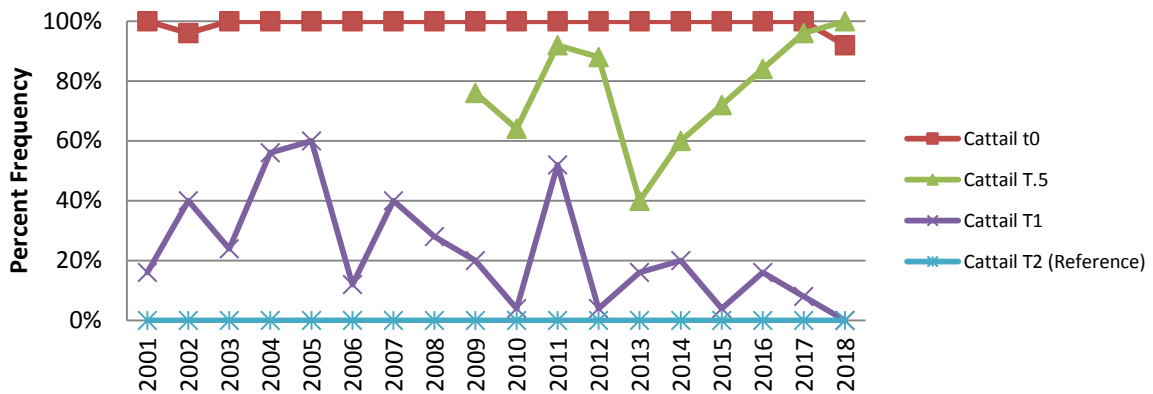
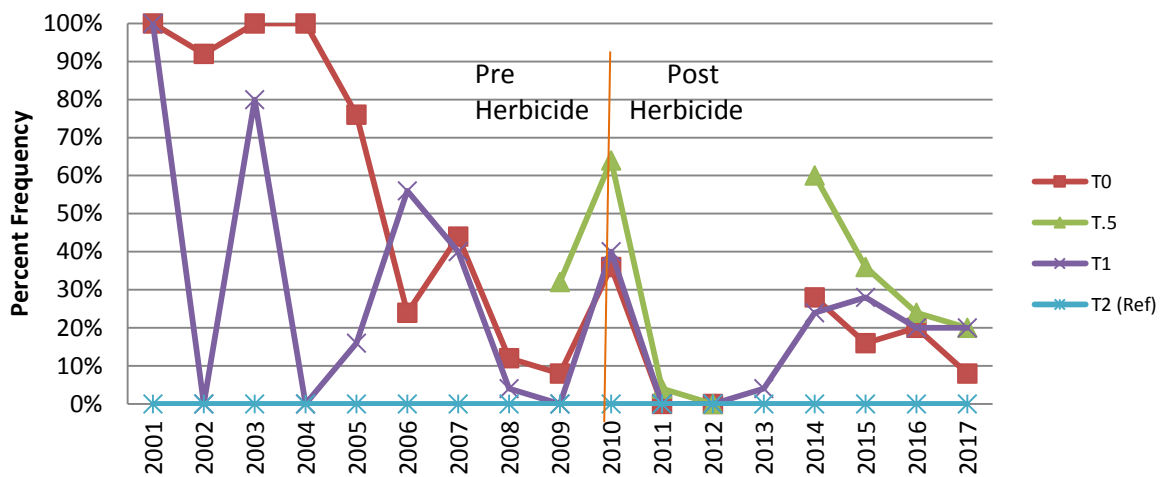


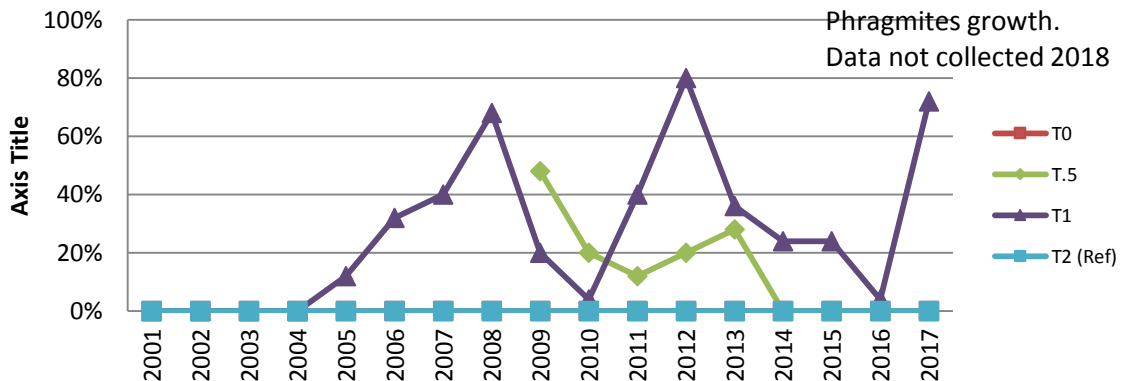
### Cattail (*Typha sp.*) on PRNWR North Pool and Reference



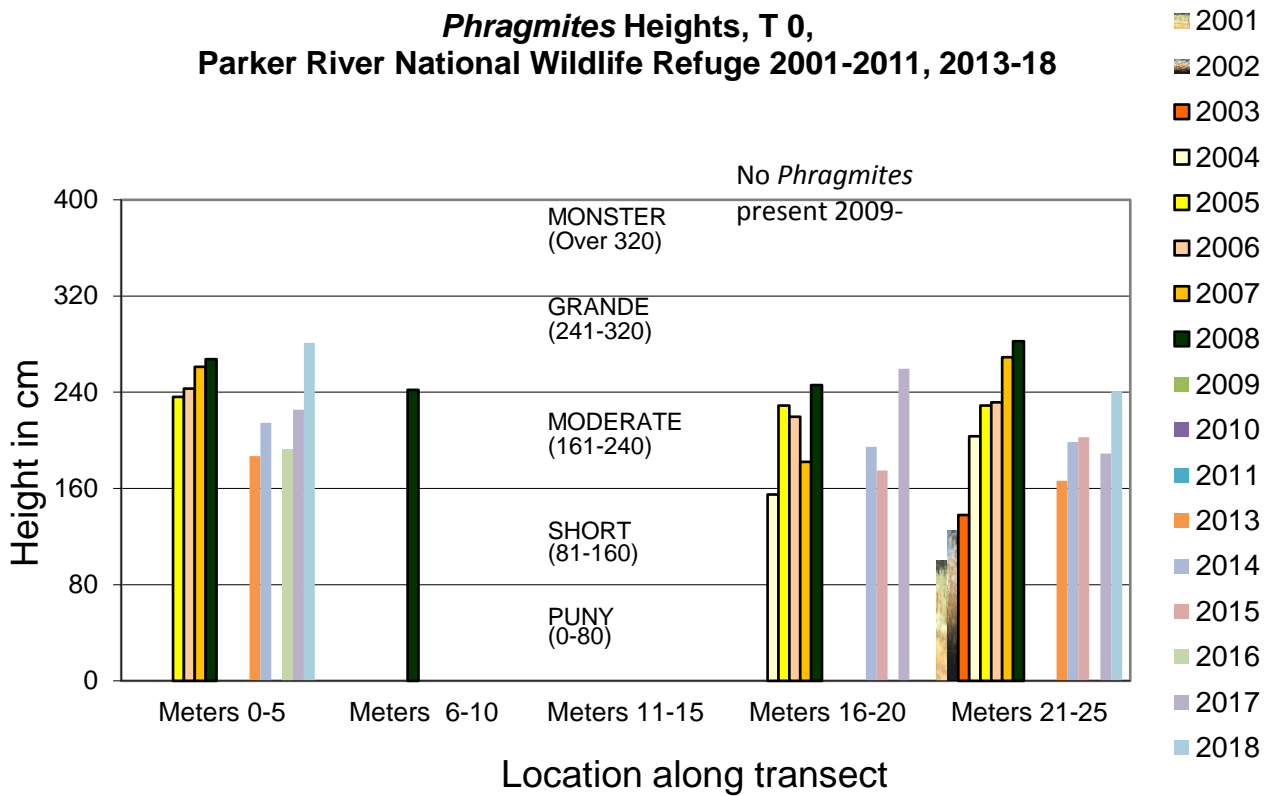
### Purple Loosestrife (*Lythrum salicaria*) on PRNWR North Pool and Reference



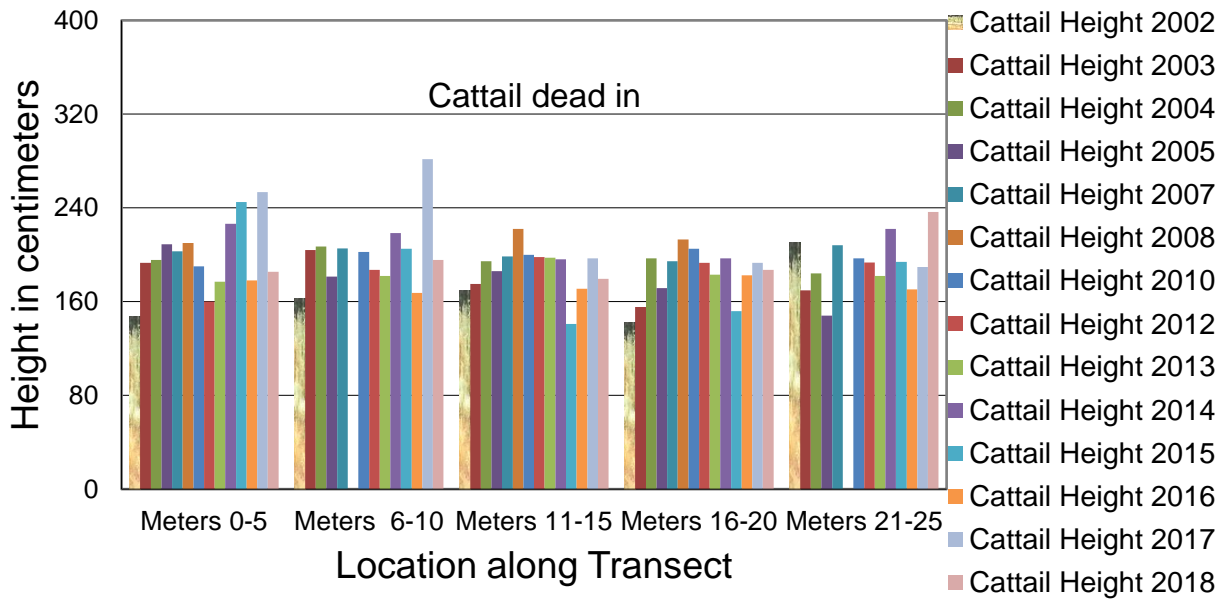
### % Phragmites monoculture on transects at PRNWR North Pool

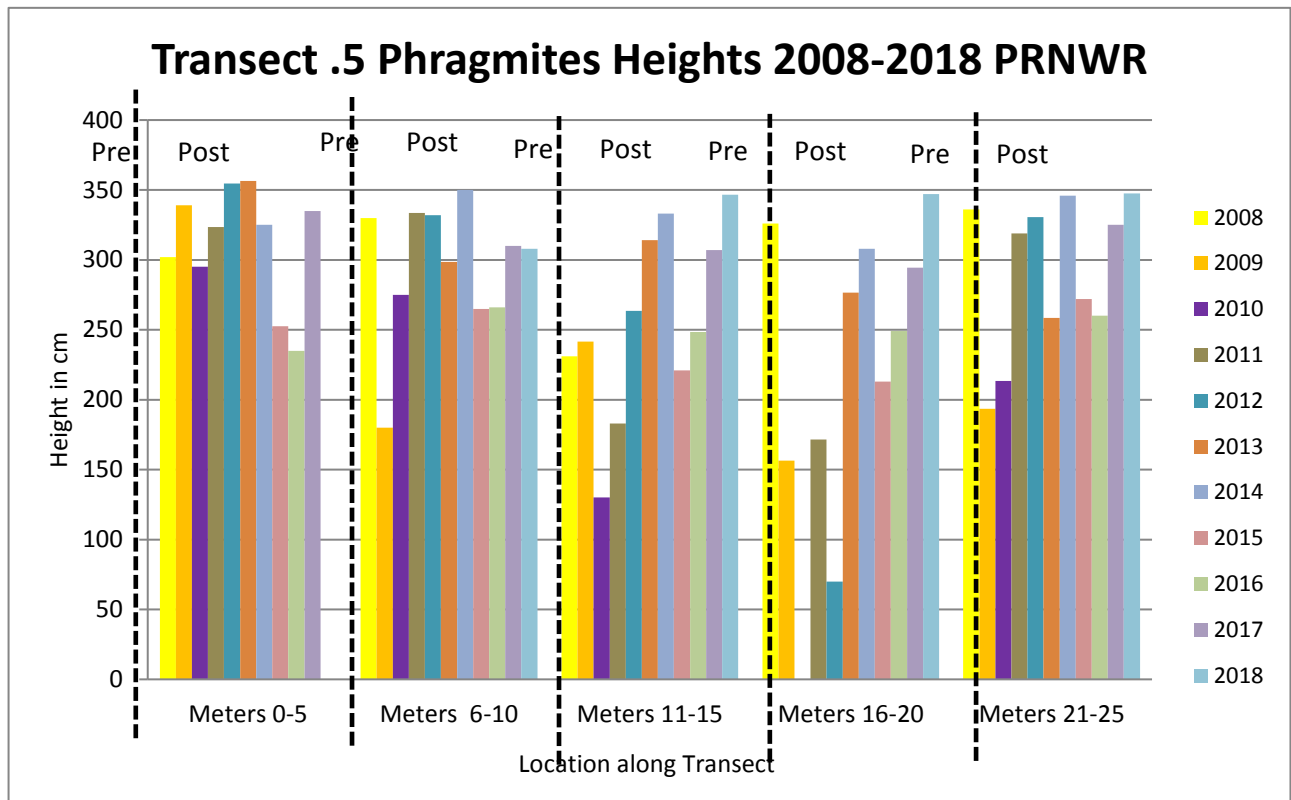


**Phragmites Heights, T 0,  
Parker River National Wildlife Refuge 2001-2011, 2013-18**



**Cattail Heights, T 0,  
Parker River National Wildlife Refuge  
2002-2005, 2009-2018**

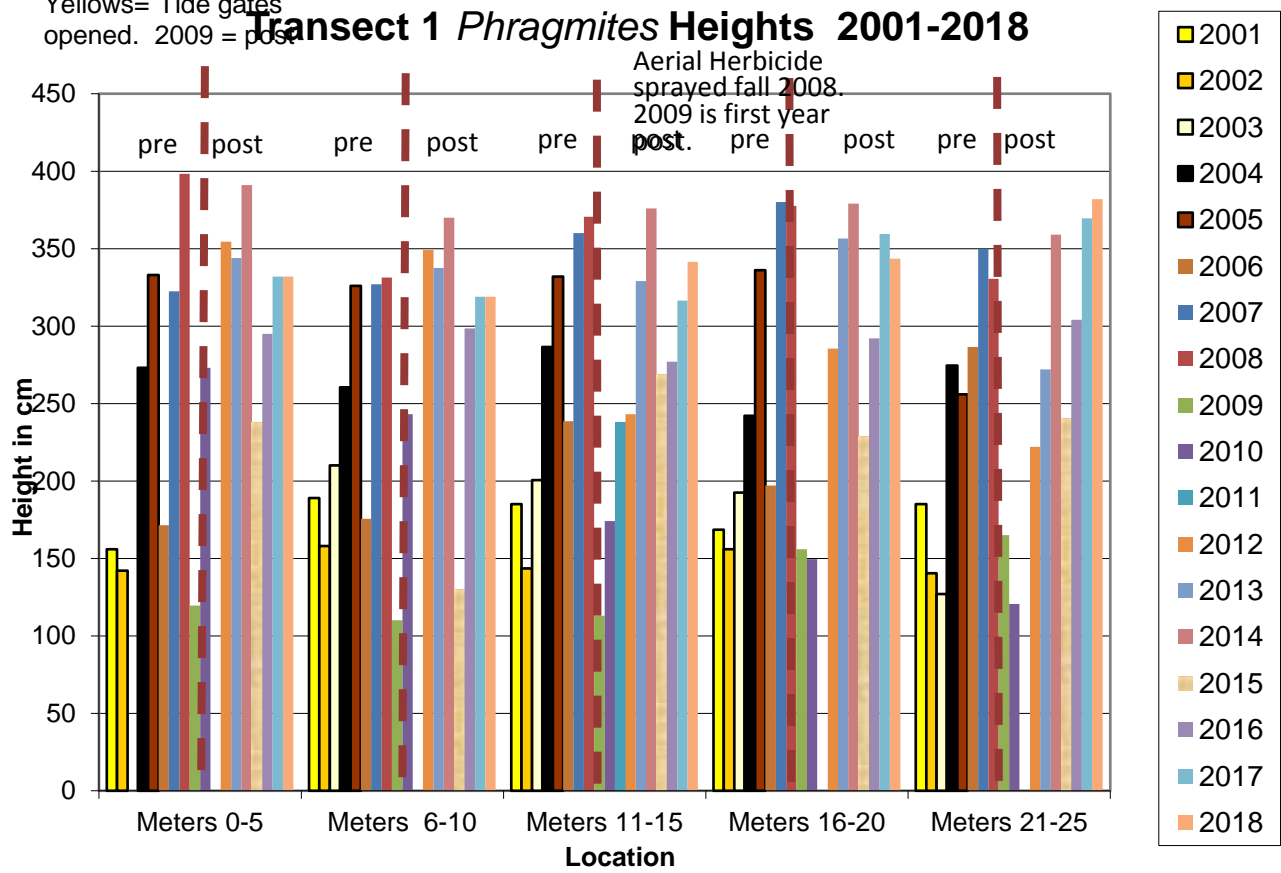




Yellows= Tide gates opened. 2009 = post

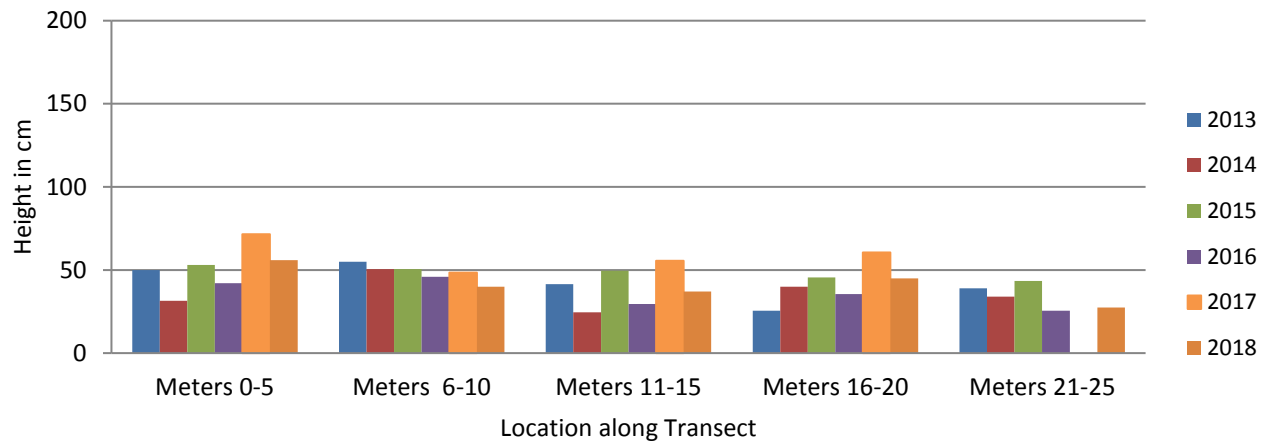
### Transect 1 Phragmites Heights 2001-2018

Aerial Herbicide sprayed fall 2008.  
2009 is first year post.





## Cordgrass Heights T2 PRNWR



Mass Audubon Salt Marsh Science Project

**Transect 0**

2009 Duff, NECC, & Sparhawk 2018 Duff

Long Range *Phragmites* Study is upstream and perpendicular to station 3? On the boardwalk

2010 Duff & Kate w/ Sparhawk

Location: PRNWR

Observers and dates

2012 Halloran, Lockwood, Orlando

**Tide gates open 2001 and 2002 and**

2001

2013 Duff & Lehman

**June-July 2003. Gates closed 2004 and 2005**

2002 Newbury Elementary Gr. 6, Nicholson

2014 Duff&MacKelvey

**Site was mowed in Fall 2001 after data collection**

2004 LD, Halloran

2015 Mary and Wakefield High

SPECIES

2005 Duff & Rose (25 cm of water!)

2016 Duff & Shain

Herbicided fall '08

2006, 2007 Duff

2017 Drew& RVCS

# of intervals present

PRNWR 1

upland end

**1 METER SEGMENTS**

marsh end

present

Year 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

%

Species	Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	# of intervals present	%	
<i>Phragmites</i>	2001																					1					1	4%	
	2002																					1	1					4	4%
	2003																					1	1			1	1	7	16%
	2004																				1	1	1	1	1	1	1	9	36%
	2005	1	1																		1	1	1	1	1	1	1	9	36%
	2006	1																			1	1	1			1	1	6	24%
	2007	1					1				1									1	1	1	1	1	1	1	1	9	36%
	2008	1	1				1				1									1	1	1	1	1	1	1	1	12	48%
	2009																											0	0%
	2010																											0	0%
	2011																											0	0%
	2012					1																	1	1				1	4%
	2013	1																										3	12%
	2014	1																				1	1				1	5	20%
	2015																				1	1	1	1				5	20%
	2016	1	1																									2	8%
	2017	1	1																	1	1	1						7	28%
	2018	1	1																	1	1							4	16%
	2019																											0	0%
<i>Cattail</i>	2001	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%	
	2002	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24	96%	
	2003	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%	
	2004	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2005	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2006	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2007	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2008	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2009	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2010	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2011	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2012	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2013	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2014	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2015	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2016	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2017	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2018	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	2019																											0	0%
<i>Aster</i>	2001																										0	0%	
	2002					1										1	1	1									4	16%	
	2003		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	21	84%	
	2004																											0	0%
	2005																											0	0%
	2006																											0	0%
	2007																											0	0%
	2008																											0	0%
	2009																											0	0%
	2010																											0	0%
	2011																											0	0%
	2012																											0	0%
Unidentified	2001																										0	0%	
	2002		1	1	1																	1	1	1	1	1	1	10	40%
	2003		1	1	1	1																						4	16%
	2004																				1							1	4%
	2005																											0	0%





SPECIES	Year	1 METER SEGMENTS																									# of intervals present in	
		upland end												marsh end														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
<i>Phragmites</i>	2008	1	1	1	1	1	1	1	1	1	1	1									1	1	1	1	1	1	24	96%
<i>Phragmites australis</i>	2009																										10	40%
is immature (no tassel)	2010	1	1	1	1	1	1	1	1	1	1											1	1	1	1	1	16	64%
Herbicide fall '08	2011	1	1	1	1	1	1	1	1	1	1	1										1	1	1	1	1	17	68%
	2012	1	1	1	1	1	1	1	1	1	1	1										1	1	1	1	1	18	72%
	2013	1	1	1	1	1	1	1	1	1	1	1										1	1	1	1	1	19	76%
	2014		1	1	1	1				1	1	1	1									1	1		1	1	14	56%
	2015		1	1	1	1																1	1	1	1	1	12	48%
	2016	1	1	1	1	1	1	1	1	1	1	1										1	1	1	1	1	24	96%
	2017	1	1	1	1	1	1	1	1	1	1	1										1	1	1	1	1	25	100%
	2018	1	1	1	1	1	1	1	1	1	1	1										1	1	1	1	1	25	100%
	2019																										0	0%
Cattail	2009																										19	76%
<i>Typha angustifolia</i>	2010	1	1	1	1	1	1	1	1	1	1	1													1	1	16	64%
	2011	1	1	1	1	1	1	1	1	1	1	1												1	1	1	23	92%
	2012																										21	84%
	2013																										10	40%
	2014																										15	60%
	2015																										18	72%
	2016																										21	84%
	2017																										24	96%
	2018																										23	92%
	2019																										0	0%
Purple Loosestrife	2009																										8	32%
<i>Lythrum salicaria</i>	2010																										16	64%
	2011																										1	4%
	2012																										0	0%
	2013																										5	20%
	2014																										15	60%
	2015																										9	36%
	2016																										6	24%
	2017																										5	20%
	2018																										2	8%
	2019																										0	0%
Orach	2010																										1	4%
<i>Atriplex patula</i>	2011																										0	0%
	2012																										0	0%
	2013																										7	28%
	2014																										1	4%
	2015																										2	8%
	2016																										8	32%
	2017																										5	20%
	2018																										0	0%
	2019																										0	0%
Creeping Bent Grass	2010																										0	0%
<i>Argostis stolonifera</i>	2011																										6	24%
	2012																										6	24%
	2013																										3	12%
	2014																										3	12%
	2015																										0	0%
	2016																										0	0%
	2017																										0	0%
	2018																										0	0%
	2019																										0	0%
Fireweed (Pilewort)	2010																										4	16%
<i>Erechtites hieracifolia</i>	2011																										0	0%
	2014																										6	24%
smart weed	2010																										1	4%
<i>polygonum punctatum</i>	2011																										0	0%
	2012																										0	0%

Salt Marsh Sedge <i>Carex paleacea</i>	2010									1	1	1	1	1														5	20%	
	2011																												0	0%
	2012														1														1	4%
	2013																												0	0%
	2014																												0	0%
	2015										1	1	1	1															4	16%
	2016																												0	0%
	2017																												0	0%
	2018																												0	0%
2019																												0	0%	
vine	2010																												2	8%
	2011																												0	0%
	2012																												0	0%
	2014																												1	4%
	2015																												0	0%
	2016																												0	0%
	2017																												0	0%
	2018																												1	4%
	2019																												0	0%
Open Water	2011																												1	4%
	2012																												0	0%
	2013																												0	0%
	2014																												0	0%
Beggars Tick <i>Bidens Tripartita</i>	2010																												4	16%
	2011																												0	0%
	2012																												0	0%
	2013																												2	8%
	2014																												2	8%
	2015																												1	4%
	2016																												3	12%
	2017																												0	0%
	2018																												0	0%
2019																												0	0%	
Aster	2013																												2	8%
	2014																												0	0%
Water Hemp <i>Amaranthus cannabinus</i>	2014																												4	16%
	2015																												0	0%
	2016																												0	0%
	2017																												0	0%
Unknown Grass	2014																												7	28%
	2015																												2	8%
	2016																												0	0%
	2017																												2	8%
	2018																												0	0%
	2019																												0	0%
Fleabane	2013																												2	8%
	2014																												2	8%
	2015																												0	0%
	2016																												3	12%
	2017																												6	24%
	2018																												0	0%
Bulrush	2016																												2	8%
	2017																												0	0%
																													0	0%
																													0	0%
																													0	0%
																													0	0%

\*Location:

upland end

1 METER SEGMENTS

marsh end

Mass Audubon Salt Marsh Science Project  
 Long Range *Phragmites* Study  
 Location: PRNWR

**Transect 1, Upstream restricted, North Pool**

Observers and dates

2001	ADR, Sue Brown, John Halloran	08 Duff & NECC	2015 Duff, Wakefield High
2002	Newbury Elementary Gr. 6	08 Duff & Newbury & RVCS	2016 Duff & Shain
2003	Oulette & Gr. 6	2010 Duff & Kate	2017 Duff, Sweeney, RVCS
2004	Duff & Gr. 6	2012 Duff	2018 Duff
2006	Nicholuson	2013 Duff & Lehrman	
2007	Nicholson	2014 Duff & Mackelvey	

**MOWED 10/01**  
**Tide gates open 2001 and 2002 and**  
**June-July 2003. Gates closed 2004 and 2005**

SPECIES

Herbicide fall '08  
 mowed in 2009

Year	1 METER SEGMENTS																									# of intervals present in	%
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
Phragmites	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	22	88%
<i>Phragmites australis</i>	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24	96%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
is immature	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
Herbicide fall '08	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20	80%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	23	92%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	24	96%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	25	100%



Water Hemp	2009																										1	4%
<i>Amaranthus cannabinus</i>	2010																										10	40%
	2011																										0	0%
	2012																										0	0%
	2013																										0	0%
	2014																										0	0%
	2015																									5	20%	
	2016																									0	0%	
	2017																									0	0%	
"Munchkin", spud, LGP	2009				1				1																	17	68%	
	2010																									0	0%	
Aster	2001																									12	48%	
<i>Aster subulatus</i> ?	2002																									25	100%	
	2003																									24	96%	
	2005																									0	0%	
	2006																									0	0%	
	2007																									0	0%	
	2008																									0	0%	
	2009																									0	0%	
	2010																									0	0%	
	2011																									0	0%	
	2012																									0	0%	
	2013																									3	12%	
	2014																									0	0%	
Marsh Elder	2009					1	1			1																5	20%	
	2010																									0	0%	
	2011					1	1																			3	12%	
Bulrush	2009								1	1	1	1	1	1												6	24%	
	2010																									0	0%	
	2011								1	1	1	1	1	1												6	24%	
Fire Weed <i>Erechtites</i>	2009																									0	0%	
	2010			1				1	1				1	1	1	1										9	36%	
	2011																									0	0%	
<i>Bidens tripartita</i>	2010																									2	8%	
	2011																									0	0%	
Unknown 4 petal yellow flower	2010																									1	4%	
	2011																									0	0%	
Bare Patch %	2010								50	30	30	80						20								7	28%	
	2011																									0	0%	
Green unknown grass	2010																									1	4%	
	2011																									0	0%	
<b>Transect 1 PRNWR</b>	2013																									2	8%	
	2014																									0	0%	
	2015																									3	12%	
	2016																									0	0%	
	2017																									0	0%	
Reddish unknown Grass	2010																								1	4%		
	2011																									0	0%	
Unknown plant	2012																									2	8%	
	2013																									0	0%	
	2014			1																						1	4%	
Salt Marsh Fleabane ( <i>Pluchea purpur</i> )	2013																									12	48%	
	2014																									0	0%	
	2015																									5	20%	
	2016																									0	0%	
	2017																									0	0%	
Unknown herbaceous plant with Green berries	2015																									2	8%	
	2016																									0	0%	
	2017																									0	0%	
Polygonum sp. ("Bulgy Bamboo")	2015																									1	4%	
	2016																									0	0%	
	2017																									0	0%	
Saltmarsh Hay ( <i>Spartina patens</i> )	2013																									2	8%	
	2014																									0	0%	
Fleabane	2016																									4	16%	
	2017																									0	0%	

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25  
 upland end 1 METER SEGMENTS marsh end





		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
		1 METER SEGMENTS																									
		upland end																						marsh end			
Marsh Elder <i>Iva frutescens</i>	2001	1																									
	2002																										
	2003																										
	2004																										
	2005																										
Sea Milkwort <i>Glaux maritima</i>	2001				1																						
	2002																										
	2003																										
Seaside Plantain <i>Plantago maritima</i> "Longneck"	2001																										
	2002																										
	2003																										
Wrack	2001	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	2002	1																									
	2009	1		1																							
	2010																										
	2011																										
	2012																										
	2013																										
	2014																										
	2015	1	1	1	1	1	1	1																			
	2016	1	1																								
2017																											

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PRNWR T2