An aerial photograph showing a complex network of waterways and marshland. A main river channel flows from the top left towards the bottom right, branching into several smaller channels that meander through a dense forest of trees. The marshland is characterized by dark, saturated soil and patches of green vegetation. A multi-lane highway with several cars is visible, running parallel to the river system. The overall scene depicts a natural landscape with significant human infrastructure.

Dispersal Potential of a Tidal River: Colonization of a Created Tidal Freshwater Marsh on the Delaware River, USA

Mary Alessio Leck, Rider University
Lawrenceville, NJ, USA
leck@rider.edu

Trenton, NJ

Abbott Marshlands

Roebling Park

Mercer County Nature and Interpretive Center

NYC
93 km

RM

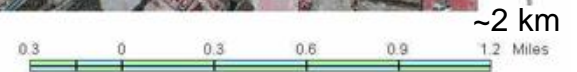
CW

Delaware River

Creek

Crosswicks

Philadelphia
47 km



**Construction 1993-94
CREATED WETLAND
1994**

Delaware River

NM

EM

I-295

SM





6 May '95

East Marsh

15 Aug '95





6 May '95

North Marsh

15 Aug. '95





6 May '95

South Marsh

Late June '95



Design

- ✧ Three sites – NM, EM, SM
- ✧ Three locations along transects
 - channel edge (ch)
 - mid point (mi)
 - upland edge (up)

Seed bank: 1995 - 1999 & 2011
(10x10x3 cm)

Vegetation: 1995 - 2011 (14 yrs)
(50x50 cm)

Topics

1. Diversity - overview
Seed bank & vegetation
2. Dispersal
3. Changes 1995-99 to 2011
4. Persistence
5. Invasive plant species
6. Conclusions

Diversity

	1995-99	2011
Seed Bank		
Total species	177 [69-111]*	62
Max. richness (x ± SE)	32.3 ± 1.8	12 ± 1.1

Vegetation

Total species	92 [33-48]*	31
Max. richness (x ± SE)	9.4 ± 0.8	6.1 ± 0.7

[]* yearly range

Asteraceae, Cyperaceae, Poaceae

Species of Note (% of total)

	CW	
	95-99	2011
Nonnative		
Seed Bank	13	17
Vegetation	12	10
Rare for NJ		
Seed Bank	3 (4.5*)	(3.2*)
Vegetation	16	5.7

(*did not flower)

NJ State Rare Species (entire CW)

- Limited duration, e.g.,
Elatine americana
G4, S2
Isoetes riparia (1994)
G4, S3
- Continuing presence, e.g.,
Heteranthera multiflora
G4, S3
Mimulus alatus
G5, S3



Dispersal

Sources of propagules:

➤ Two watersheds

Delaware River, ~ 322 km

Crosswicks Creek, ~ 37 km

➤ Lateral tidal movement –
as much as 16.7 km

- Six new seed bank species in 2011
- No preexisting wetland seed bank
- Planted - 14 species



Dispersal



Hydrochory

Seed Bank & Vegetation Changes

Sites:

NM, EM, SM: **mi

Locations:

ch, mi, up: **SM

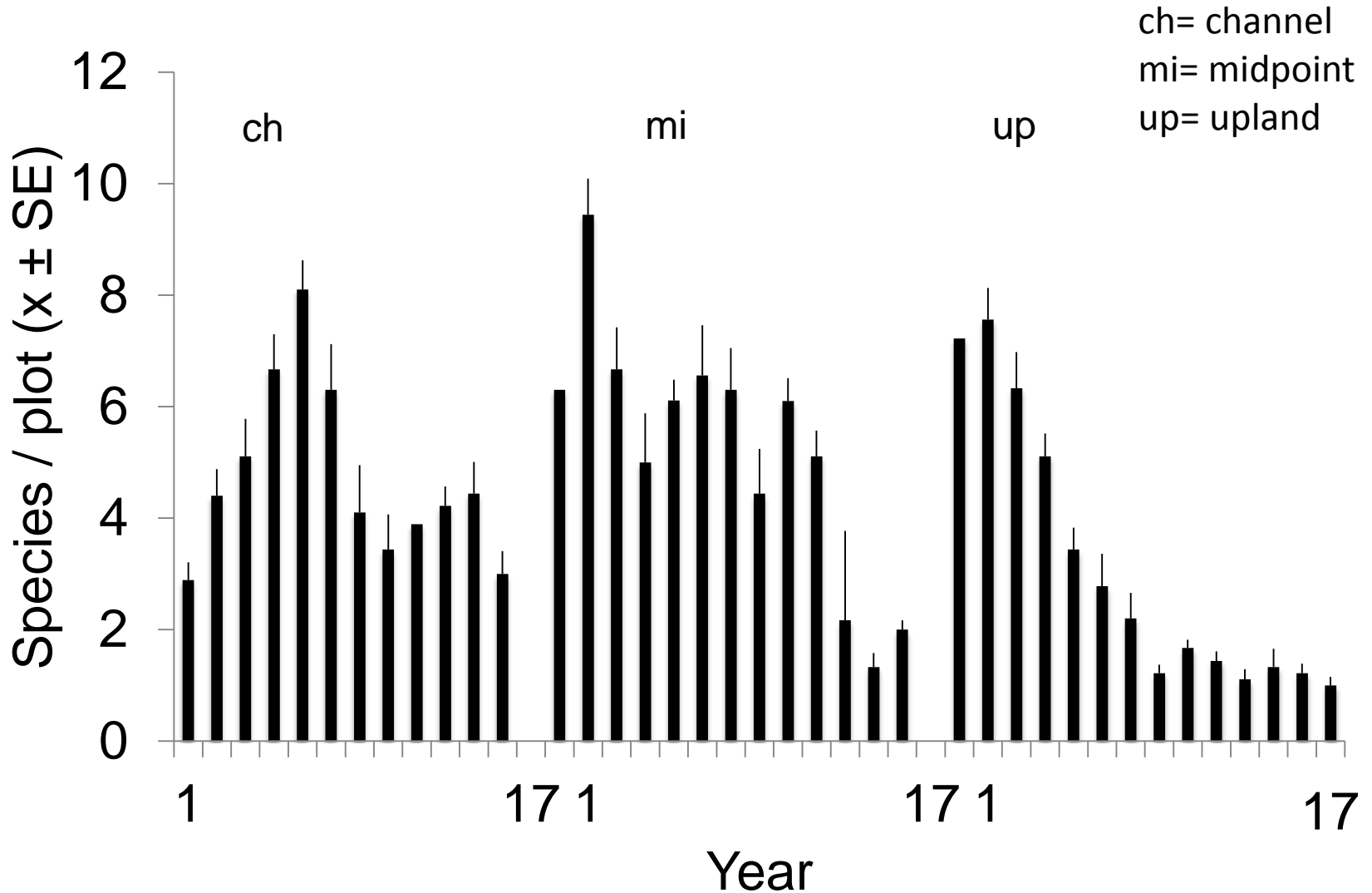
Sites: Seed Bank (mi)

	1999	2011	% (<)
NM			
Total species	39	25	38
Species (x ± SE)	17 ± 2	11 ± 1	37
Density/ m ² (x ± SE)	247,680 ± 85,870	41,450 ± 7,380	83
EM			
Total species	51	23	53
Species (x ± SE)	23 ± 2	12 ± 1	49
Density/ m ² (x ± SE)	201,490 ± 34,735	63,383 ± 4,797	68
SM			
Total species	46	14	63
Species (x ± SE)	24 ± 2	8 ± 0.4	66
Density/ m ² (x ± SE)	394,600 ± 30,020	29,467 ± 4,807	93

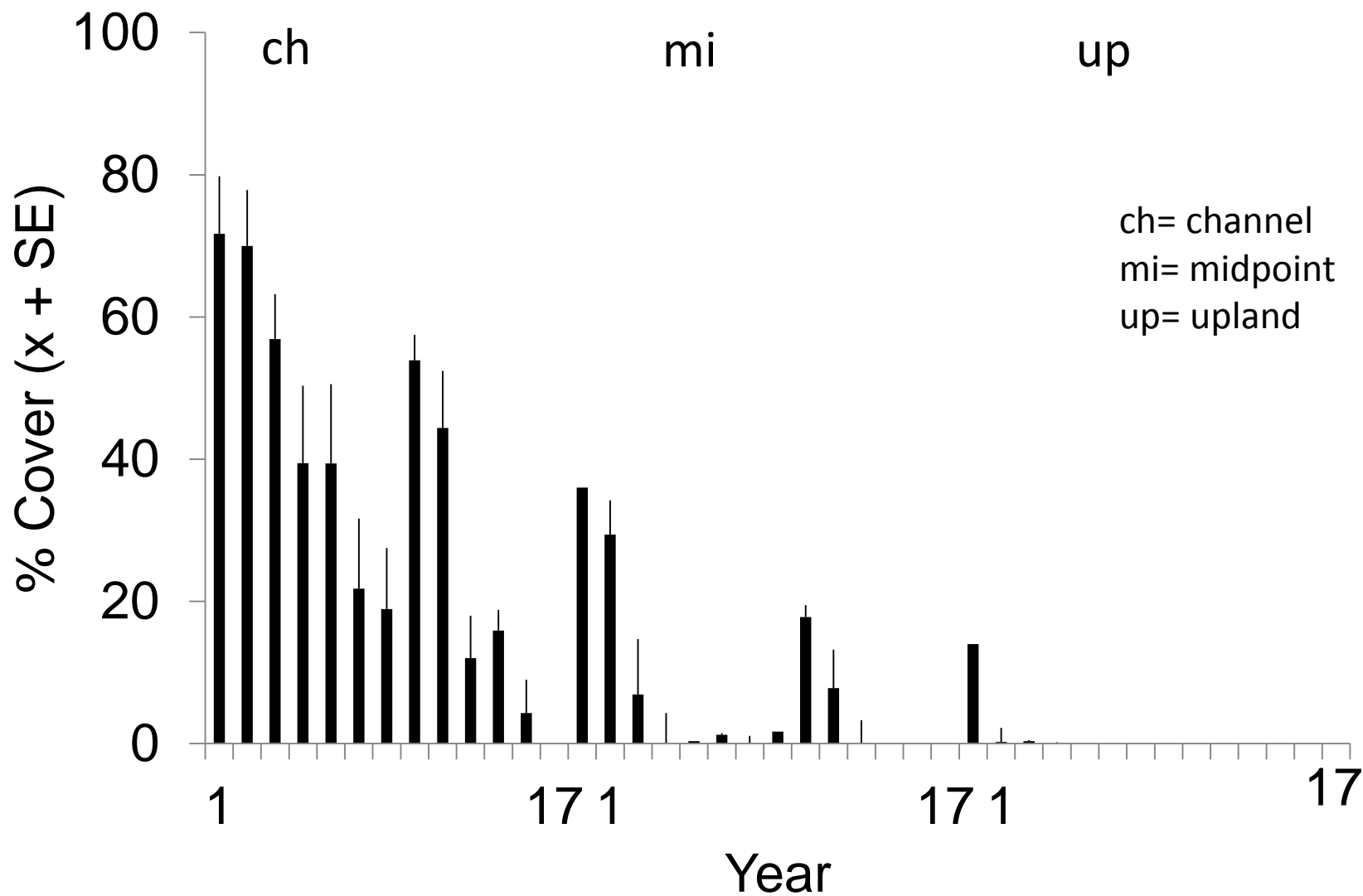
Sites: Vegetation (mi)

	1998	2011	%(<)
NM			
Total species	17	12	29
Species ($x \pm SE$)	6.8 ± 0.6	3.2 ± 0.7	53
EM			
Total species	21	4	81
Species ($x \pm SE$)	7.8 ± 0.6	2 ± 0.3	74
SM			
Total species	13	4	69
Species ($x \pm SE$)	5 ± 0.4	2 ± 0.2	60

Locations: Species Richness - Vegetation (SM)



Locations: Veg. (SM) *Polygonum punctatum*



Persistence: June - Seed Bank (mi) rank

1999

NM

1. *Lythrum salicaria*
2. *Ludwigia palustris* (4)*
3. *Lindernia dubia* (+)

EM

1. *Lythrum salicaria*
2. *Juncus effusus* (4)
3. *Ludwigia palustris* (6)

SM

1. *Lythrum salicaria*
2. *Ludwigia palustris* (4)
3. *Juncus acuminatus* (+)

2011

NM, EM, SM

1. *Lythrum salicaria*
2. *Mikania scandens*
3. *Phragmites australis*

()* Rank or presence in 2011
nearly all small seeded

**Persistence – *Juncus effusus*
Seed Bank (mi) (March density/ m² x ± SE)**

	1999	2011
NM	233 ± 117	17 ± 14
EM	9,486 ± 3,415	15,400 ± 3,078
SM	516 ± 354	0

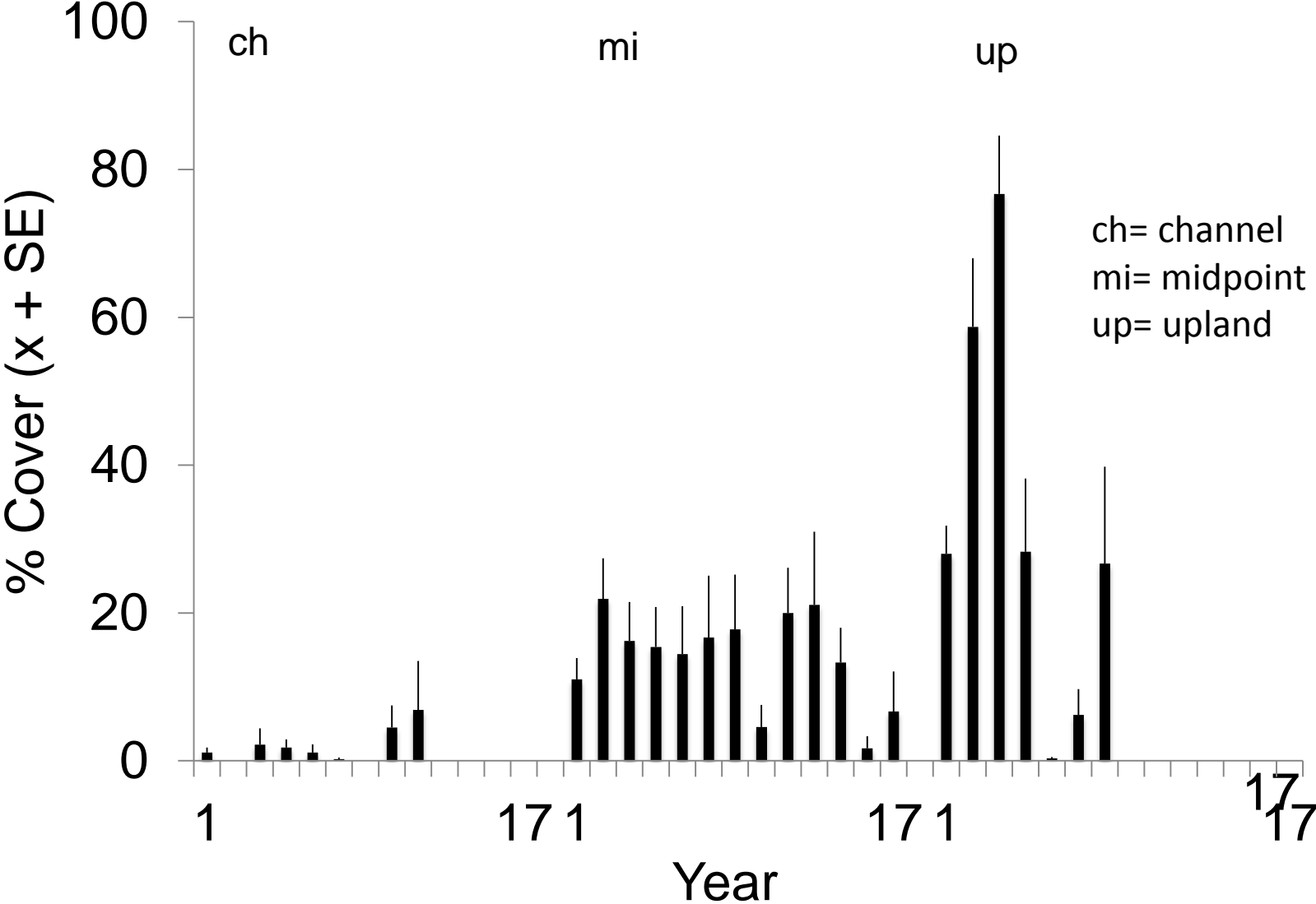
(Vegetation all plots: <3% FQ -1998-2001; 0% after 2001)

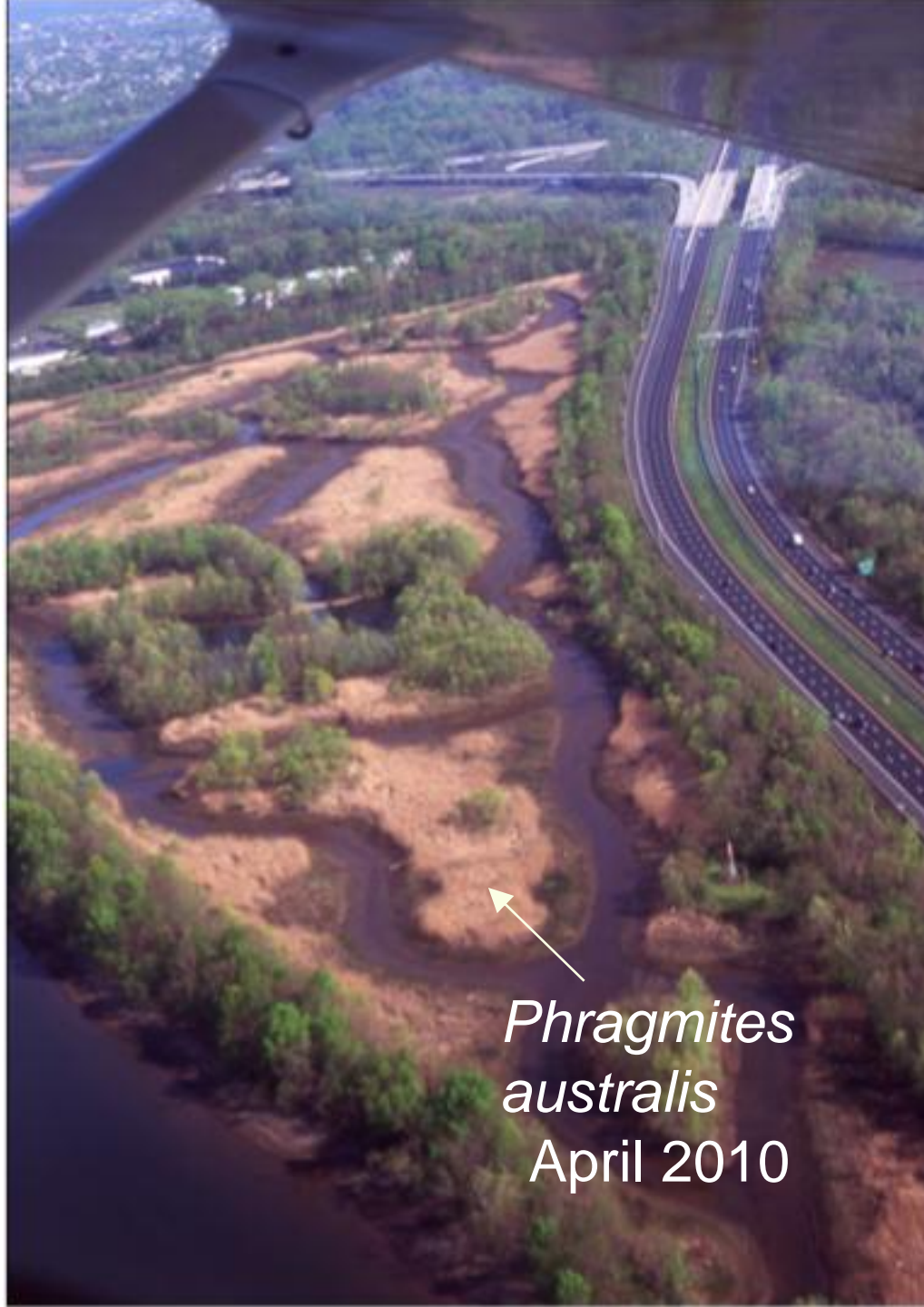
Invasive Species (max. density; FQ = % plots)

Species	1995-1999		2011	
	Seed Bank / m ²	Vegetation (FQ)	Seed Bank / m ²	Vegetation (FQ)
<i>Lythrum salicaria</i>	207,900 ± 30,760	89	29,280 ± 19,300	14*
<i>Phalaris arundinacea</i>	567 ± 454	47	0	3*
<i>Phragmites australis</i>	133 ± 133	28	10,380 ± 2,974	64

*NM

Locations: Veg. (SM) *Lythrum salicaria*





*Phragmites
australis*
April 2010

Factors Contributing to Diversity

- A. Effective dispersal –
 - seeds, seedlings, fragments
 - Varied dispersal modes
 - Tidal connectivity
- B. Habitat diversity: temporal, spatial
- C. Species attributes
 - Variable growth forms & tolerances
- D. Site features

Conclusions

1. Dispersal potential high, external input continuing impact of vegetation, sediment
2. Initial colonizers small seeded & with persistent seed banks
3. Species differed in persistence
4. Persistence differed in seed bank & vegetation
5. Invasive species of changing importance
6. *Phragmites australis*

Acknowledgements

Animals (birds, etc.),

Grasses: CF Leck

Field Work, Plant IDs,

Technical: colleagues,
students, friends & family

Support: Rider University

Grant: NJ Wetlands
Research Institute

Site access:

NJ Department
of Transportation



Lobelia cardinalis (EM 02)



Hydrochory



Anemochory



Zoochory



SM ch 2011