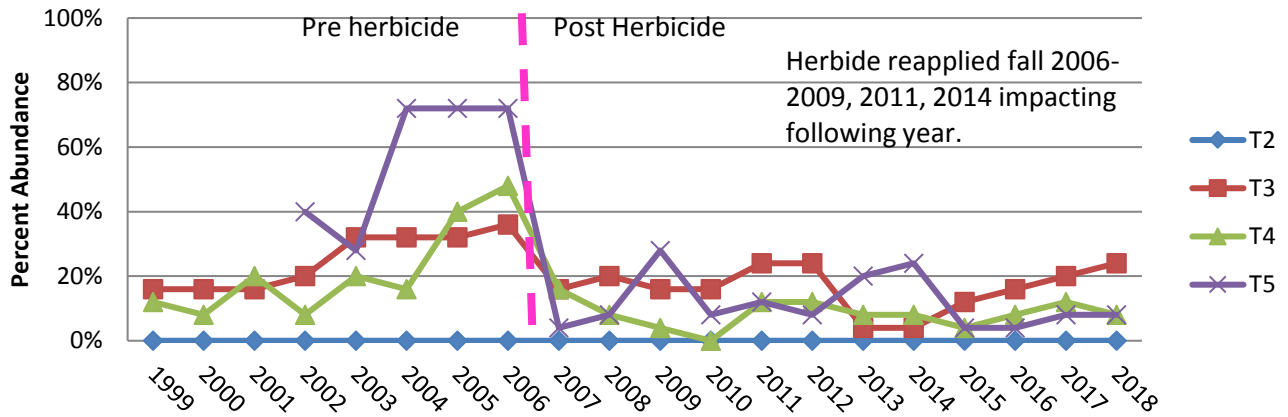
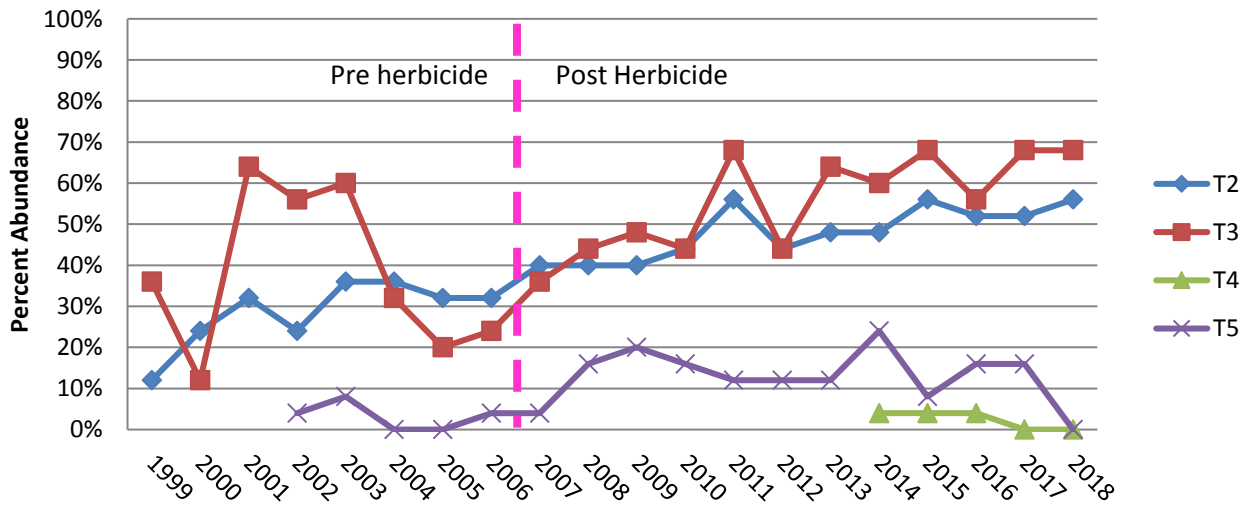


Phragmites at Joppa Flats

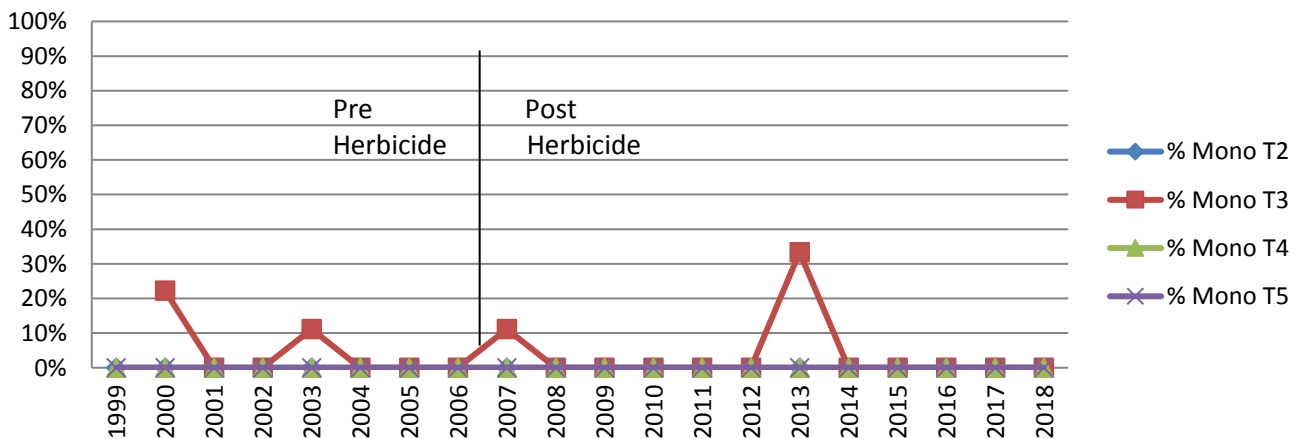


Herbicide used to control *Phragmites* reapplied fall 2006-2009, 2011 impacting following year. (Did not impact Cattail)

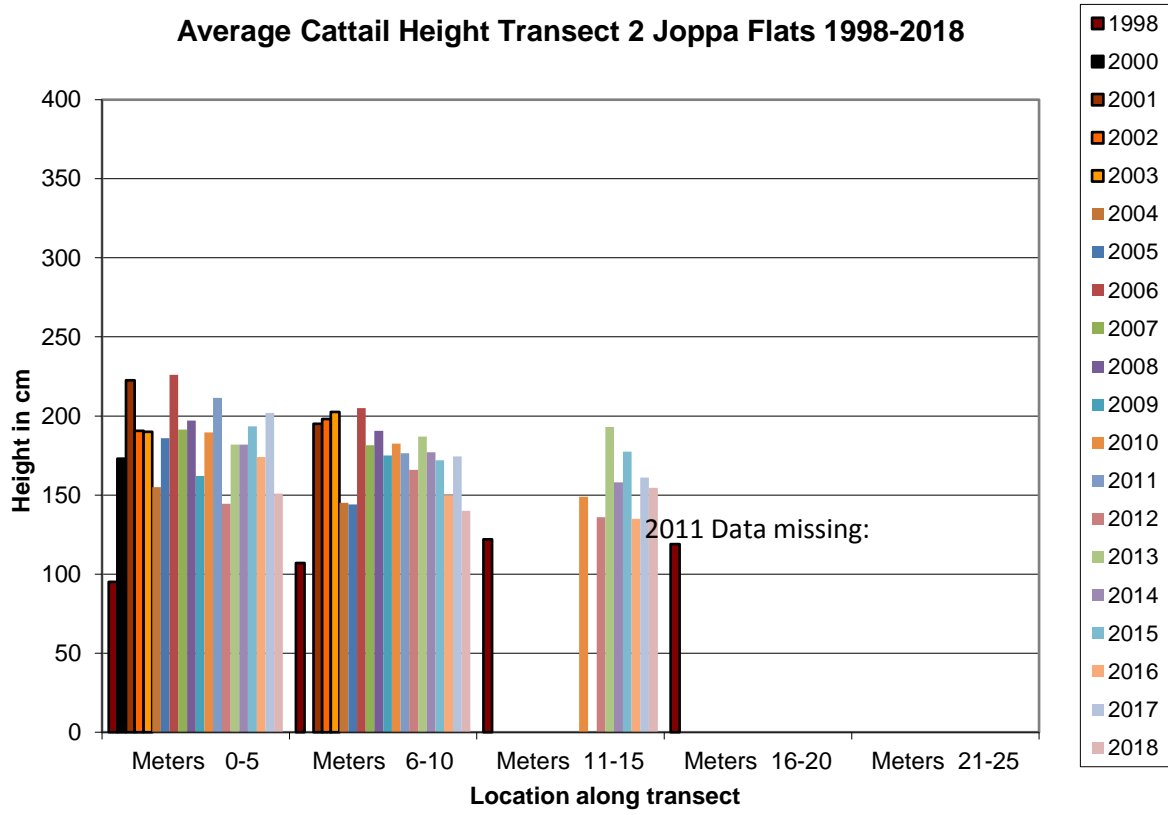
Cattail at Joppa Flats



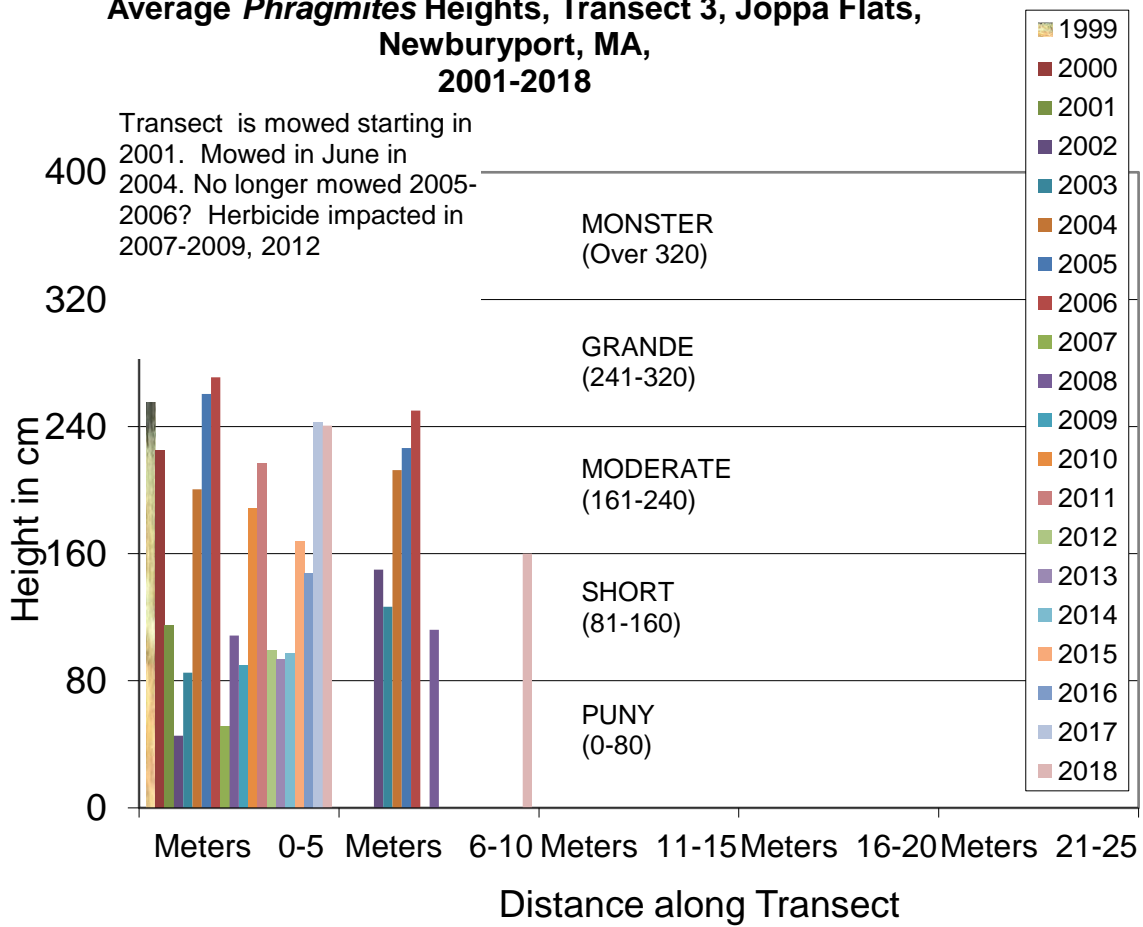
% Phragmites Monoculture Joppa Flats



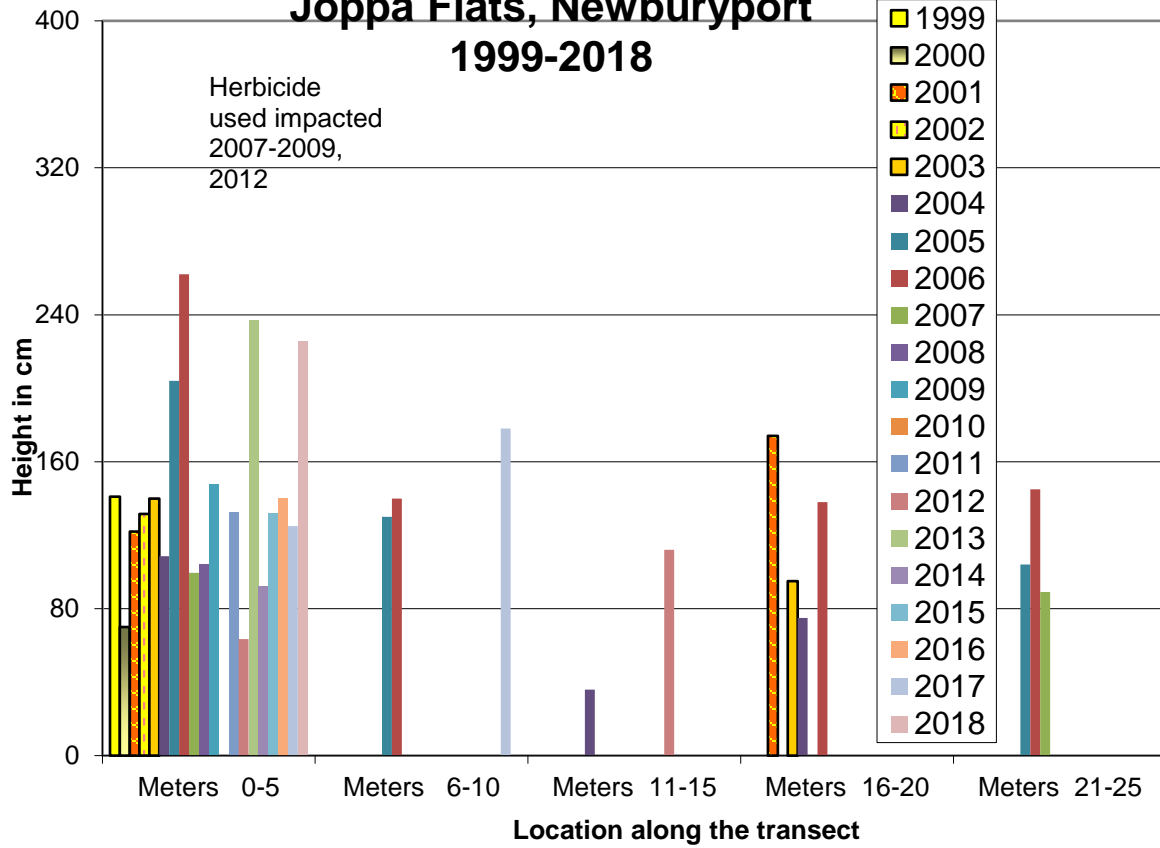
Average Cattail Height Transect 2 Joppa Flats 1998-2018



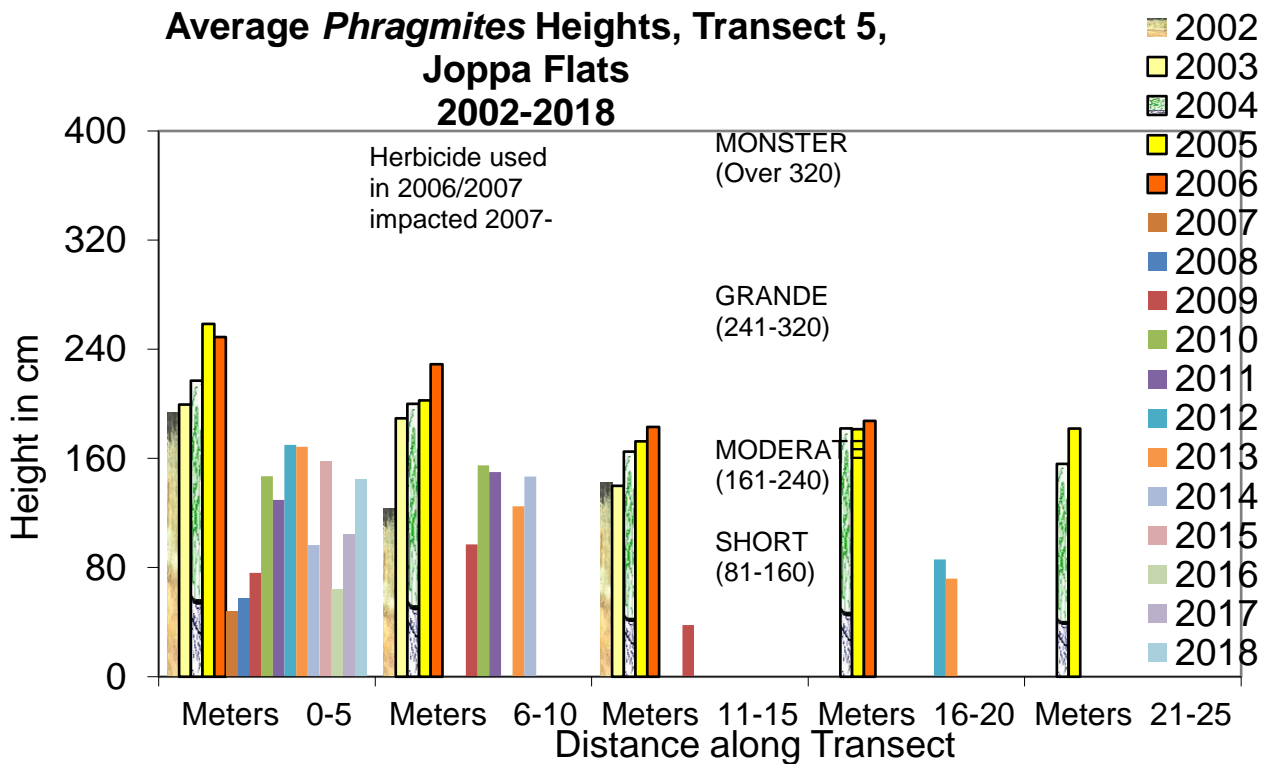
Average *Phragmites* Heights, Transect 3, Joppa Flats, Newburyport, MA, 2001-2018



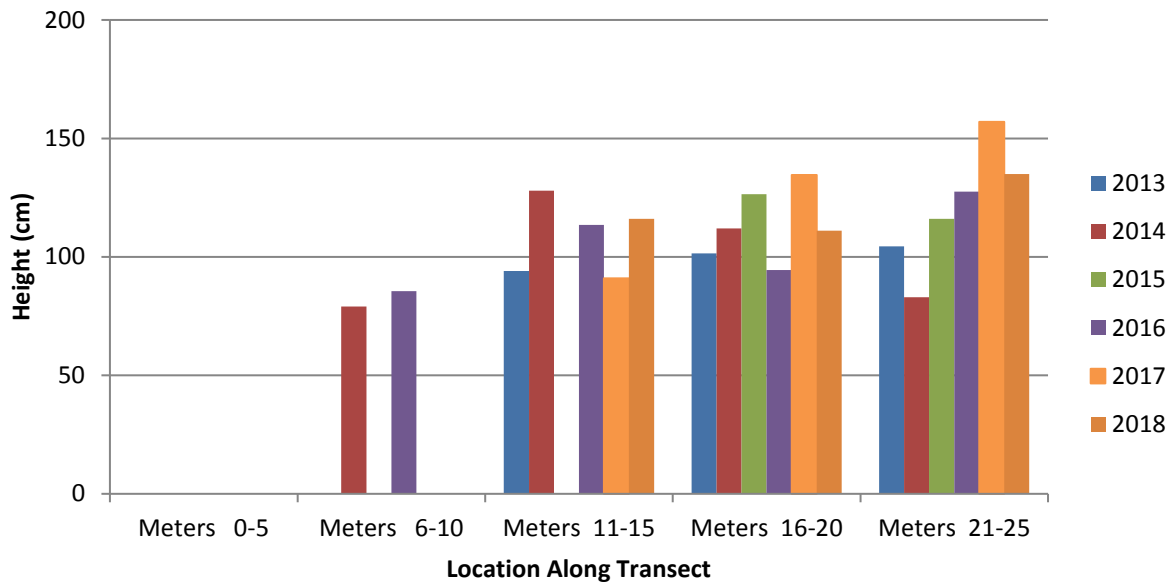
Average *Phragmites* Heights, Transect 4, Joppa Flats, Newburyport 1999-2018



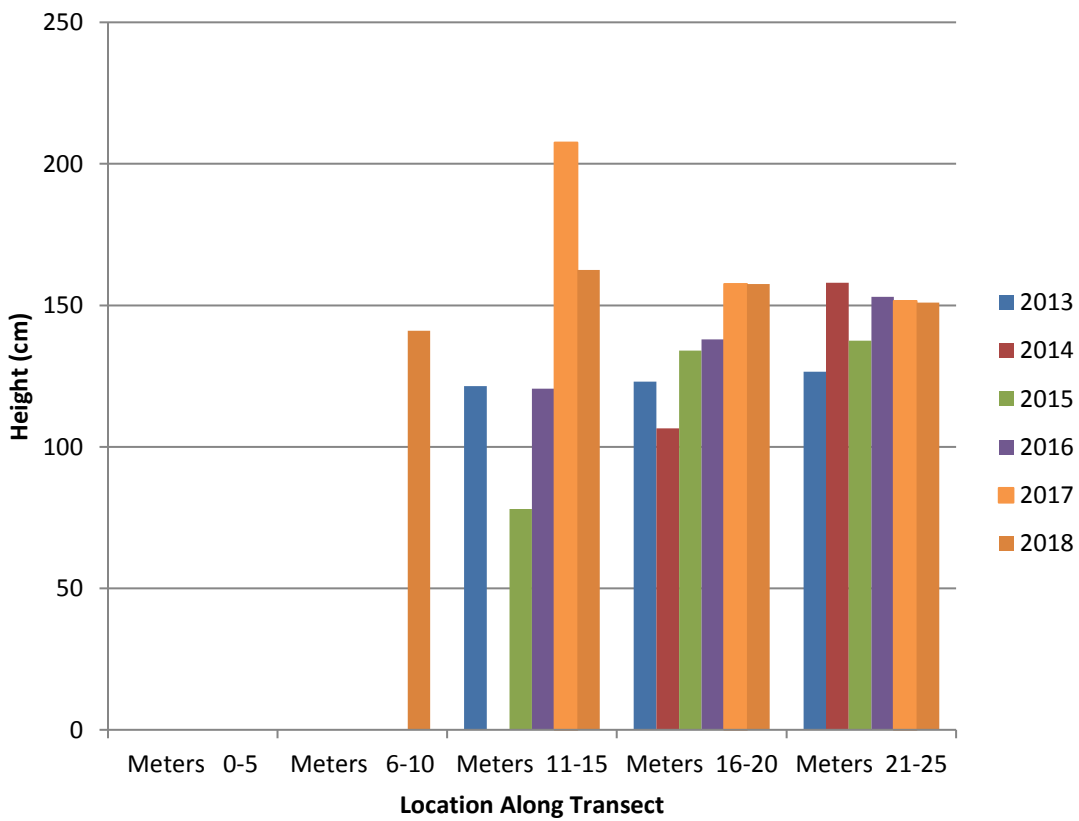
Average *Phragmites* Heights, Transect 5, Joppa Flats 2002-2018



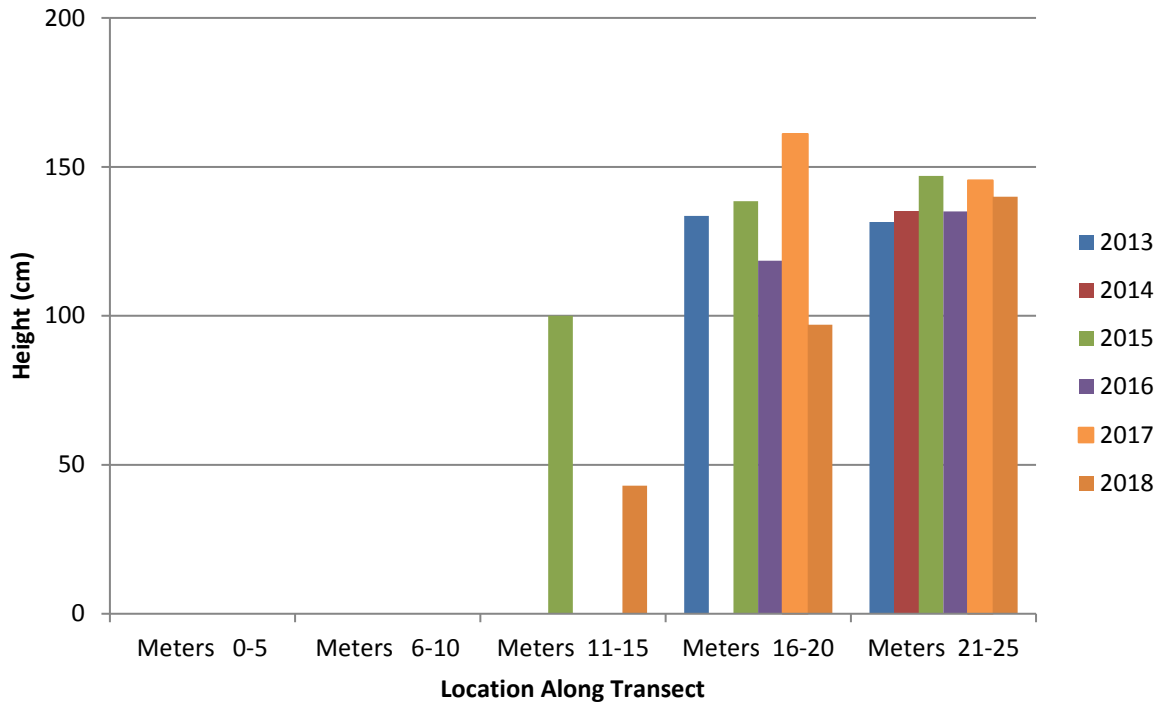
Saltmarsh Cordgrass Heights Joppa Flats Transect 2



Saltmarsh Cordgrass Heights Joppa Flats Transect 3



Saltmarsh Cordgrass Heights Joppa Flats Transect 5



Transect 2 (Near house on stilts)

Observers

2013 Duff & Nock
 2014 Duff & Nock
 2015 Duff & Nock
 2016 Duff & Nock
 2017 Duff & Nock
 2018 Duff & Nock

Peat over sandy soil

2003 Duff
 2004 Munson, Halloran, gr 8
 2005 Halloran
 2006-2010 Duff & Nock
 2011 Halloran & Nock
 2012 Lockwood & Nock, Duff

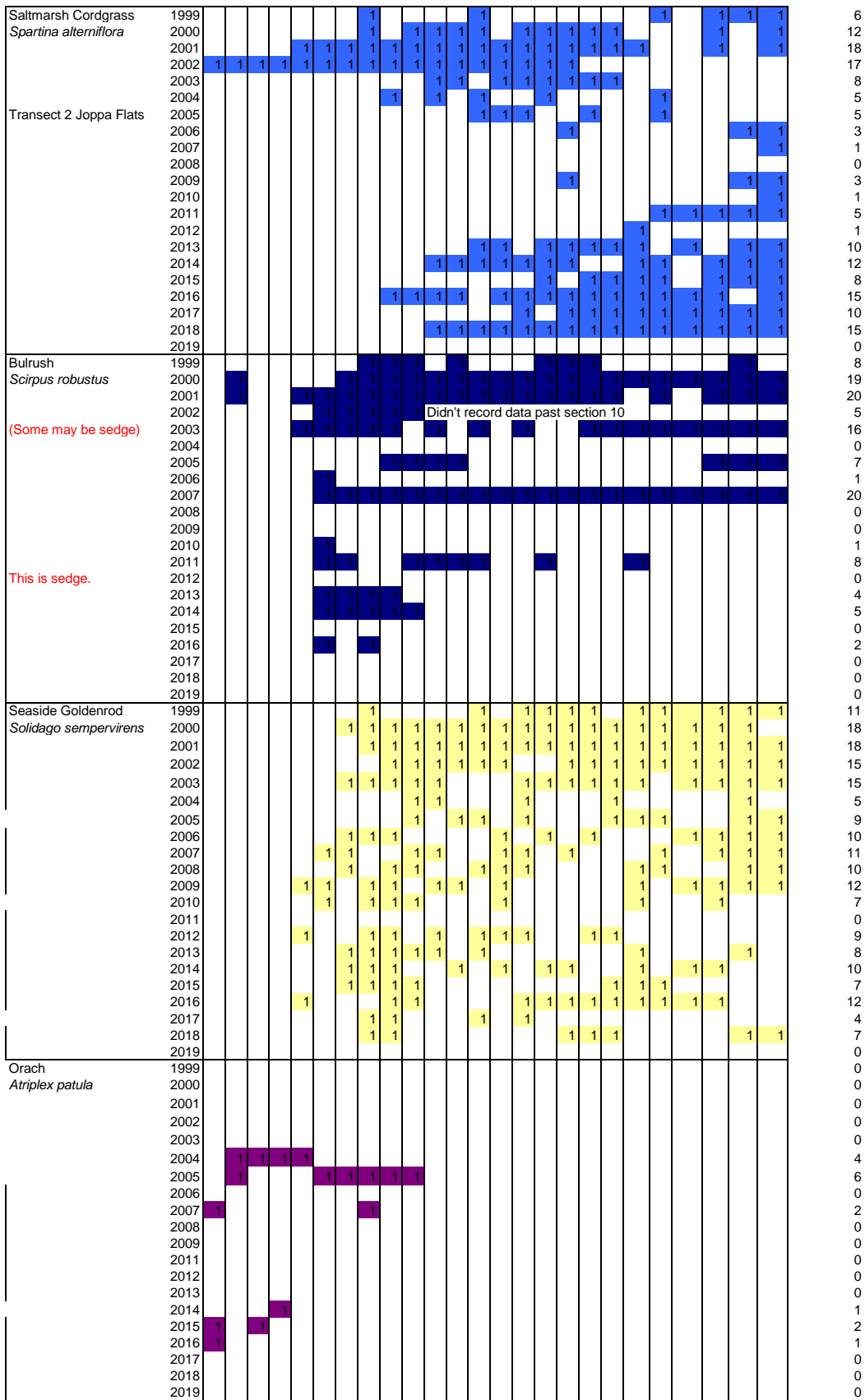
SPECIES

12 species

1 METER SEGMENTS

of intervals present

Year	upland end																									marsh end	# of intervals present
	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		
Cattail <i>Typha angustifolia</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	1	3	
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	8	
Maturity not recorded	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	10	
Black Grass <i>Juncus gerardii</i>																										0	
																										0	
																										16	
																										0	
																										18	
																										7	
																										0	
																										3	
																										2	
																										8	
																										2	
																										15	
																										0	
																										0	
																										20	
																										13	
																										5	
																										1	
																										4	
																										5	
																										0	
Creeping Bent Grass <i>Agrostis stolonifera</i>																										20	
																										18	
																										18	
																										19	
																										18	
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Saltmarsh Hay <i>Spartina patens</i>																										17	
																										7	
																										17	
																										4	
																										16	
																										16	
																										6	
																										17	
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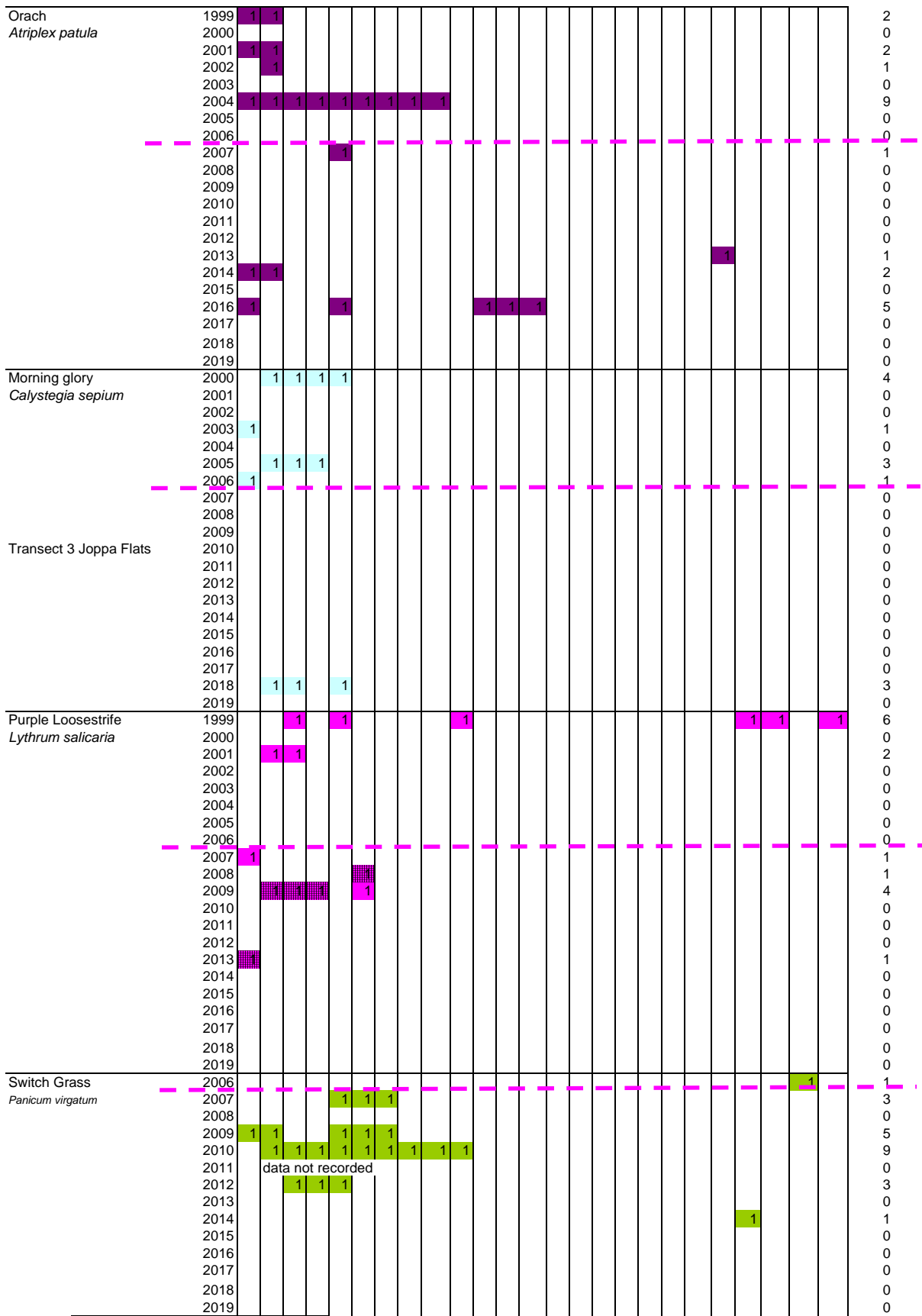


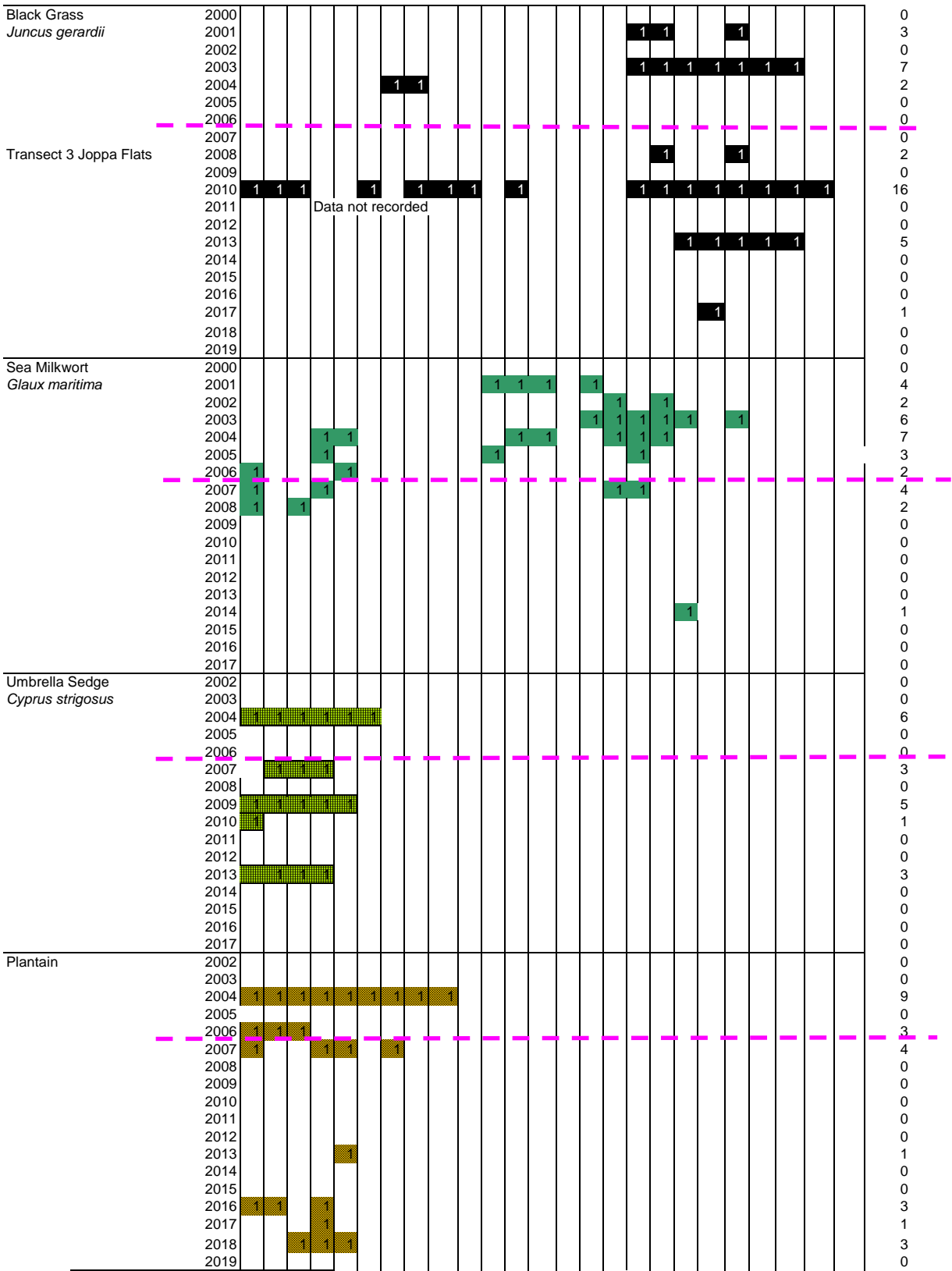
Fresh Water Cordgrass <i>Spartina pectinata</i>	1999																			0	
	2000																			0	
	2001			1	1	1			1											4	
	2002			1			1									1	1			4	
	2003																			0	
	2004																			0	
	2005									1										1	
	2006									1	1	1	1	1	1	1	1			7	
	2007													1						2	
	2008				1					1	1	1	1	1	1	1	1	1	1	12	
	2009				1	1	1			1		1		1	1	1	1	1	1	11	
	2010				1	1				1	1	1		1	1	1			1	11	
	2011																			0	
	2012																		1	1	7
	2013				1					1	1	1		1	1	1			1		6
	2014																				0
	2015				1	1	1	1	1	1	1	1	1	1	1					1	10
	2016														1	1	1	1	1	1	5
	2017										1		1								2
2018									1											1	
2019																				0	
Aster <i>Aster sp.</i>	1999																			0	
	2000																			2	
	2001																			1	
	2002																			0	
	2003																			1	
	2004																			4	
	2005																			0	
	2006																			6	
	2007																			2	
	2008																			10	
	2009																			11	
	2010																			2	
	2011																			13	
	2012																			0	
	2013																			7	
	2014																			4	
	2015																			13	
	2016																			8	
	2017																			0	
2018																			3		
2019																			0		
Wrack	1999																			0	
	2000																			0	
	2001																			5	
	2002																			0	
	2003																			0	
	2004																			0	
	2005																			14	
	2006																			3	
	2007																			3	
	2008																			7	
	2009																			18	
	2010																			1	
	2011																			0	
	2012																			6	
	2013																			0	
	2014																			6	
	2015																			0	
	2016																			5	
	2017																			7	
2018																			0		
2019																			0		
Switchgrass <i>Panicum virgatum</i>	1999																			0	
	2000																			0	
	2001																			7	
	2002																			0	
	2003																			0	
	2004																			0	
	2006																			0	
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	2017																			0	
	2018																			0	
2019																			0		

Baltic Rush <i>Juncus balticus</i>	2003							1													
	2004							1													
	2005																				
	2006																				
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2016											1	1	1								
2017																					
2018																					
2019																					
Seaside Arrow Grass <i>Triglochin maritima</i>	2001								1												
	2002								1												
	2003																				
	2004																				
	2005																				
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2015								1	1												
2016											1	1	1								
2017																					
2018																					
2019																					
Silverweed <i>Potentilla anserina</i>	2002									1	1	1	1	1							
	2003	None recorded																			
	2004																				
	Transect 2 Joppa Flats	2005																			
		2006											1	1							
		2007																			
		2008																			
		2009																			
		2010																			
2011																					
2012																					
2013																					
2014																					
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2016																					
Purple Loosestrife <i>Lythrum salicaria</i>	2003							1													
	2004																				
	2005																				
	2006																				
	2007						1	1													
	2008																				
	2009								1												
	2010									1						1					
	2011	1																			
	2012							1					1								
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	2015												1								
2016																					
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Fig.





Seaside Arrowgrass <i>Trigloclin maritima</i>	2002									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	2003																															
	2004																															
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	2007																															
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	2009																															
	2010		1																													
	2011																															
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	2016																															
	2017																															
	2018																															
	2019																															
	Smartweed <i>(Polygonum punctatum)</i>	2012		1	1																											
2013																																
Blackberry	2012		1																													
2013																																
2014																																
Mustard	2012		1																													
2013																																
2014																																
Baltic Rush	2010																															
2011																																
2012																																
2013																																
Wrack	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	1	1	1		
2005			1	1	1	1																										
2006																																
2007																																
2008																																
2009																																
2010																																
Transect 3 Joppa Flats	2011																															
2012			1	1																												
2013																																
2014			1	1	1																											
2015			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1															
2016																																
2017																																
Water Hemp <i>(Amaranthus cannabinus)</i>	2012																															
2013																																
2014																																
2015																																
2016																																
2017																																
2018																																
2019																																
Salt Marsh Fleabane <i>Pluchea purpurascens</i>	2010																															
2011																																
2012																																
2013			1		1	1																										
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2017																																
Vine	2014																															
2015																																
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2017																																
Glasswort <i>Salicornia europaea</i>	2016																															
2017																																
Marsh Elder <i>Iva frutescens</i>	2016																															
2017																																

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Location: Joppa Flats, Newburyport
Transect 3 (near parkinglot)

upland end 1 METER SEGMENTS marsh end

Mass Audubon Salt Marsh Science Project **Transect 4 (Near Doughnut Hole Panne)**

Long Range Phragmites Study

Observers

Location: Joppa Flats, Newburyport 1999-2011 Duff & Nock 2013 Duff & Nock 2016 Duff & Nock
 Sandy soil under peat 2011 Halloran & Nock 2014 Duff, & Nock 2017 Duff & Nock
 2012 Lockwood & Nock 2015 Duff & Nock 2018 Duff & Nock

SPECIES

12 species present

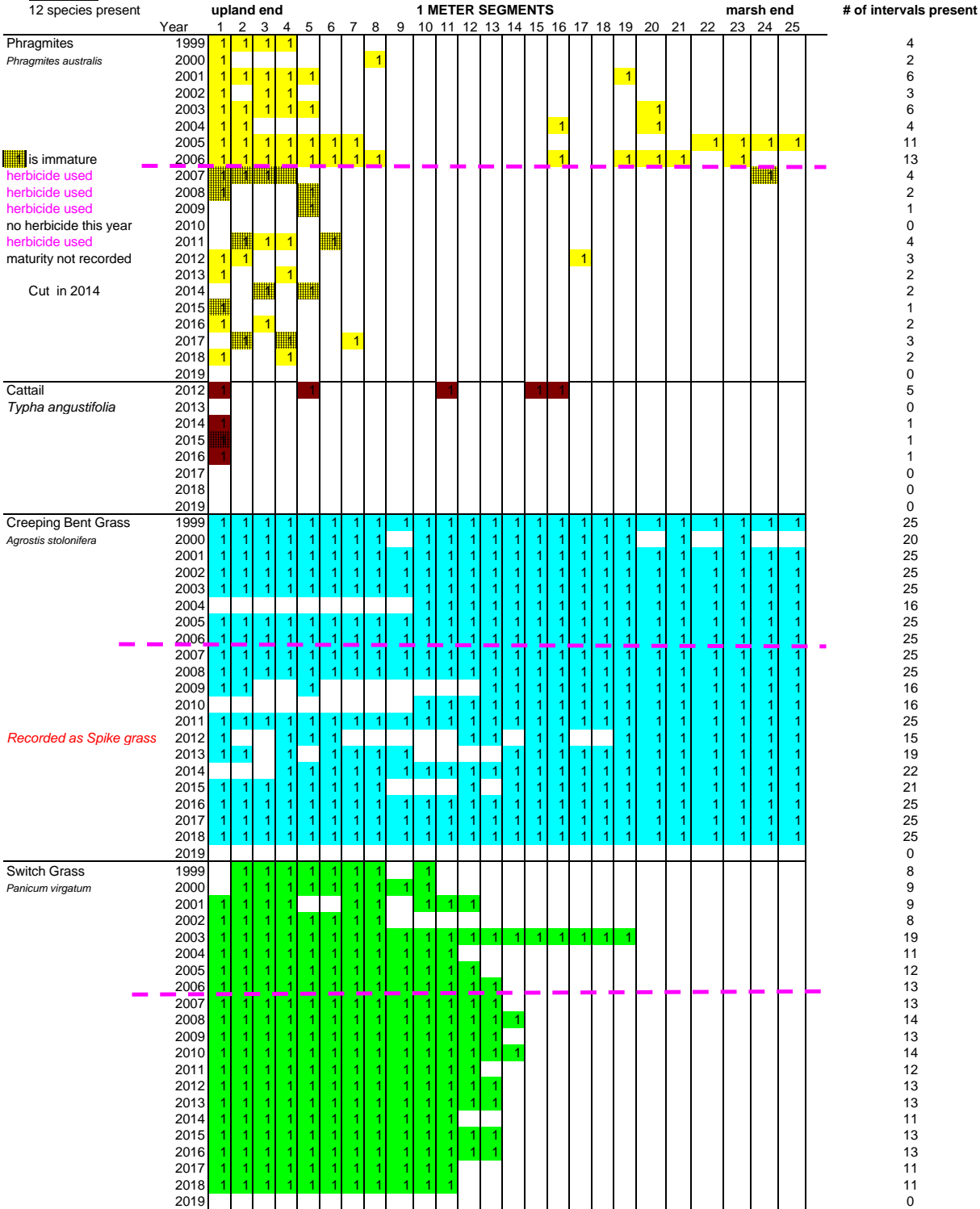
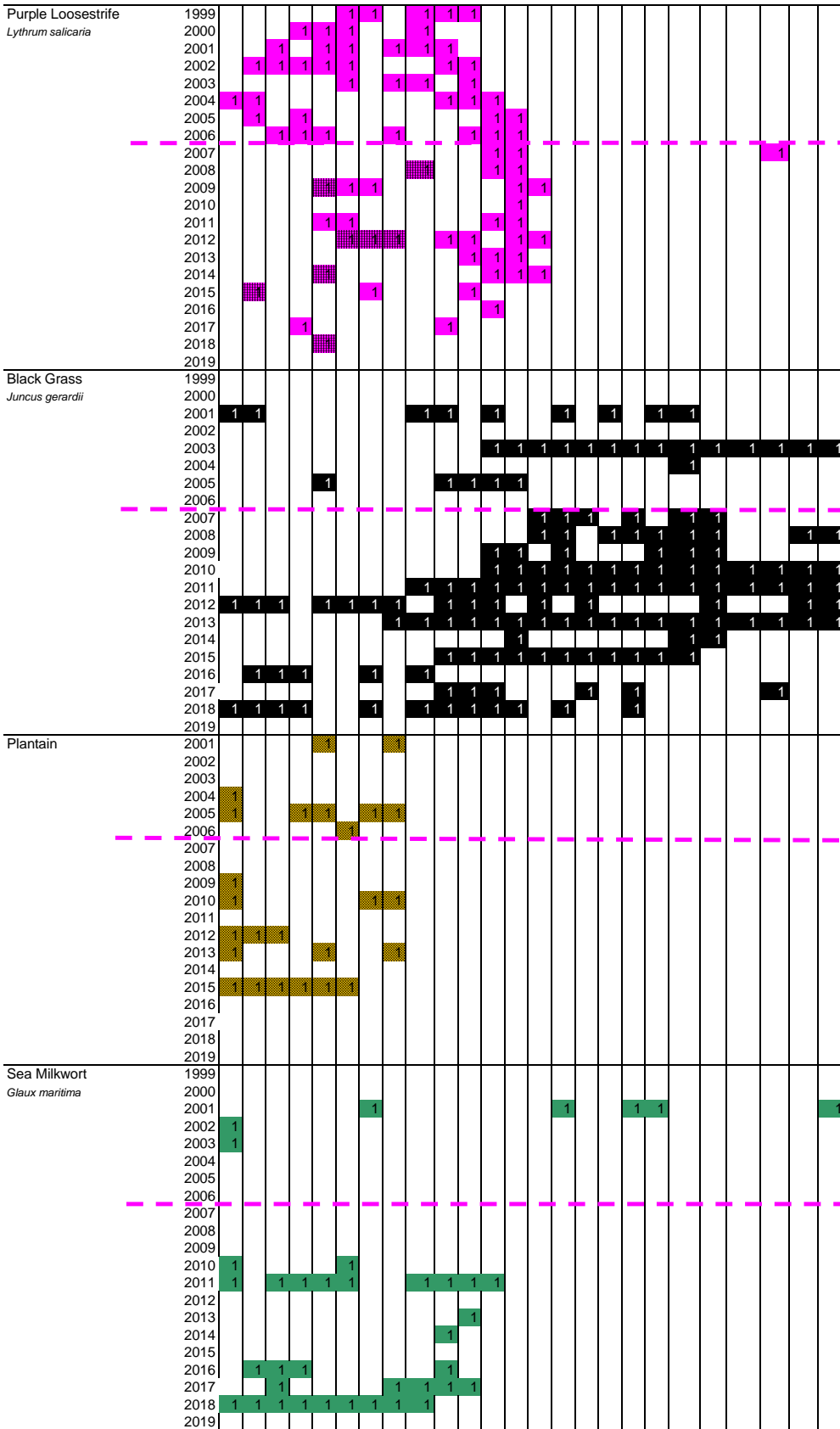


Fig.

Freshwater Cordgrass	
<i>Spartina pectinata</i>	
1999	
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Goldenrod	
<i>Solidago sempervirens</i>	
1999	
2000	1 1
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2005	1 1
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2008	1 1
2009	1 1
2010	1 1
2011	1 1
2012	1 1
2013	1 1
2014	1 1
2015	1 1
2016	1 1
2017	1 1
2018	1 1
2019	
Fescue	
<i>Festuca rubra</i>	
1999	
2000	
2005	
Salt Marsh Cordgrass	
<i>Spartina alterniflora</i>	
1999	1
2000	1 1
2001	1 1
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2004	1
2005	none recorded
2006	
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2010	1
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Aster	
<i>Aster subulatus</i>	
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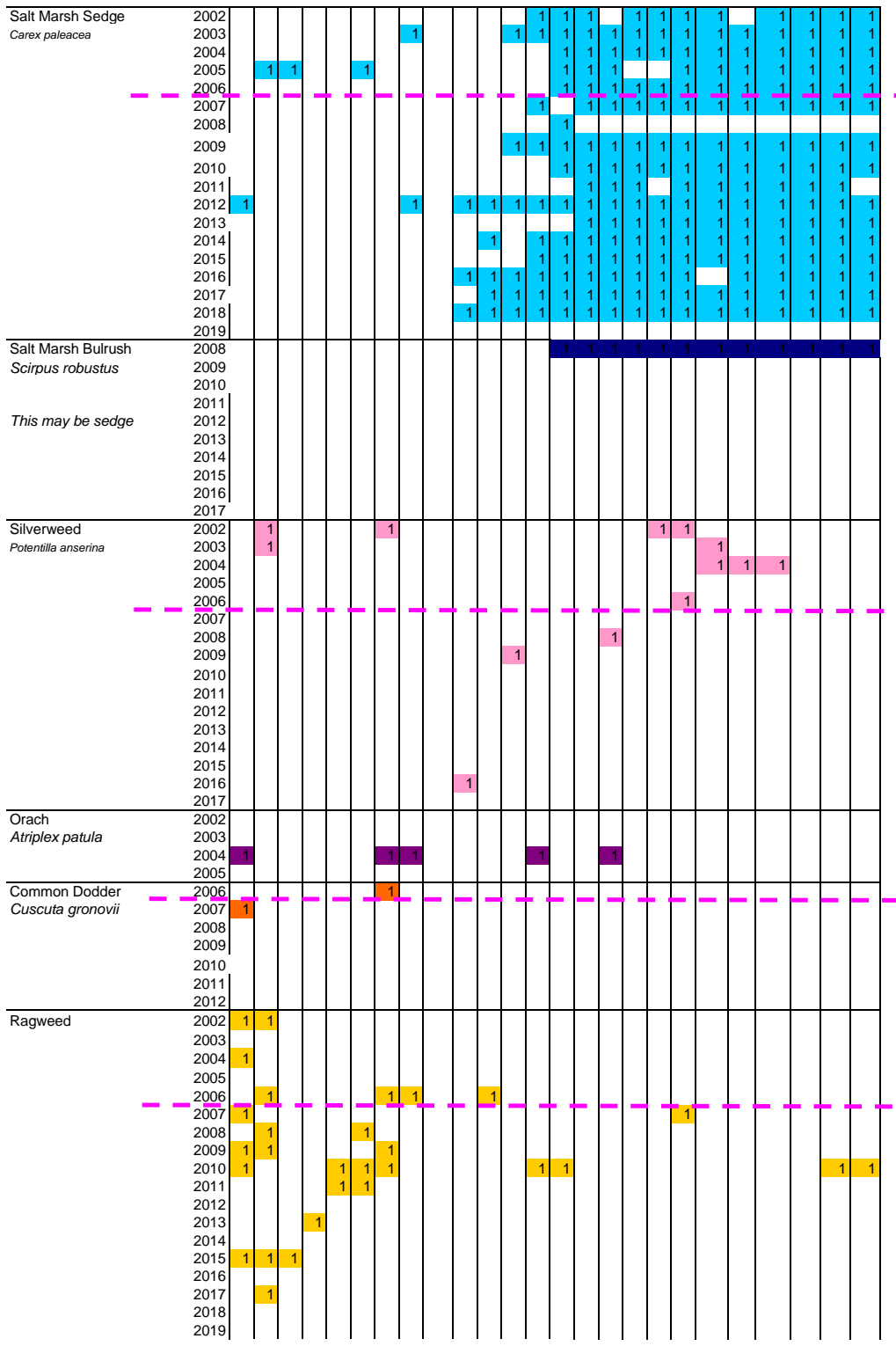
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Fig.



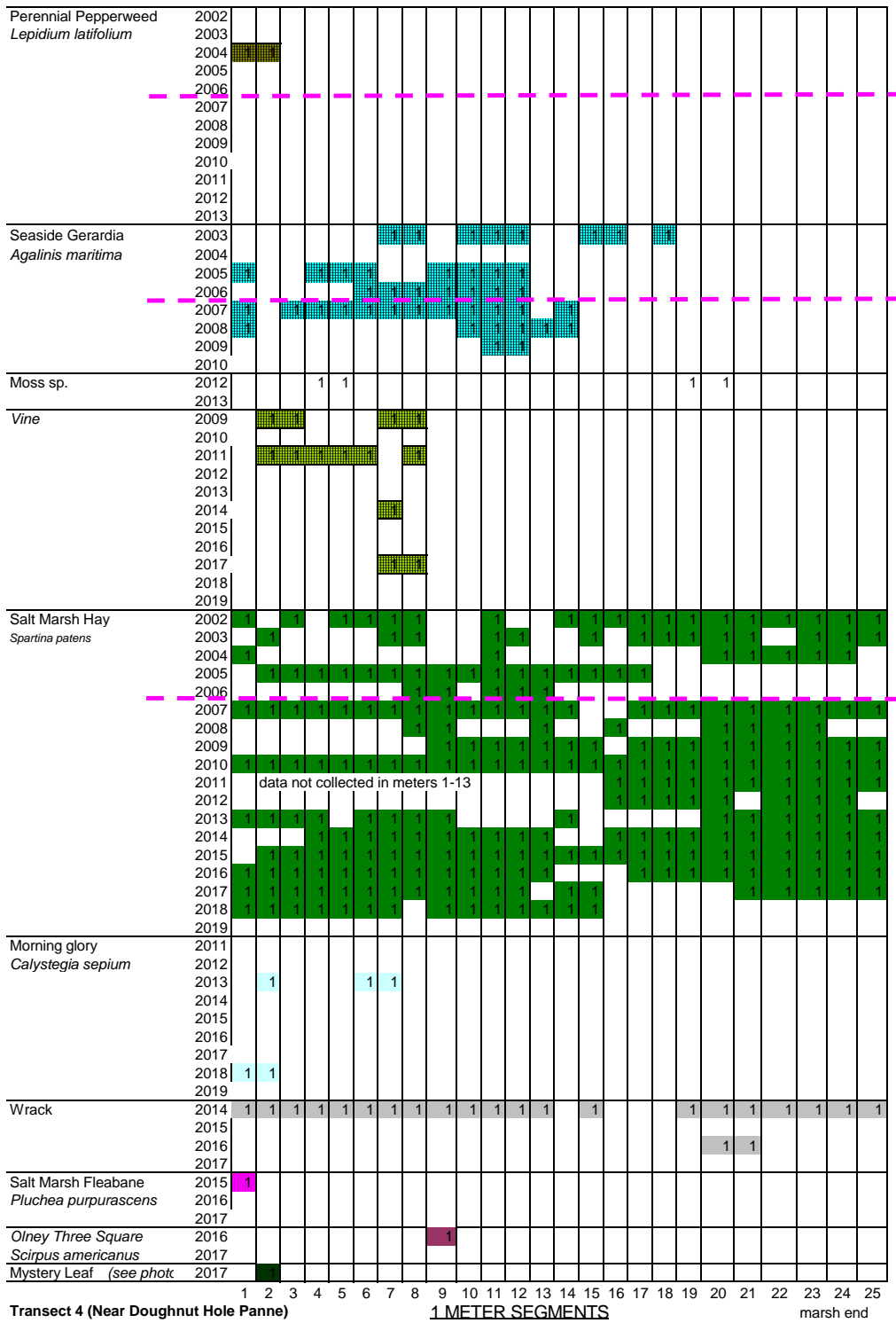
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Fig.



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Transect 4 (Near Doughnut Hole Panne) 1 METER SEGMENTS marsh end
Joppa Flats, Newburyport, MA

Mass Audubon Salt Marsh Science Project

Transect 5 Joppa Flats

Long Range Phragmites Study

Observers and dates

2012 Lockwood & Buchsbaum

Location: Joppa Flats, Newburyport

2002 Duff/Kagle

2013 Duff & Nock

2017 Duff & Nock

N 42° 47.989'

2003 4/21/2004 for Fall 2003, Duff, Latham & Magnuson

2014 Duff & Nock

2018 Duff & Nock

W 070° 50.824'

2005 Duff -2010 Duff and Nock

2015 Duff & Nock

Sandy soil under peat

2011 Halloran & Nock

2016 Duff & Nock

SPECIES

upland end

1 METER SEGMENTS

marsh end

of intervals 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
Phragmites	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
<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
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
herbicide used																									
herbicide used																									
herbicide used																									
no herbicide this year																									
herbicide used																									
Cut																									
Cattail																									
<i>Typha angustifolia</i>																									
Creeping Bent Grass	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
<i>Agrostis stolonifera</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	1

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Common Dodder <i>Cuscuta gronovii</i>	2008	1																						
	2009																							
	2009																							
	2010																							
Mystery Globe Plant	2008																							
	2009																							
	2010																							
Tall Dead, Flowering & woody	2002																							
	2003					1	1	1	1				1	1	1	1	1							
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Switchgrass <i>Panicum virgatum</i>	2009					1	1																	
	2010	1	1	1	1	1	1	1																
	2011																							
	2012																							
	2013																							
Wrack <i>Panicum virgatum</i>	2009											1	1	1	1	1		1			1	1		
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	2011																							
Transect 5 Joppa Flats	2012																							
	2013															1	1	1	1					
	2014																							
	2015																							
	2016											1	1	1				1	1		1	1	1	
	2017							1	1	1	1	1	1	1	1									
	2018							1	1	1	1	1	1				1							
	2019																							
Olney Three Square <i>Scirpus americanus</i>	2009														1	1				1				
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Umbrella Sedge <i>Cyperus strigosus</i>	2015																							
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Vine	2005																							
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Baltic Rush <i>Juncus balticus</i>	2016	1	1	1																				
	2017																							
Orach <i>Atriplex patula</i>	2016																							
	2017																							

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upland 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 marsh end
1 METER SEGMENTS
Location: Joppa Flats, Newburyport Transect 3 (near parkinglot)