

Secondary Effects and Fate of Fluridone Used to Eradicate Elodea

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)
Brienne 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



**John Morton, Suresh Sethi, Matt Bowser,
Edgar Guerron-Orejuela, Jen Peura**

Fluridone kills elodea systemically and selectively with few nontarget effects

- ✓ Absorbed through roots and shoots (systemic)
- ✓ Inhibits carotenoid synthesis (photosynthesis) and elodea is particularly sensitive (selective)
- ✓ Applied as liquid or slow-release pellets
- ✓ Degrades by photolysis, adsorption, absorption
- ✓ Needs to be in water column for 45 – 90 days



Fluridone has few restrictions

As determined by the U.S. EPA and the State of Alaska – fluridone poses a negligible risk to human health and the environment when used according to label instructions.

- ✓ **No** Swimming Restrictions
- ✓ **No** Potable Water Restrictions (drinking)
 - 2000x Safety Margin
 - Maximum rate (150 PPB) – 2 quarts of water per day – 2000X below NOEL (No-Observed-Effect-Level)
- ✓ **No** Fishing Restrictions

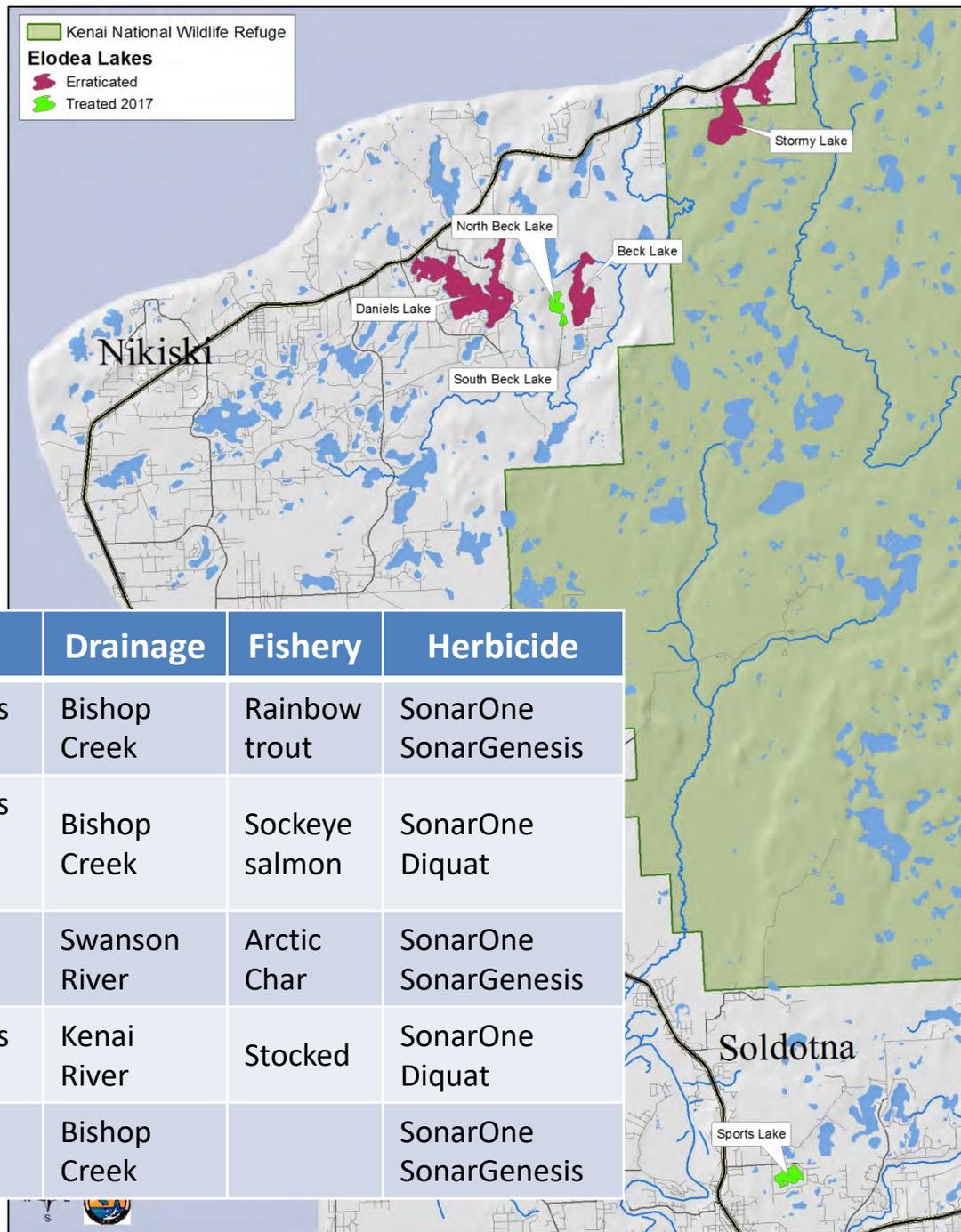
Fluridone degrades fairly rapidly

- ✓ Soil adsorption coefficient (K_{oc}): **350-2200** (soil type, pH)
 - Indicates a strong affinity to bind with soil particles
 - Low risk of soil leaching and offsite movement
 - Low risk of movement to ground water

- ✓ Half-life in aquatic environments (in-water): **14-60 days**
 - Dependent upon UV light
 - Adsorption

- ✓ Half-life in aquatic environments (hydrosoil): **120-270 days**
 - Desorption
 - Microbial composition
 - Aerobic / anaerobic

Elodea-infested lakes on the Kenai Peninsula



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	diquat fluridone	\$360k
Sept 2014	pellet	pellet	pellet	
June 2015	pellet	pellet	pellet	\$144k
June 2016	pellet	pellet	pellet	\$116k
cost	\$113K	\$320K	\$197K	\$620K

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

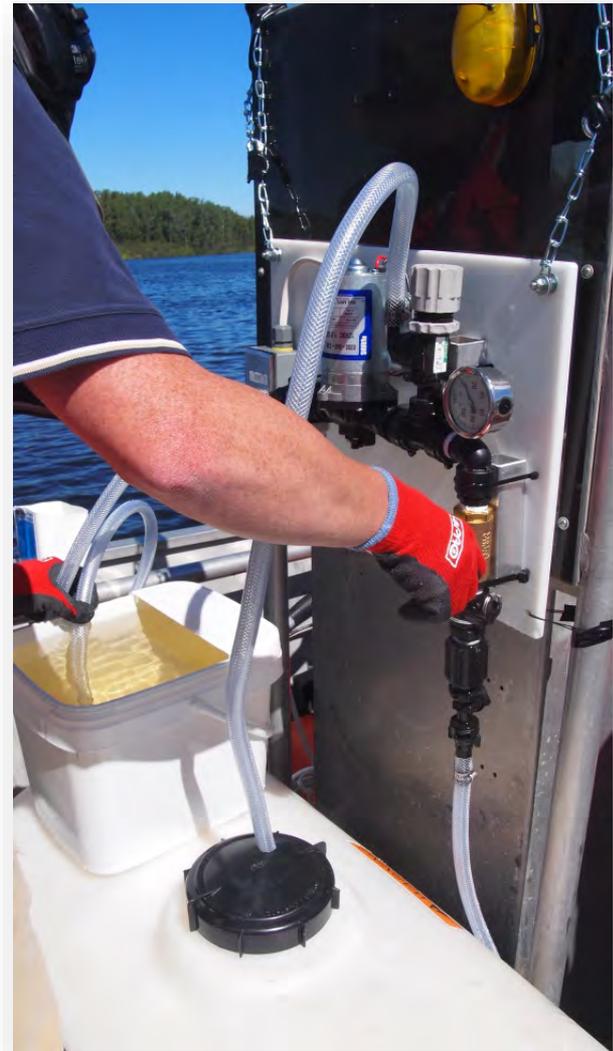
	Beck	Stormy	Daniels	Cost
acres	200	400	660 (100)	
approach	WHOLE	WHOLE	PARTIAL	
June 2014	liquid/pellet fluridone	liquid/pellet fluridone	diquat fluridone	\$360k
Sept 2014	pellet	pellet	pellet	
June 2015	pellet	pellet*	pellet*	\$144k
June 2016	pellet	pellet	pellet	\$116k

~\$400K

Application equipment



Pellet blower for SonarONE



Pump for Sonar Genesis, Diquat



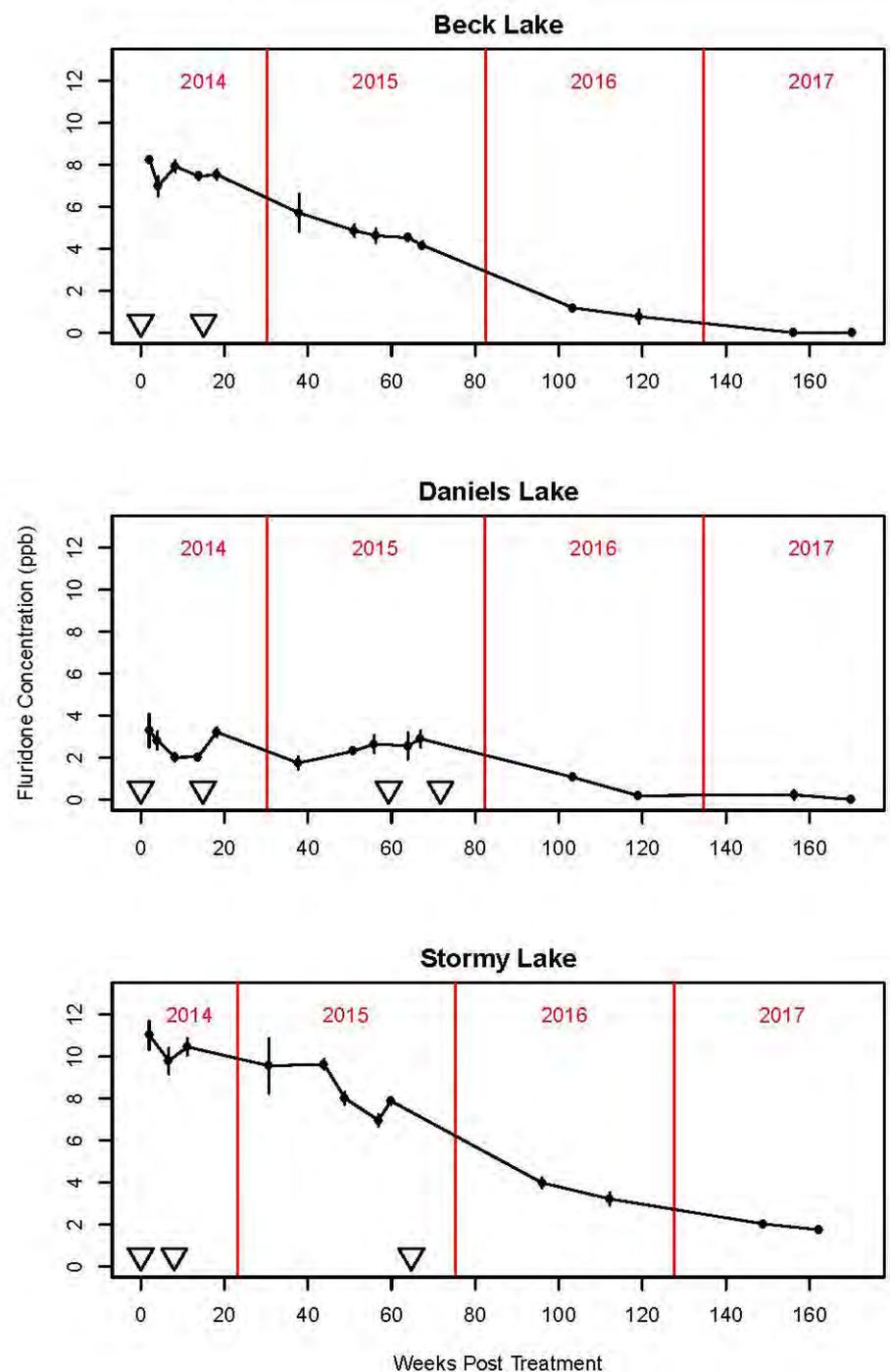
Sampling design to assess fluridone concentrations in water column

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
Total Samples		31	31	13	13	13		
Grand Total		101						

Is it working?



- 1st application (Beck, Daniels) 3-4 Jun 14
- 1st application (Stormy) 23 Jul 14
- 2nd application (Beck, Daniels, Stormy) 16-17 Sep 14
- 3rd application (Daniels) 24 Jul 15
- 4th application (Daniels) 19 Oct 15



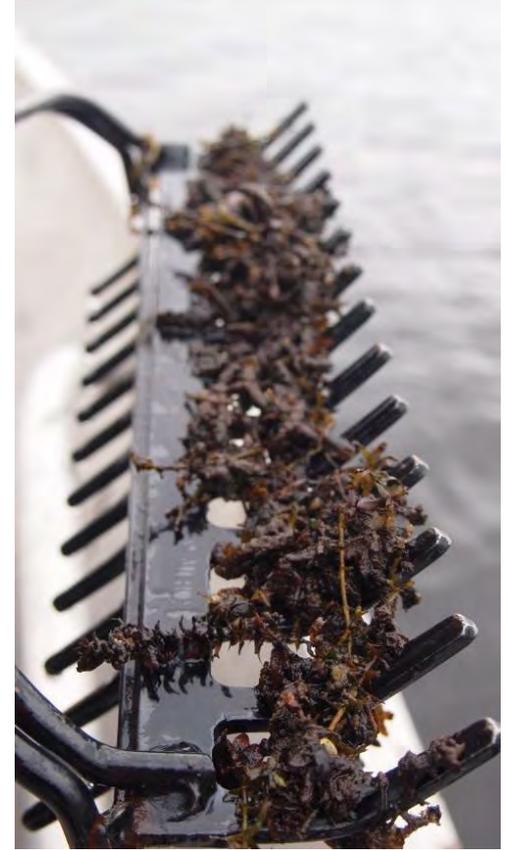
Is it working?



2 weeks (Stormy)



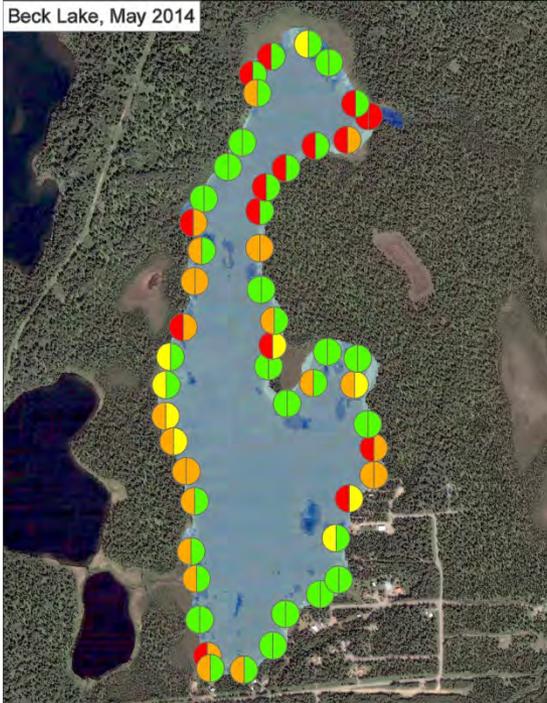
8 weeks (Beck)



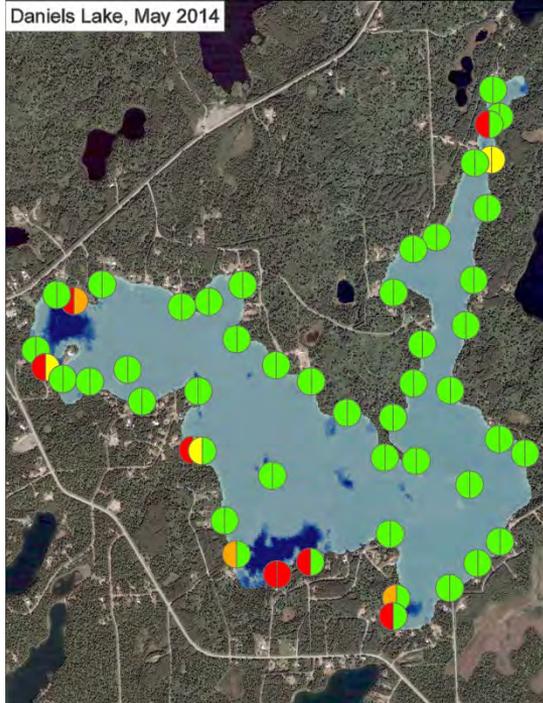
14 weeks (Beck)

Is it working?

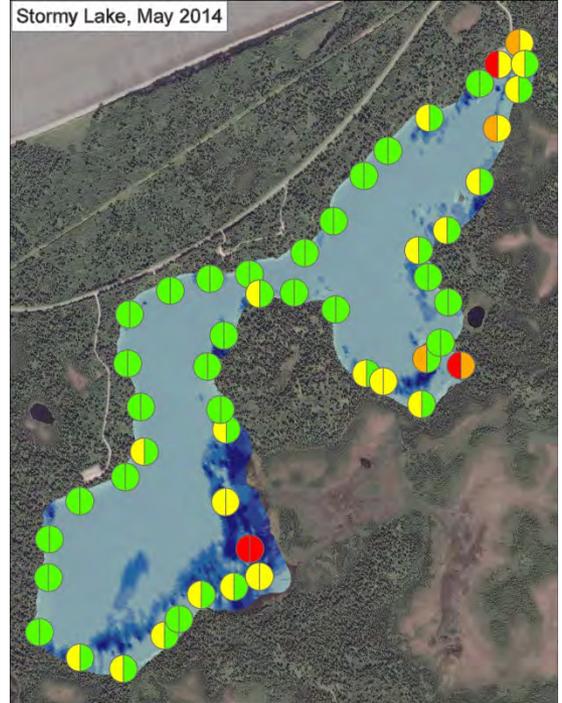
Beck Lake, May 2014



Daniels Lake, May 2014



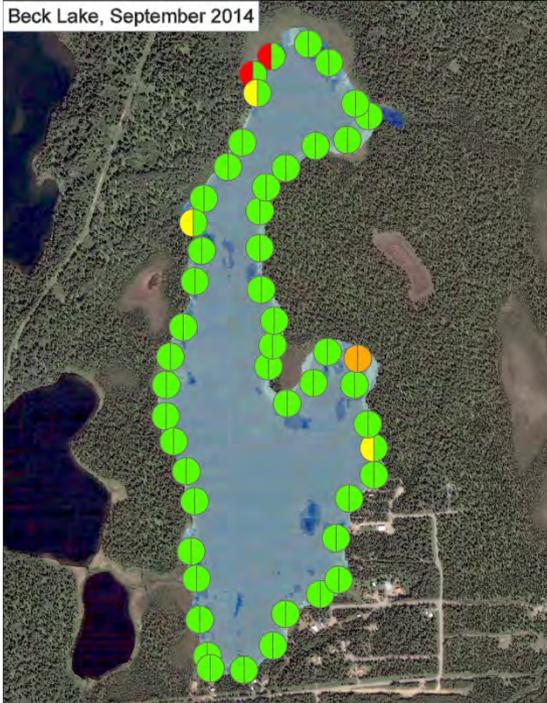
Stormy Lake, May 2014



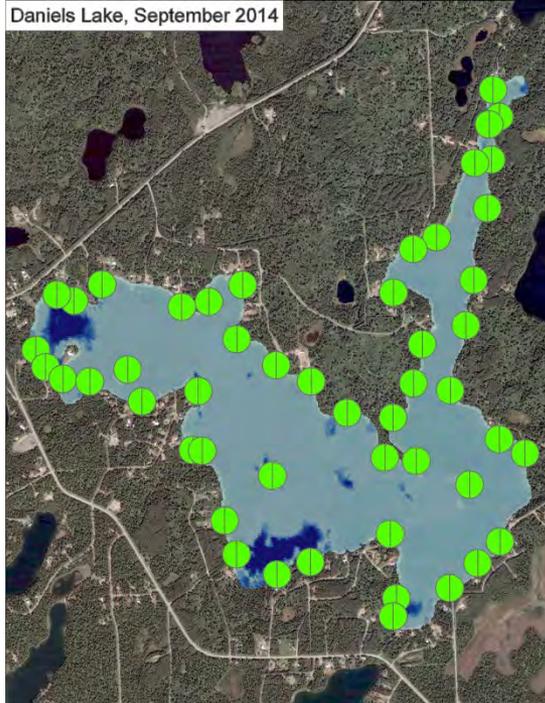
SURVEY	LAKE		
	Beck	Daniels	Stormy
May 2014 (pre-trmt)	70	22	50

Is it working?

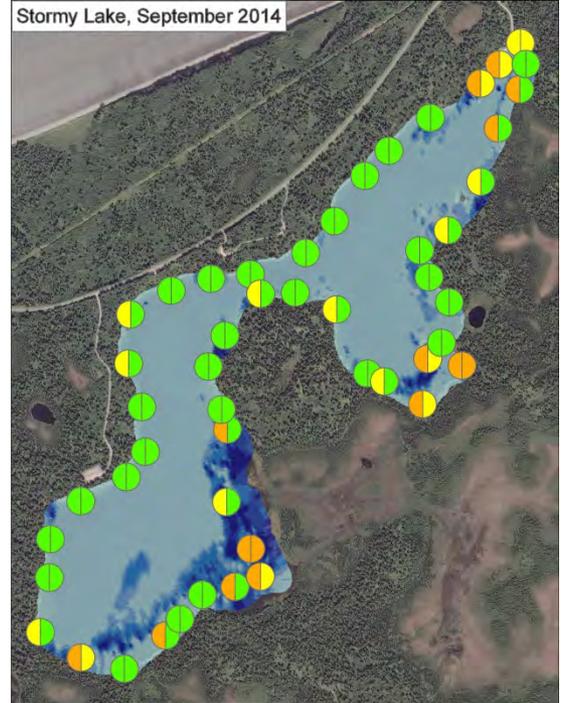
Beck Lake, September 2014



Daniels Lake, September 2014



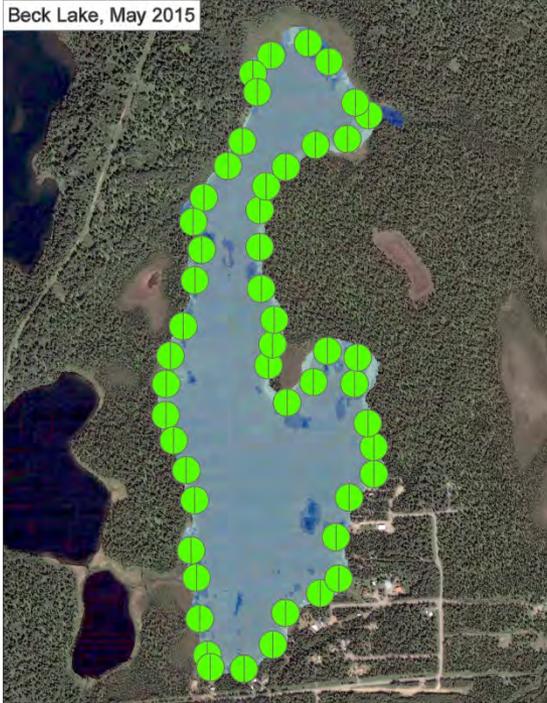
Stormy Lake, September 2014



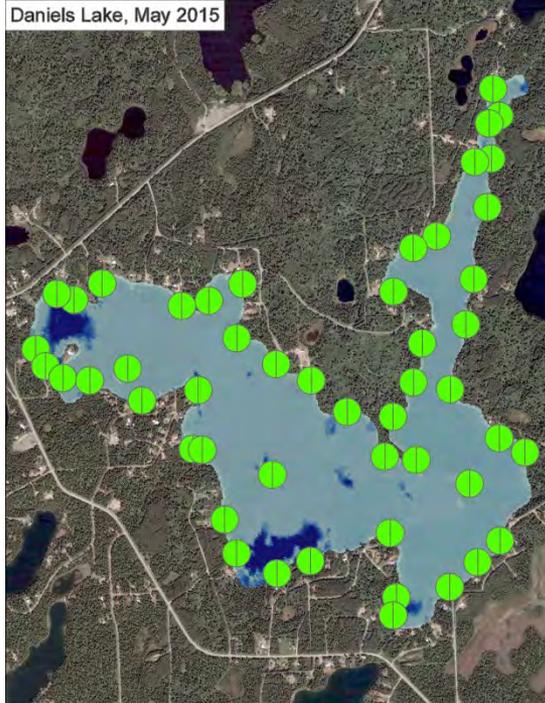
SURVEY	LAKE		
	Beck	Daniels	Stormy
May 2014 (pre-trmt)	70	22	50
Sept 2014 (post)	12	0	46

Is it working?

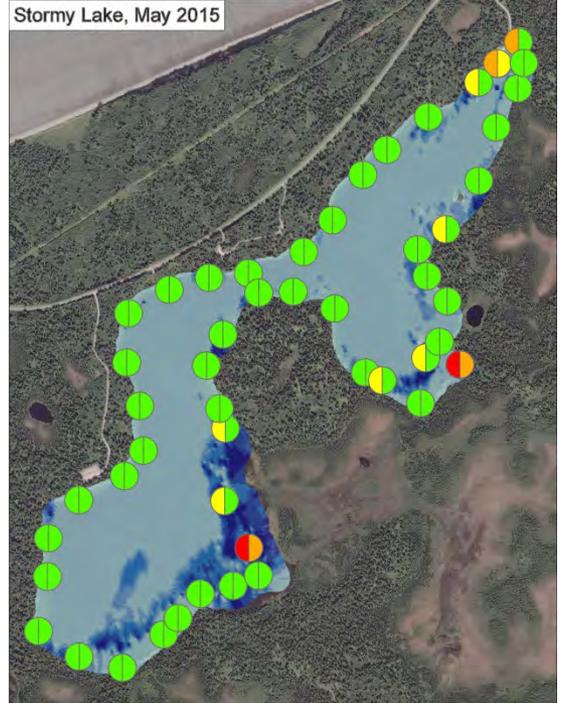
Beck Lake, May 2015



Daniels Lake, May 2015



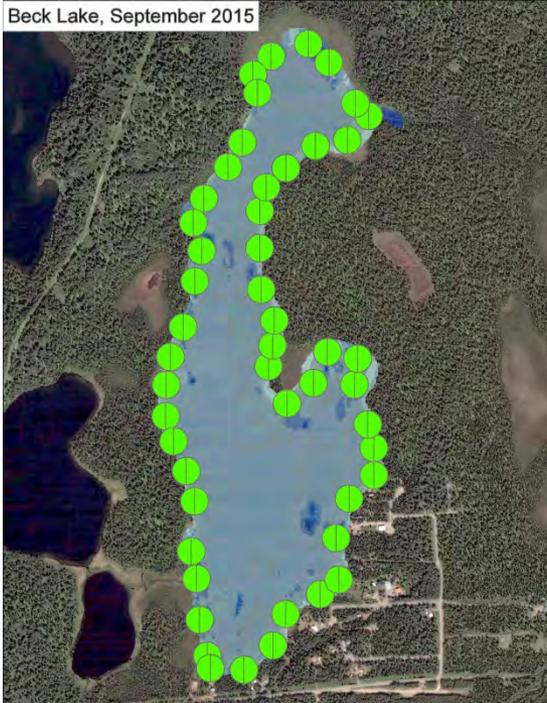
Stormy Lake, May 2015



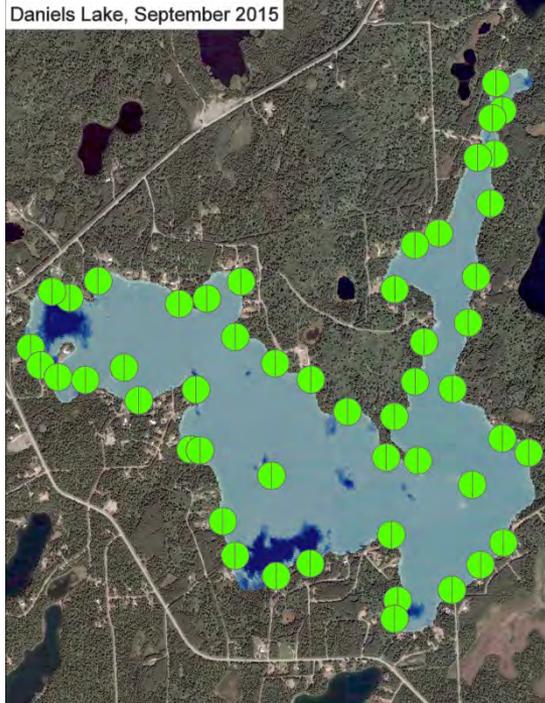
SURVEY	LAKE		
	Beck	Daniels	Stormy
May 2014 (pre-trmt)	70	22	50
Sept 2014 (post)	12	0	46
May 2015 (post)	0	0	20

Is it working?

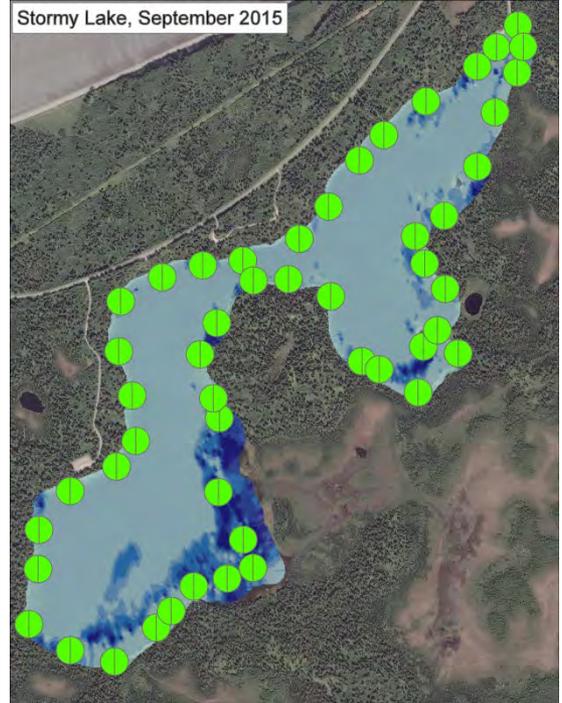
Beck Lake, September 2015



Daniels Lake, September 2015



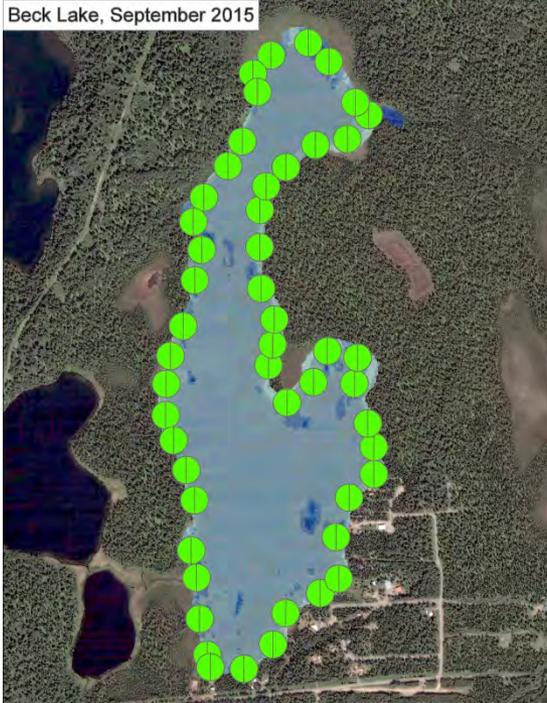
Stormy Lake, September 2015



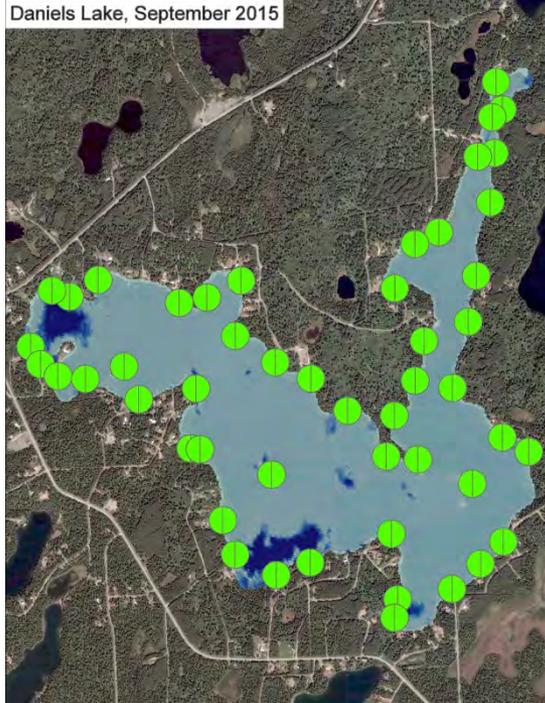
SURVEY	LAKE		
	Beck	Daniels	Stormy
May 2014 (pre-trmt)	70	22	50
Sept 2014 (post)	12	0	46
May 2015 (post)	0	0	20
Sept 2015 (post)	0	0	0*

Is it working?

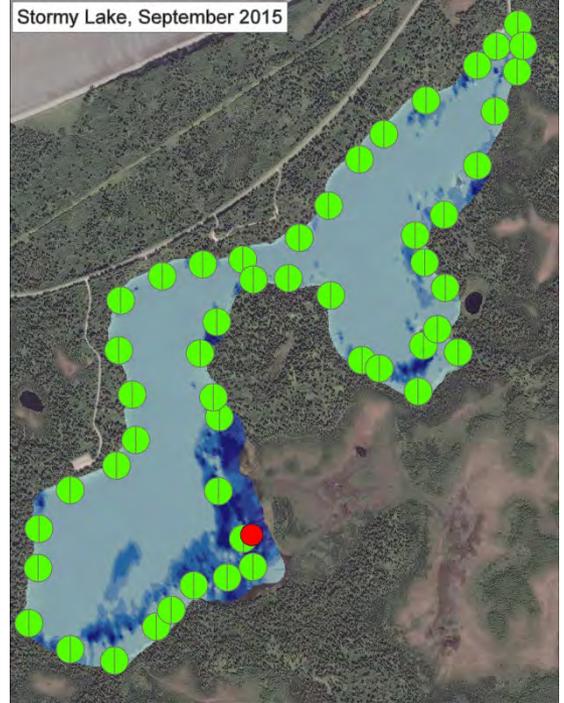
Beck Lake, September 2015



Daniels Lake, September 2015

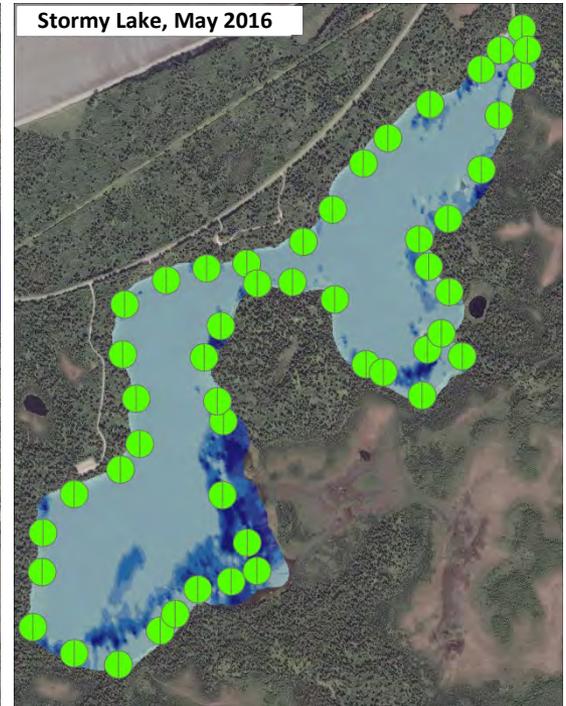
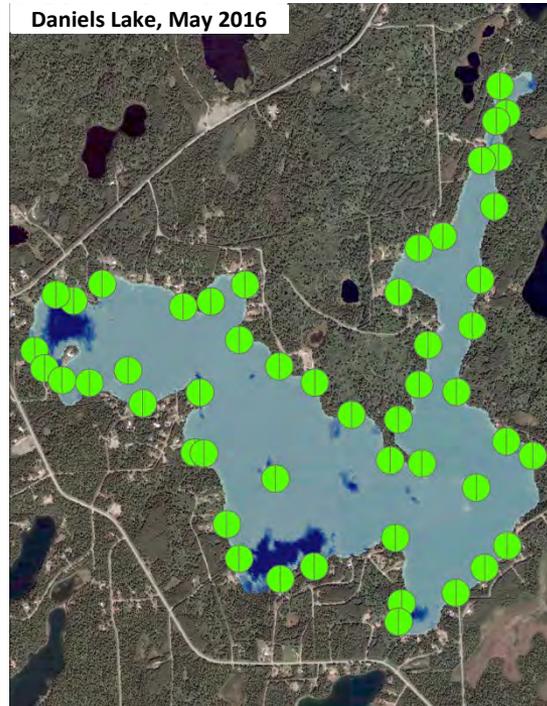


Stormy Lake, September 2015



SURVEY	LAKE		
	Beck	Daniels	Stormy
May 2014 (pre-trmt)	70	22	50
Sept 2014 (post)	12	0	46
May 2015 (post)	0	0	20
Sept 2015 (post)	0	0	0*

Is it working?

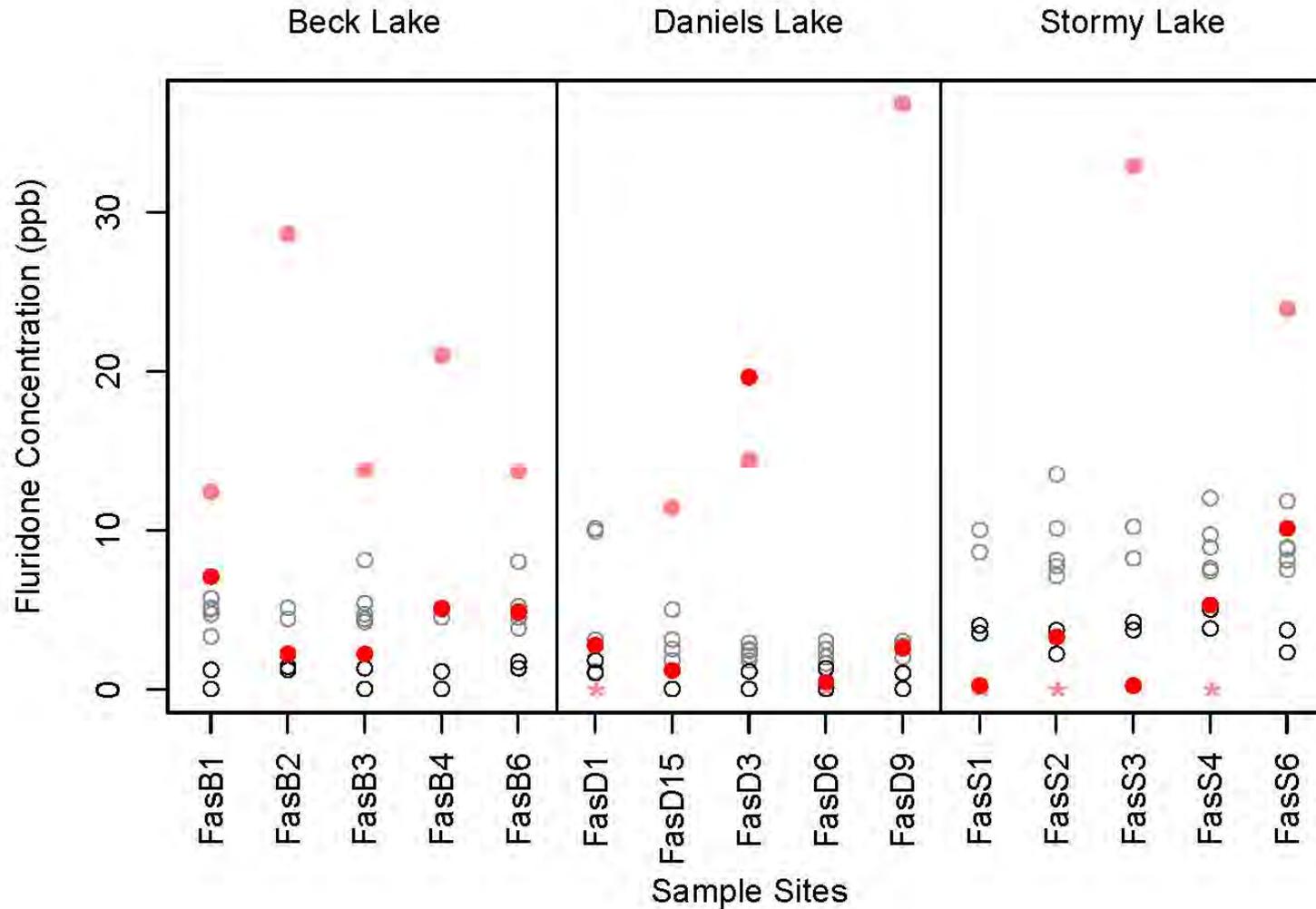


SURVEY	LAKE		
	Beck	Daniels	Stormy
May 2014 (pre-trmt)	70	22	50
Sept 2014 (post)	12	0	46
May 2015 (post)	0	0	20
Sept 2015 (post)	0	0	0*
May 2016 (post)	0	0	0

Does fluridone persist in sediment?

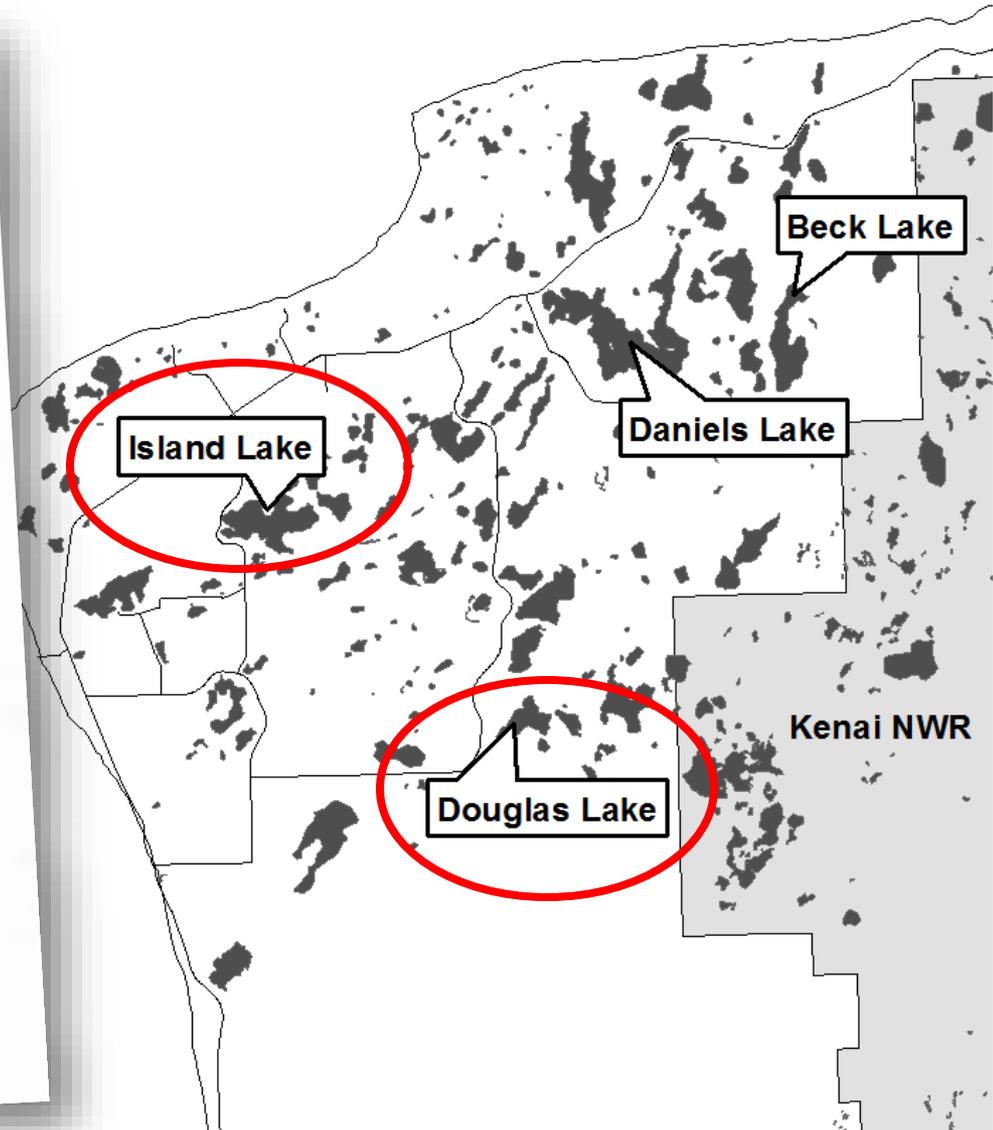
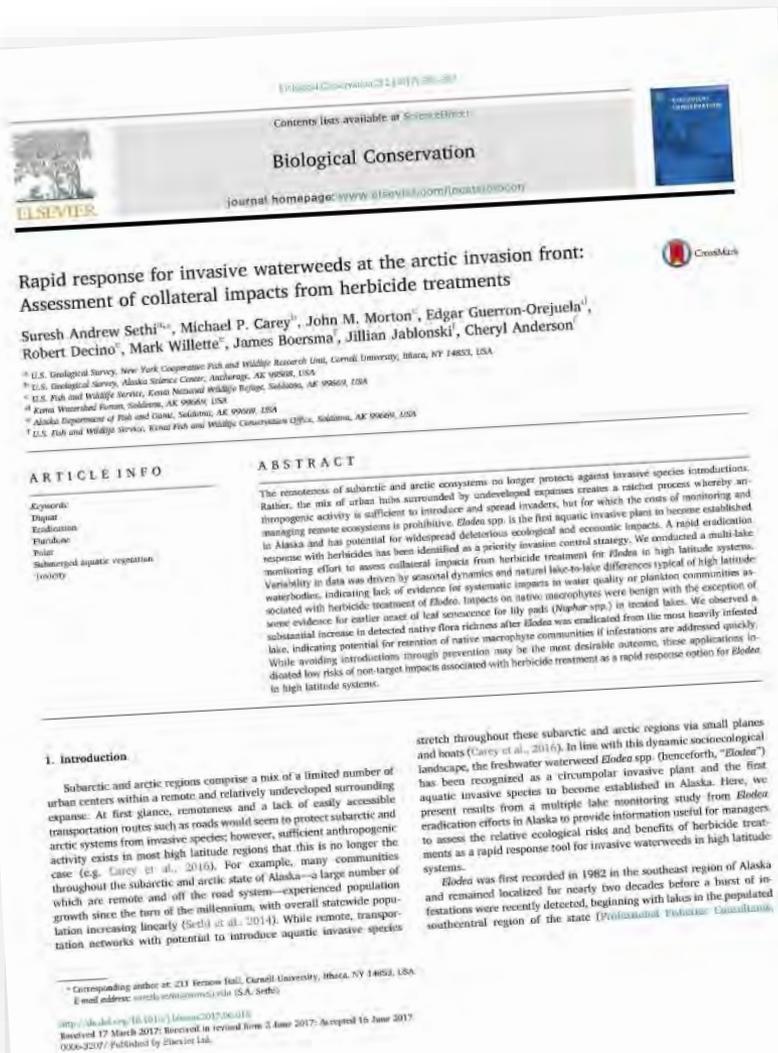


Does fluridone persist in sediment?

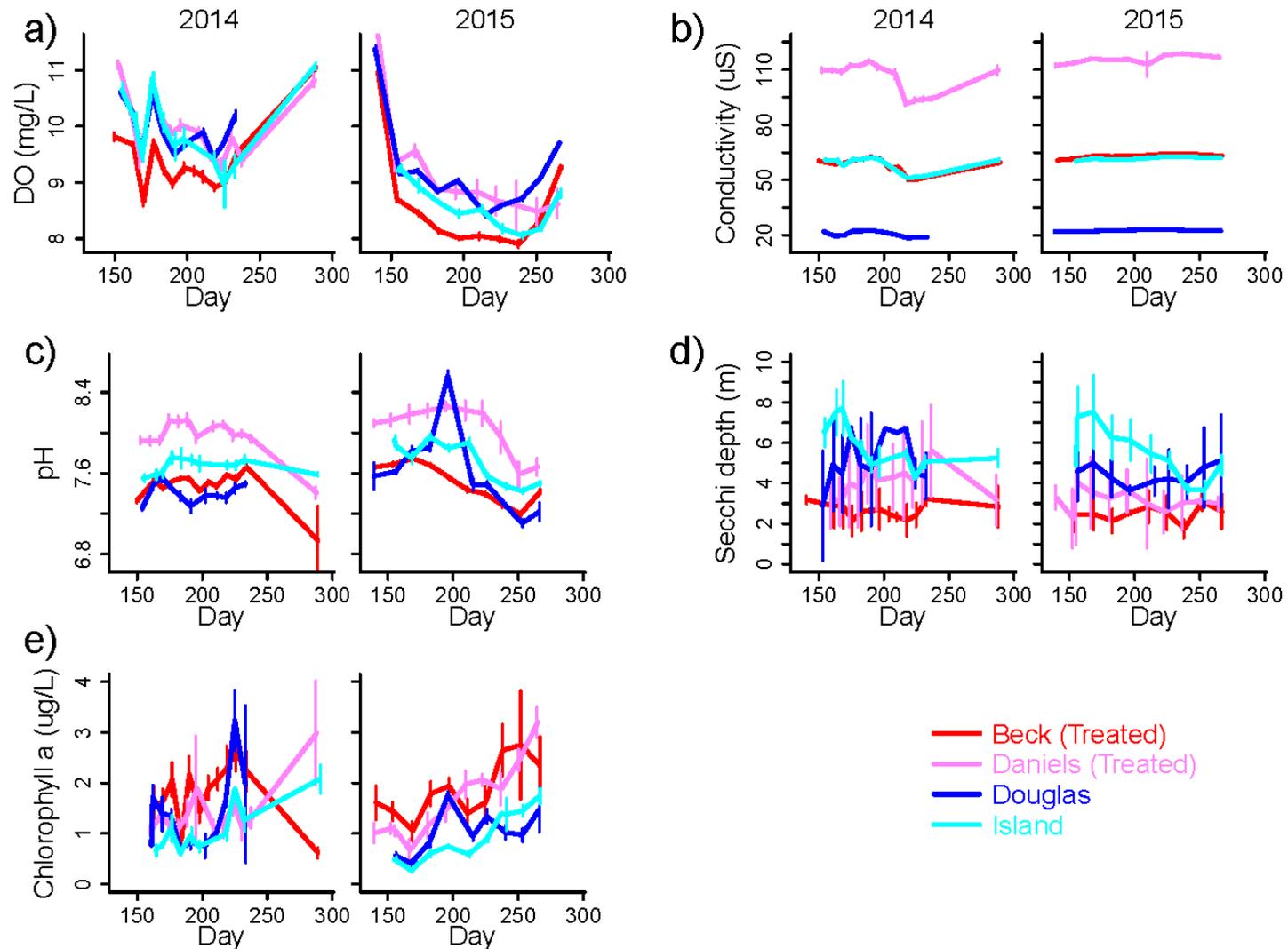


*no detect, 2015 avg = 13.9, 2016 avg = 4.5

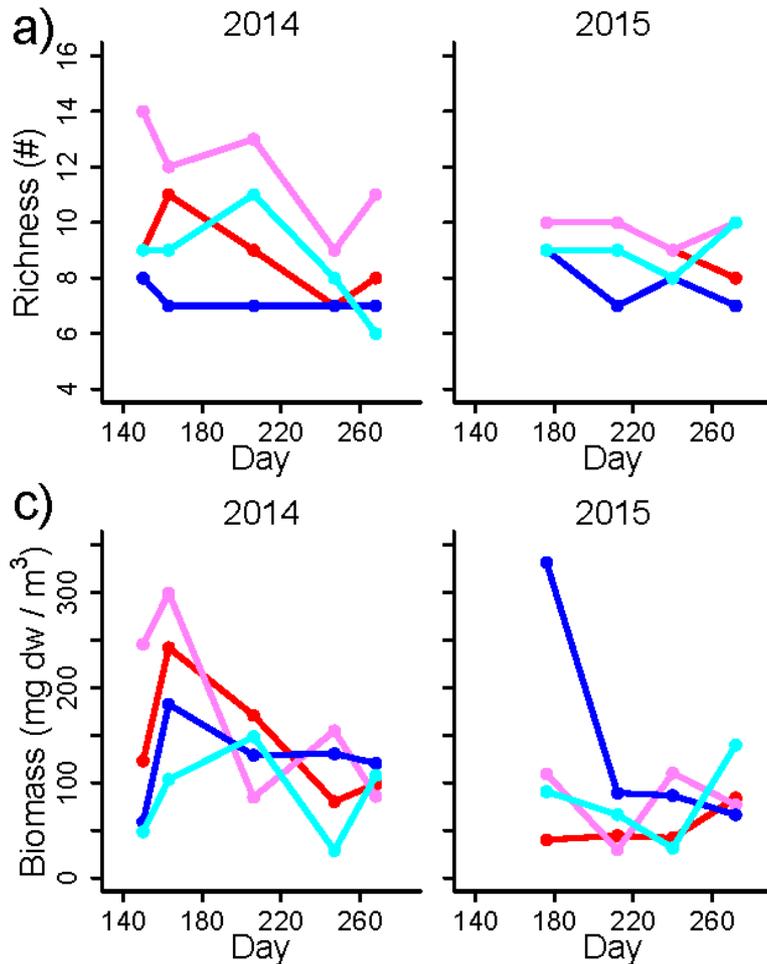
Other secondary effects of fluridone



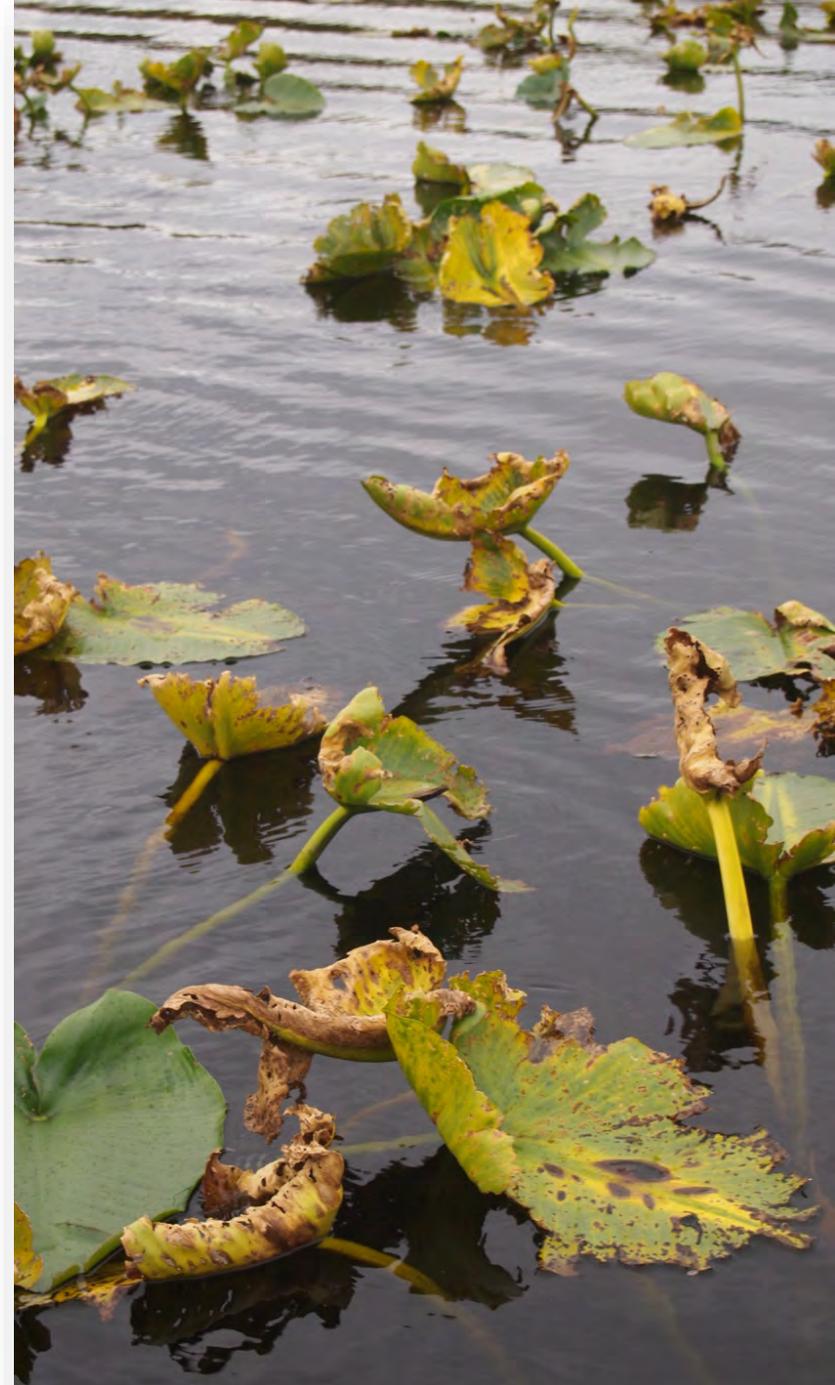
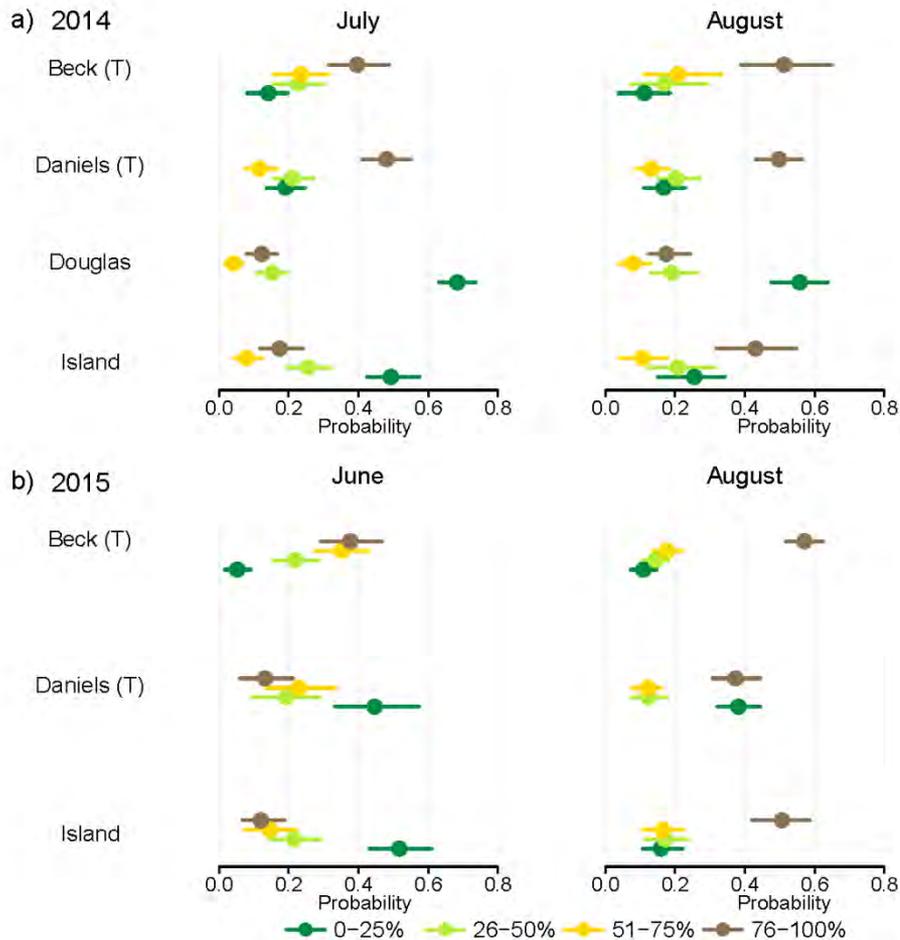
No systematic effect on water quality



No systematic effects on zooplankton



Earlier onset of senescence in Nuphar



No evidence that *Myriophyllum* has recovered



Scientific Name	Common Name	Beck Lake	Stormy Lake	Daniels Lake
<i>Calla palustris</i>	wild calla	x		
<i>Callitriche hermaphroditica</i> L.	northern water starwort	x		
<i>Eleocharis palustris</i>	common spikerush	x		
<i>Elodea canadensis</i> x <i>nuttallii</i>	waterweed hybrid	x	X	X
<i>Equisetum fluviatile</i>	water horsetail	x		
<i>Fontinalis antipyretica</i>	common water moss	x	X	X
<i>Hippuris vulgaris</i>	common mare's-tail	x		
<i>Myriophyllum sibiricum</i>	shortspike watermilfoil	x	X	X
<i>Nuphar lutea</i>	yellow pond lily	x	X	X
<i>Potamogeton</i> spp. (<i>P. epihydrous</i> , <i>P. friessii</i> , <i>P. gramineus</i> , <i>P. praelongus</i> , <i>P. pusillus</i> , <i>P. richardsonii</i>)	pondweeds	x	X	X
<i>Ranunculus aquatilis</i>	water crowfoot		X	
<i>Schoenoplectus tabernaemontani</i>	bulrush		X	
<i>Sparganium angustifolium</i>	narrowleaf burreed	x	X	X
<i>Sparganium natans</i>	small bur-reed	x	X	X
<i>Utricularia intermedia</i>	flatleaf bladderwort	x	X	X

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





Daniels Lake post-treatment

QUESTIONS??