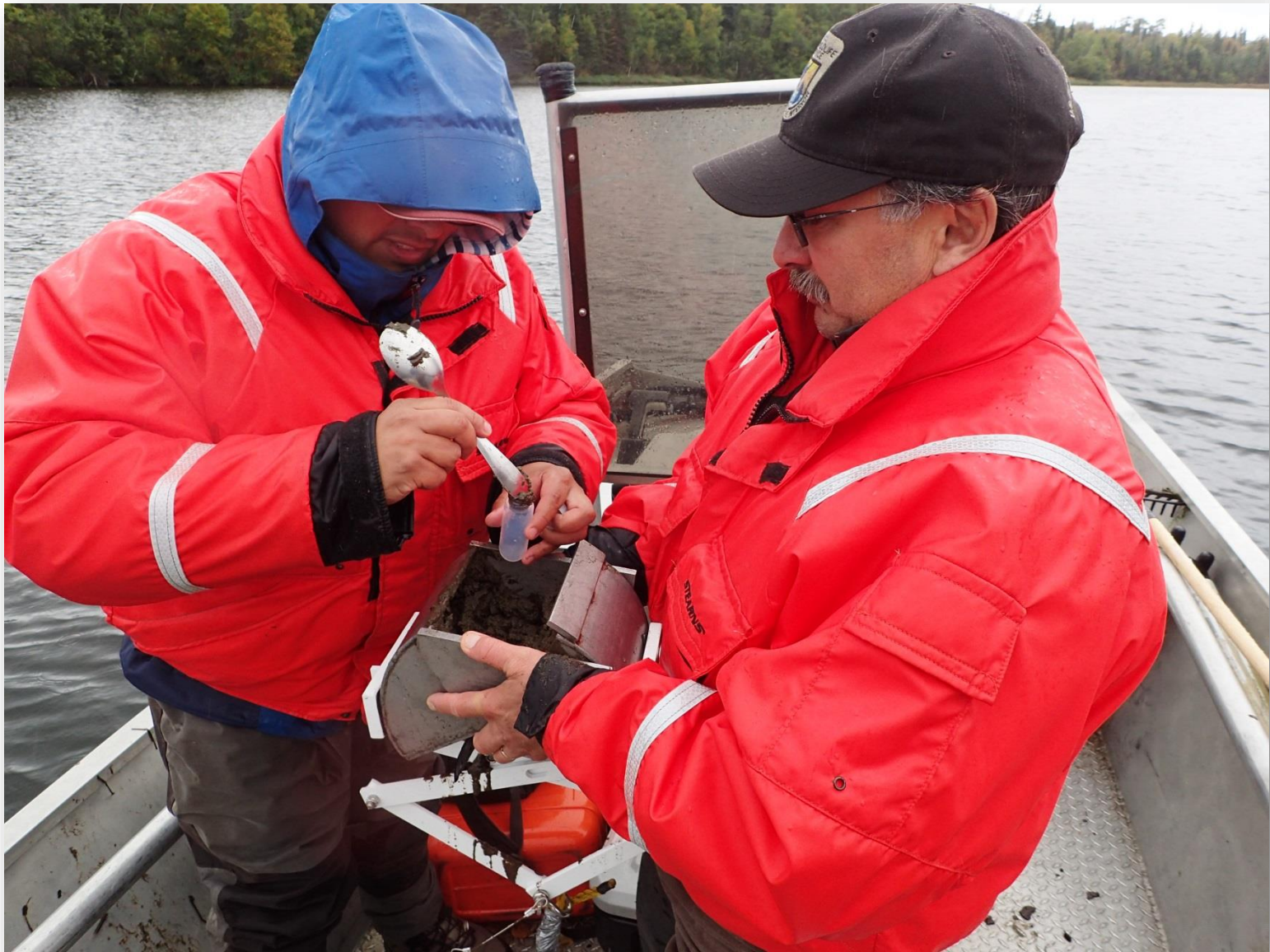




# No fluridone detectable (< 1 ppb) in 2 drinking wells in Daniels and Beck Lakes

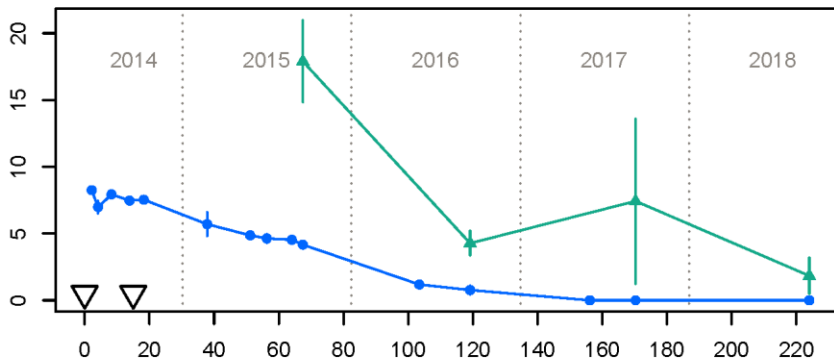


# Does fluridone persist in sediment?

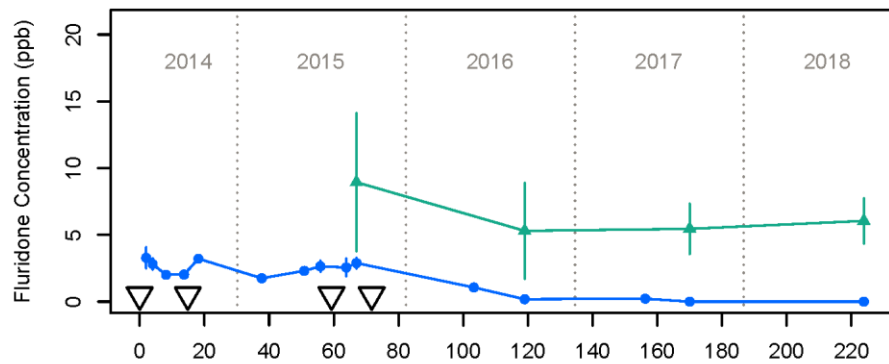




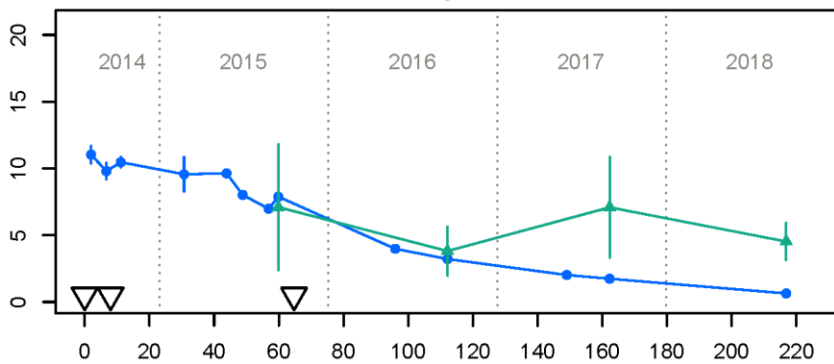
**Beck Lake**



**Daniels Lake**



**Stormy Lake**



Weeks Post Treatment

**Fluridone in lake bottom sediments higher than water column, but negligible ( $\leq 5$  ppb) 2 years post application**



**Sports Lake**  
**Feb 2017**

# 3 more lakes on the Kenai Peninsula infested



**Hilda-Seppu Lakes**  
**Jul 2017**



**Sandpiper Lake**  
**Sep 2019**



# Why Kenai cares about other parts of Alaska.....



**PETCO,  
Soldotna**



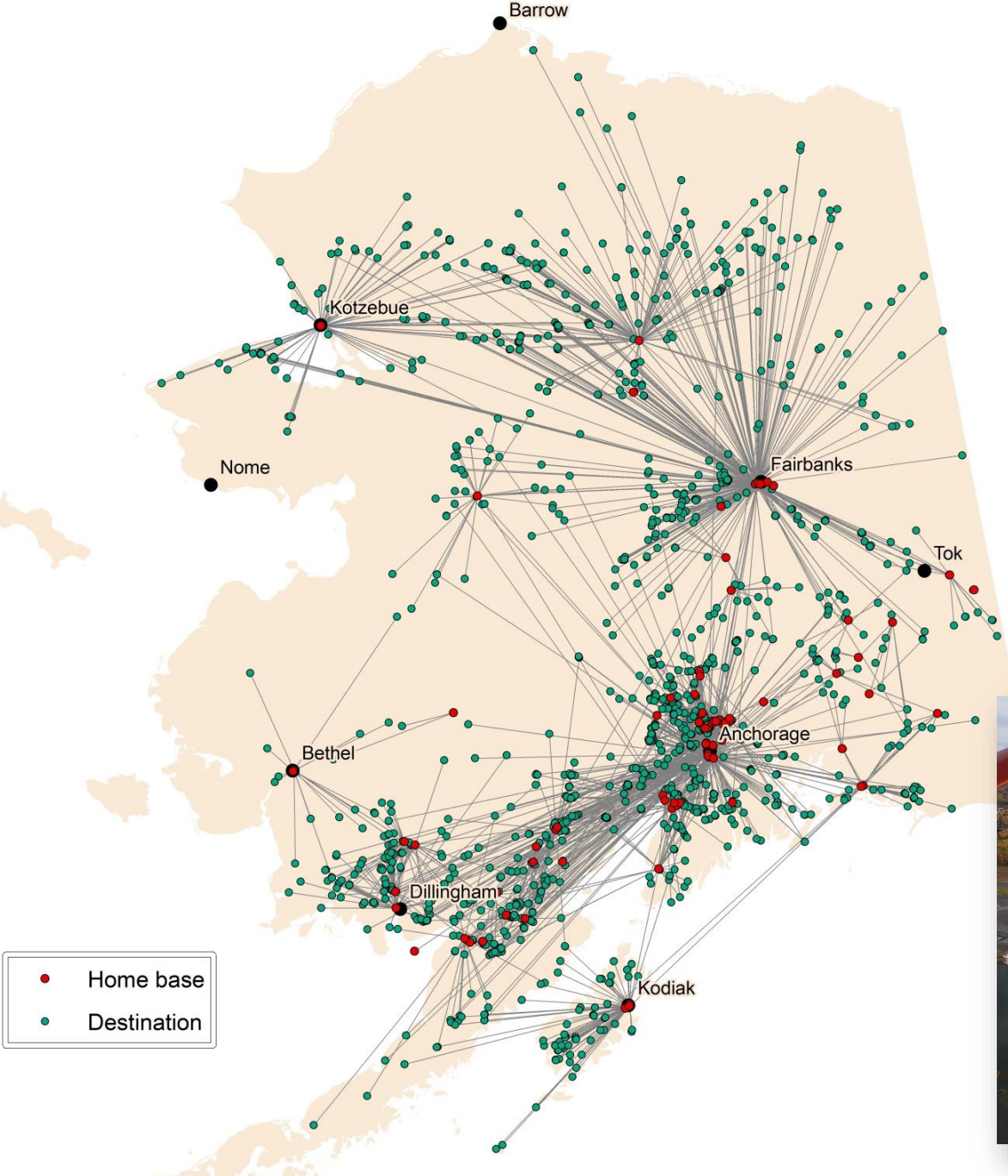
**Cordova**



**Sports  
Lake**

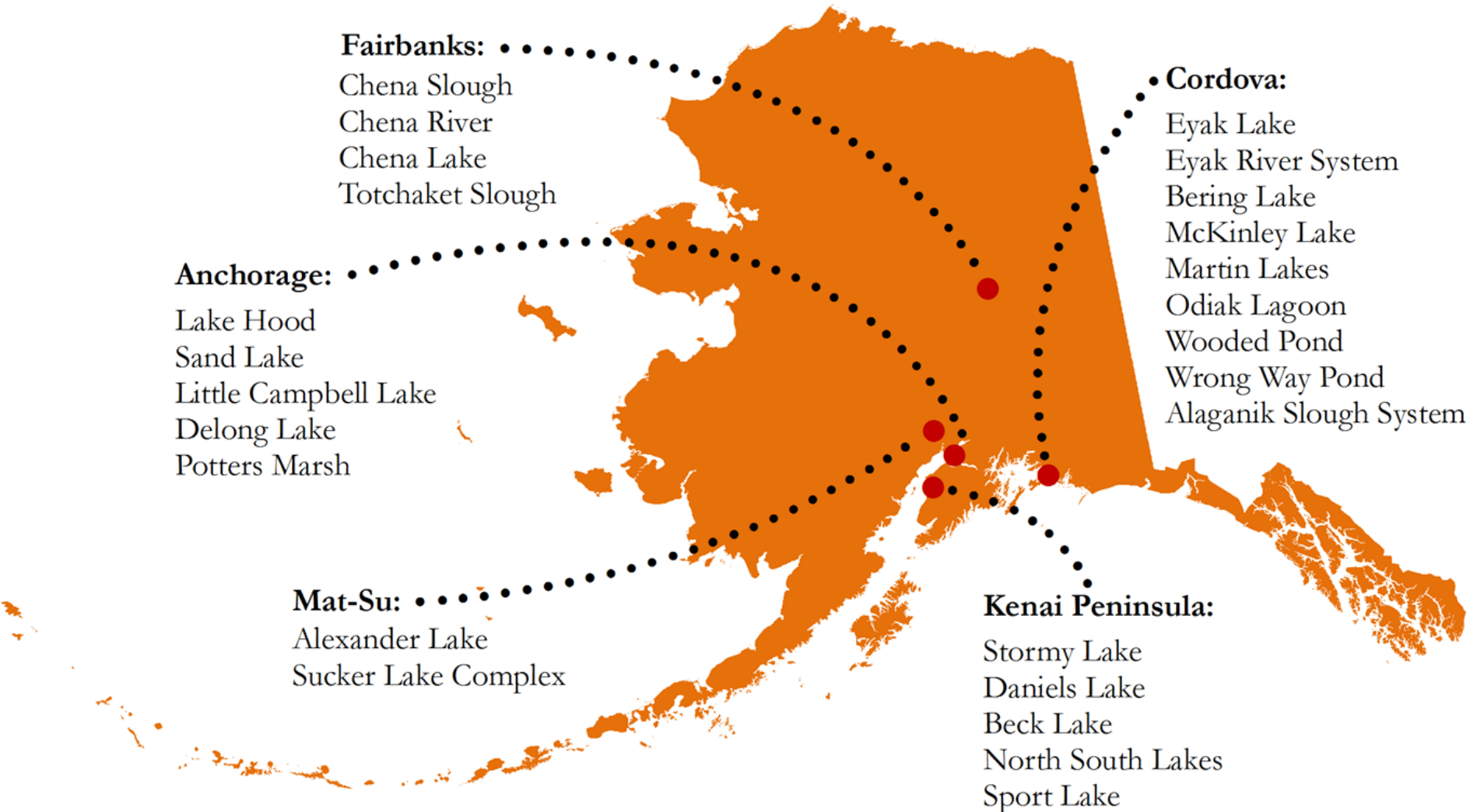


# Floatplane destinations





# Status of other elodea management efforts in Alaska







# Daniels Lake post-treatment

**QUESTIONS??**