

Comparison of the Retention and Growth of Native Freshwater Mussels Reintroduced into Nine Streams of the Delaware Estuary, 2011-2014

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2015 Delaware Estuary Science & Environmental Summit

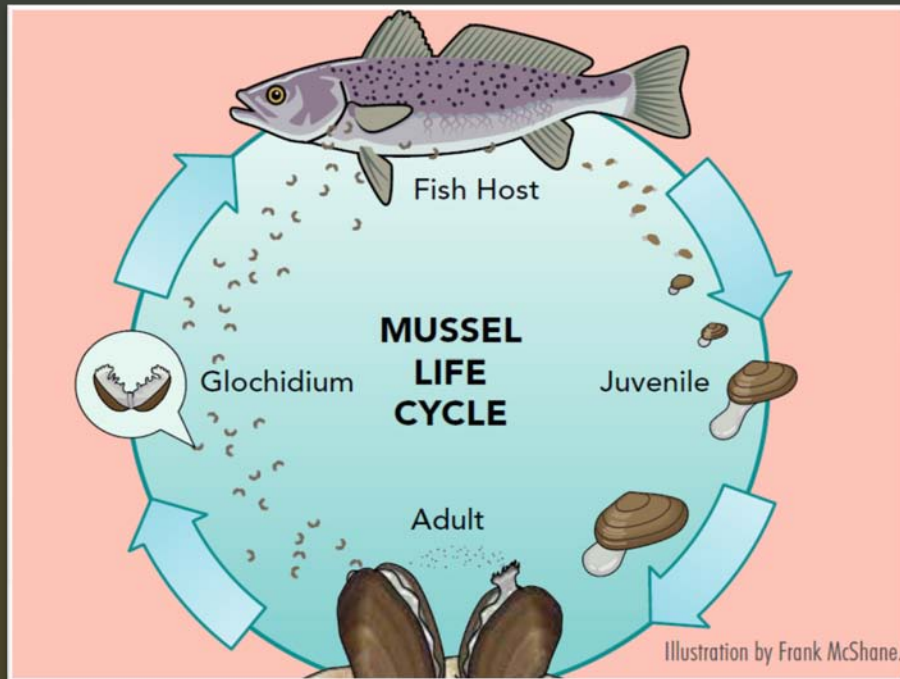
January 27th 2015

THE ACADEMY
OF NATURAL SCIENCES
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Freshwater Mussels

- Long life span
- Slow growth
- Sensitive to environmental stressors (e.g. flood disturbance)
- Complex life cycle



Freshwater Mussels

- Stabilize stream bed and enhance ecosystem complexity
- Particle filtration services via filter feeding
- North American biodiversity



...most imperiled taxa in North America!

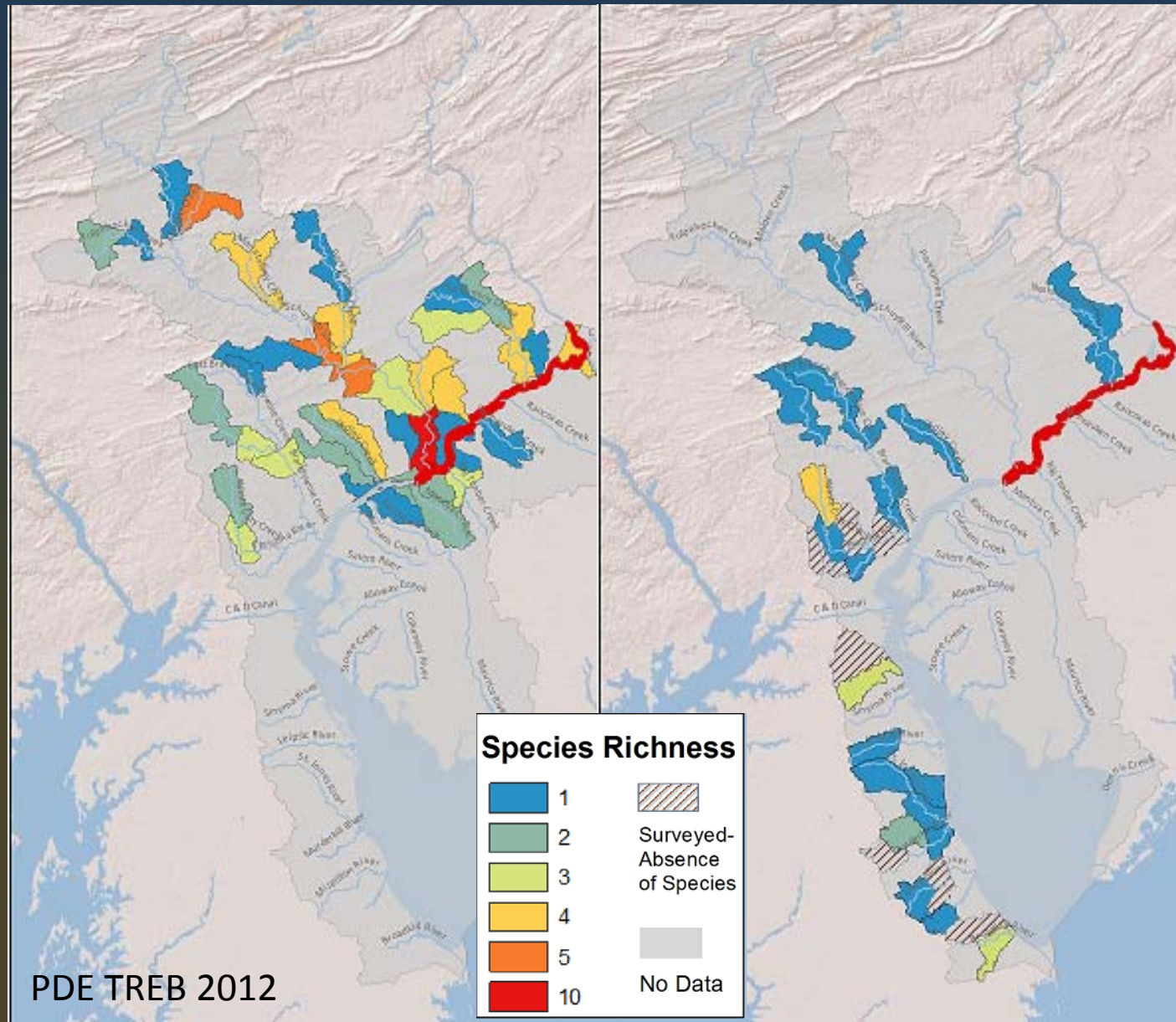
Mussels within Delaware River basin in poor status as well

State Status Listing of Freshwater Mussel Species				
		State Conservation Status		
Scientific Name	Common Name	DE	NJ	PA
<i>Alasmidonta heterodon</i>	Dwarf Wedgemussel	Endangered	Endangered	Critically Imperiled
<i>Alasmidonta undulata</i>	Triangle Floater	Extirpated?	Threatened	Vulnerable
<i>Alasmidonta varicosa</i>	Brook Floater	Endangered	Endangered	Critically Imperiled
<i>Anodonta implicata</i>	Alewife Floater	Extremely Rare	no data	Extirpated?
<i>Elliptio complanata</i>	Eastern Elliptio	Common	Common	Apparently Secure
<i>Lampsilis cariosa</i>	Yellow Lampmussel	Endangered	Threatened	Apparently Secure
<i>Lampsilis radiata</i>	Eastern Lampmussel	Endangered	Threatened	Imperiled
<i>Lasmigona subviridis</i>	Green Floater	no data	Endangered	Imperiled
<i>Leptodea ochracea</i>	Tidewater Mucket	Endangered	Threatened	Extirpated?
<i>Liguma nasuta</i>	Eastern Pondmussel	Endangered	Threatened	Imperiled
<i>Margaritifera margaritifera</i>	Eastern Pearlshell	no data	no data	Critically Imperiled
<i>Pyganodon cataracta</i>	Eastern Floater	no data	no data	Vulnerable
<i>Strophitus undulatus</i>	Squawfoot	Extremely Rare	Species of Concern	Apparently Secure

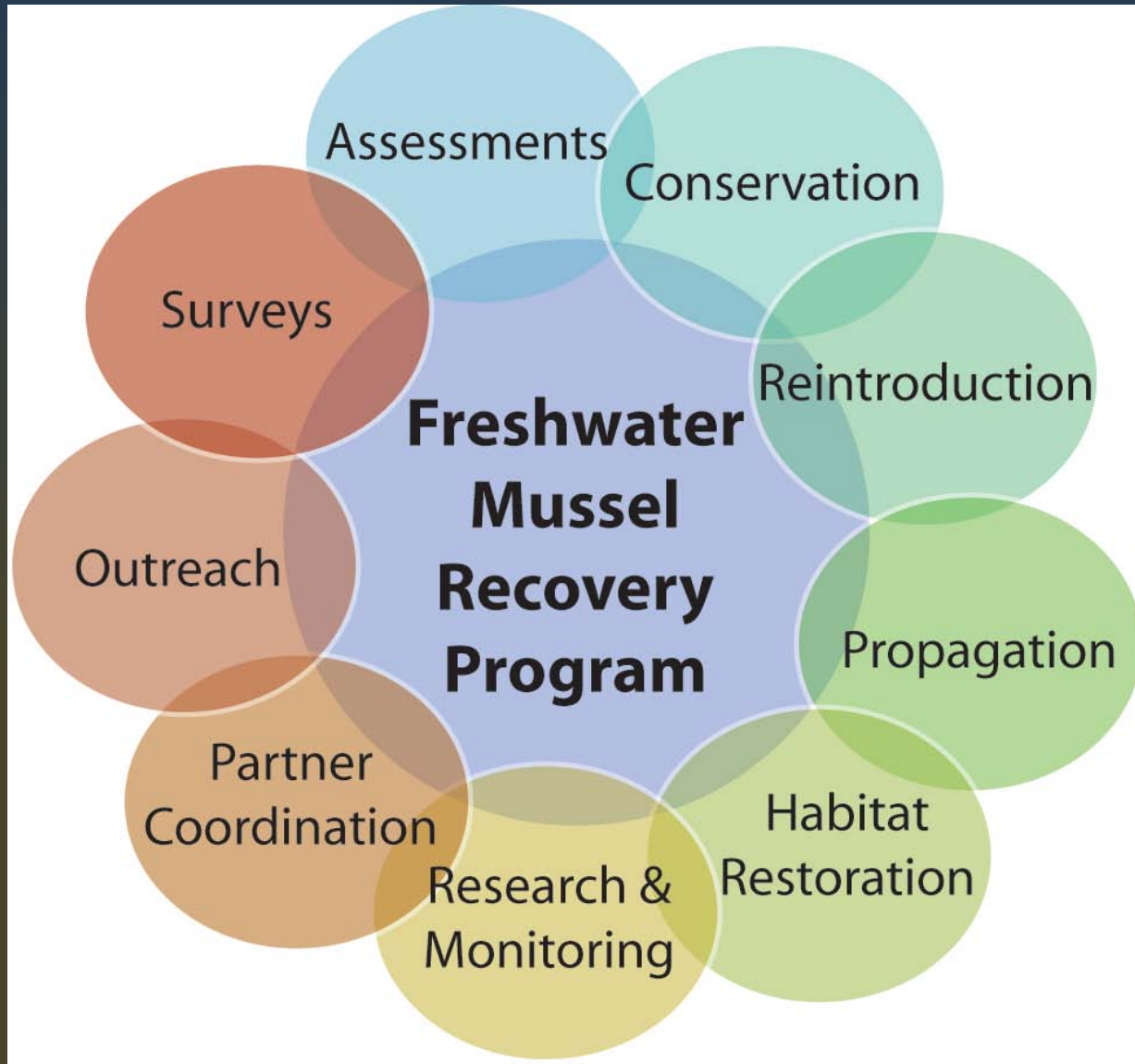
Mussels in the Delaware River Basin

1919 Species Richness

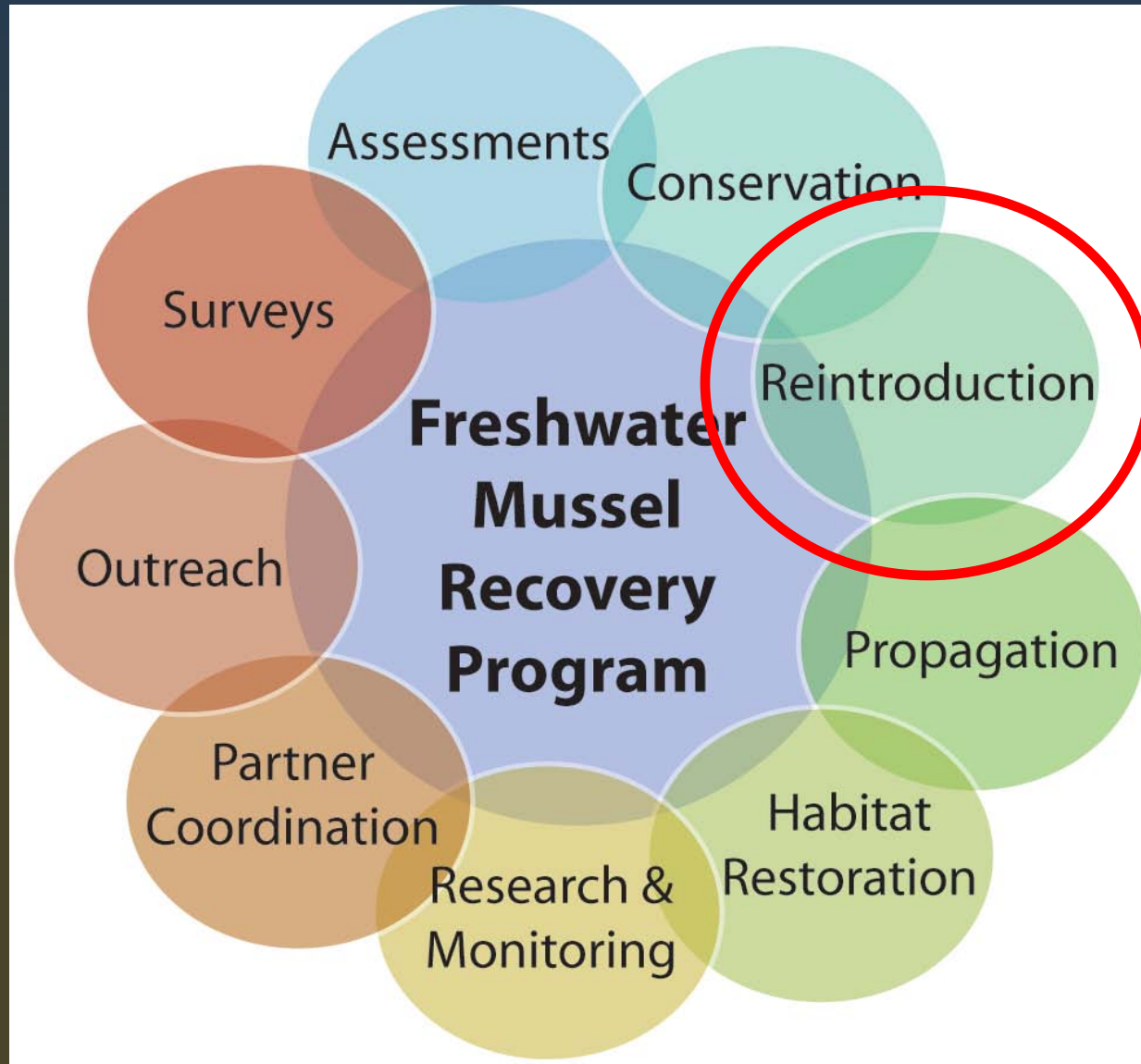
1996 Species Richness



Freshwater Mussel Recovery Program (FMRP)



Freshwater Mussel Recovery Program (FMRP)



Mussels in the Delaware River Basin



Eastern floater
(*Pyganodon cataracta*)
“Pycat”



Eastern elliptio
(*Elliptio complanata*)
“Elliptio”

Collection

- Acquire Permits
- Source of mussels
 - Delaware River (PA)
 - Brandywine River (DE)
- Hand collection via wading and snorkeling



Tagging

Dual-tag method

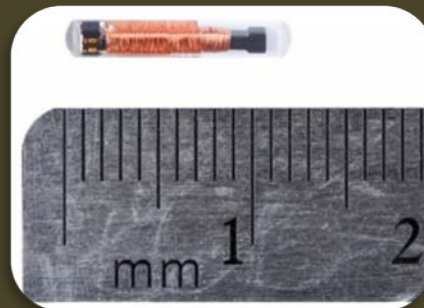
- PIT (Passive Integrated Transponder) tag
- Plastic ID Tag

Adhesion

- Marine epoxy (PIT tag)
- Super glue (Plastic tag)

Data Collection

- Tag Data
- Shell Lengths



Deployment

Suitable Habitat

- Substrate
- Flow
- Depth
- Refugia from flood disturbances

Grouping

- Similar size range
- 25-30 mussels

Deploying in stream

- Hand deploy, multiple beds per stream



Monitoring

Monitoring Surveys

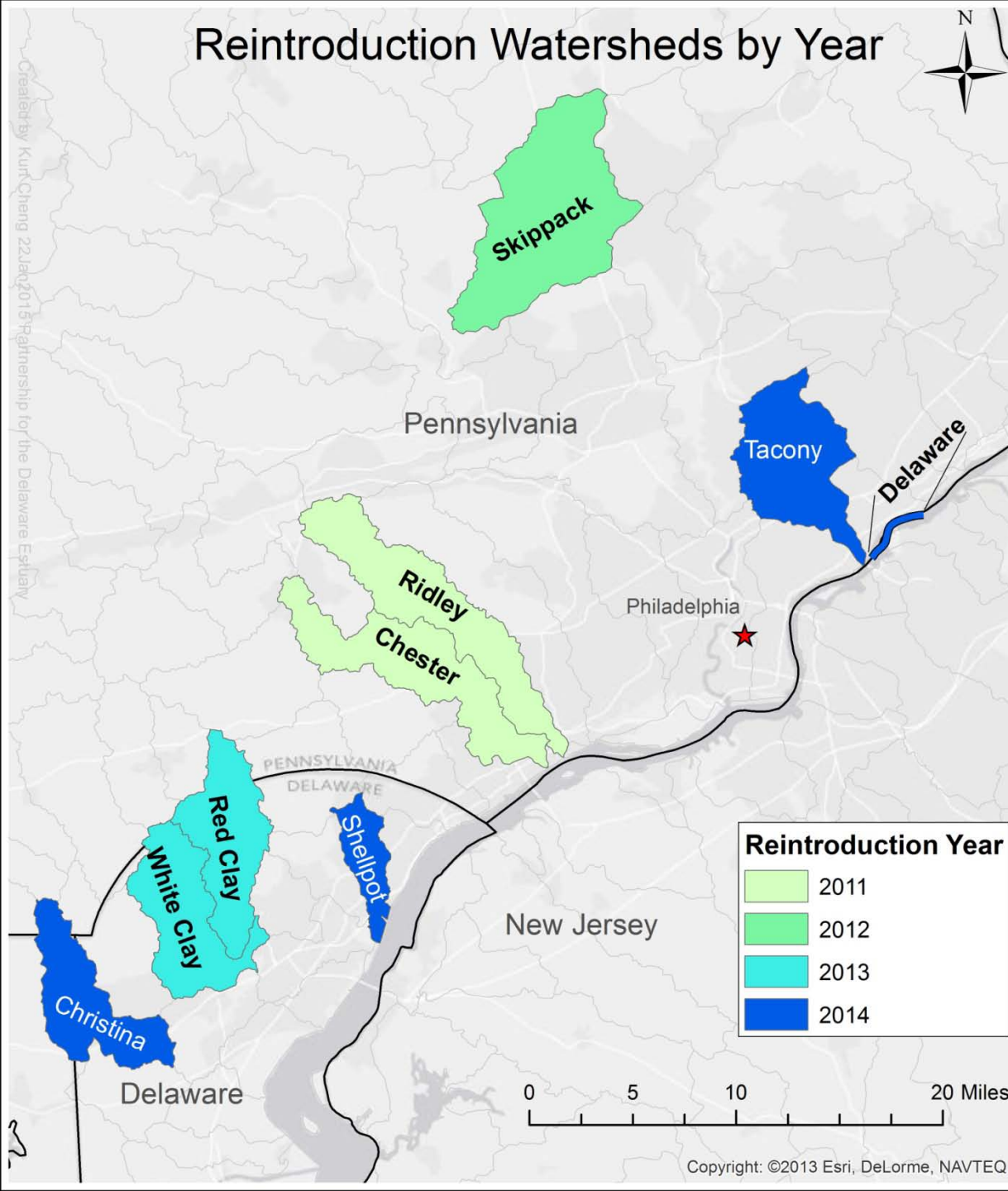
- 2 field technicians
- PIT tag reader
- Records tag data within 8" range
- Multiple sweeps
- Conservative by design

Data Collected

- Bed Retention
- Shell Length 1x/yr
- Water Quality (pH, DO, temperature, conductivity)



Reintroduction Watersheds by Year



- 2011-2014
- Range of urbanization
- Tidal and Non-Tidal

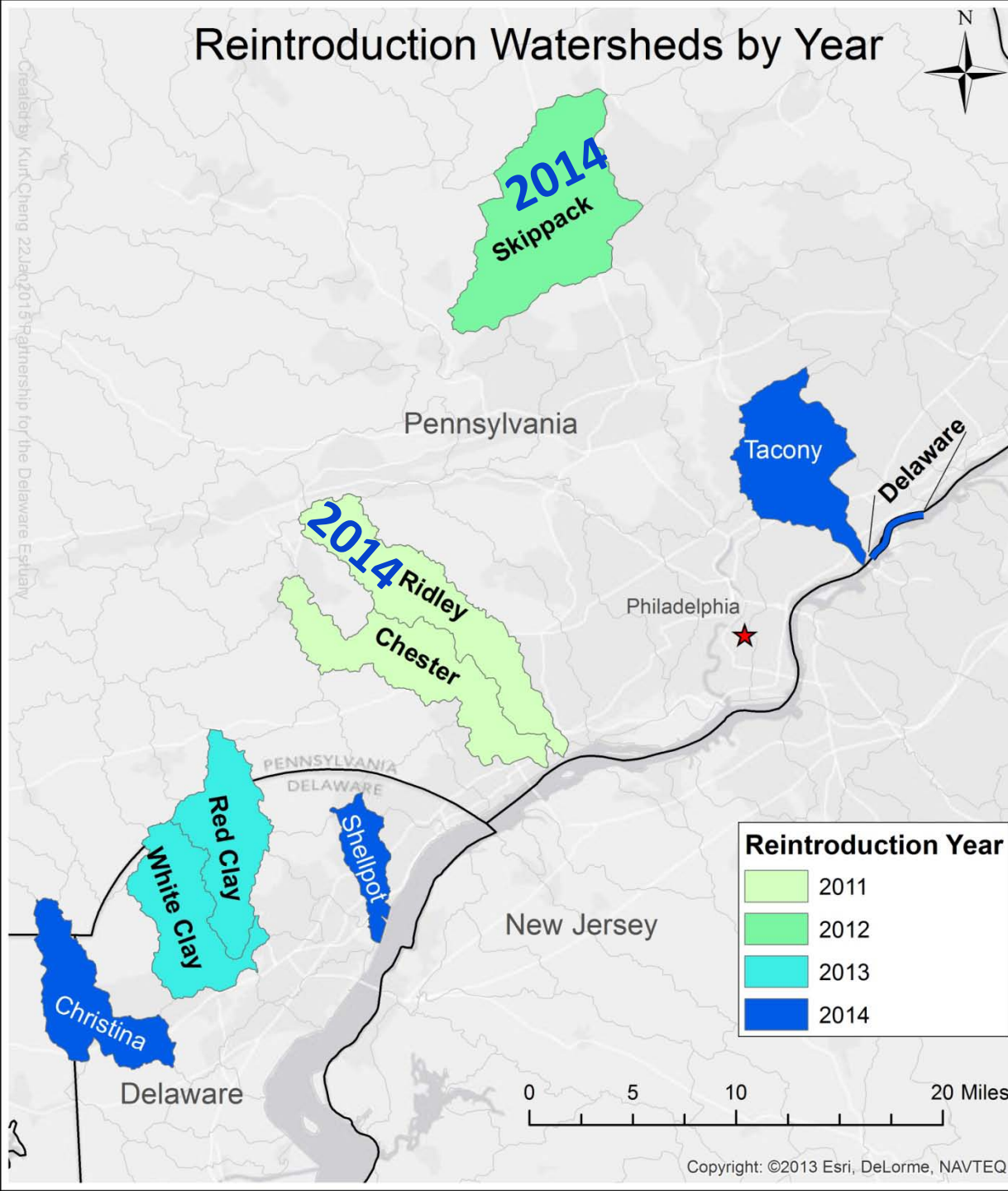
Pennsylvania

- 5 Streams
- Elliptio & Pycat

Delaware

- 4 Streams
- Elliptio only

Reintroduction Watersheds by Year



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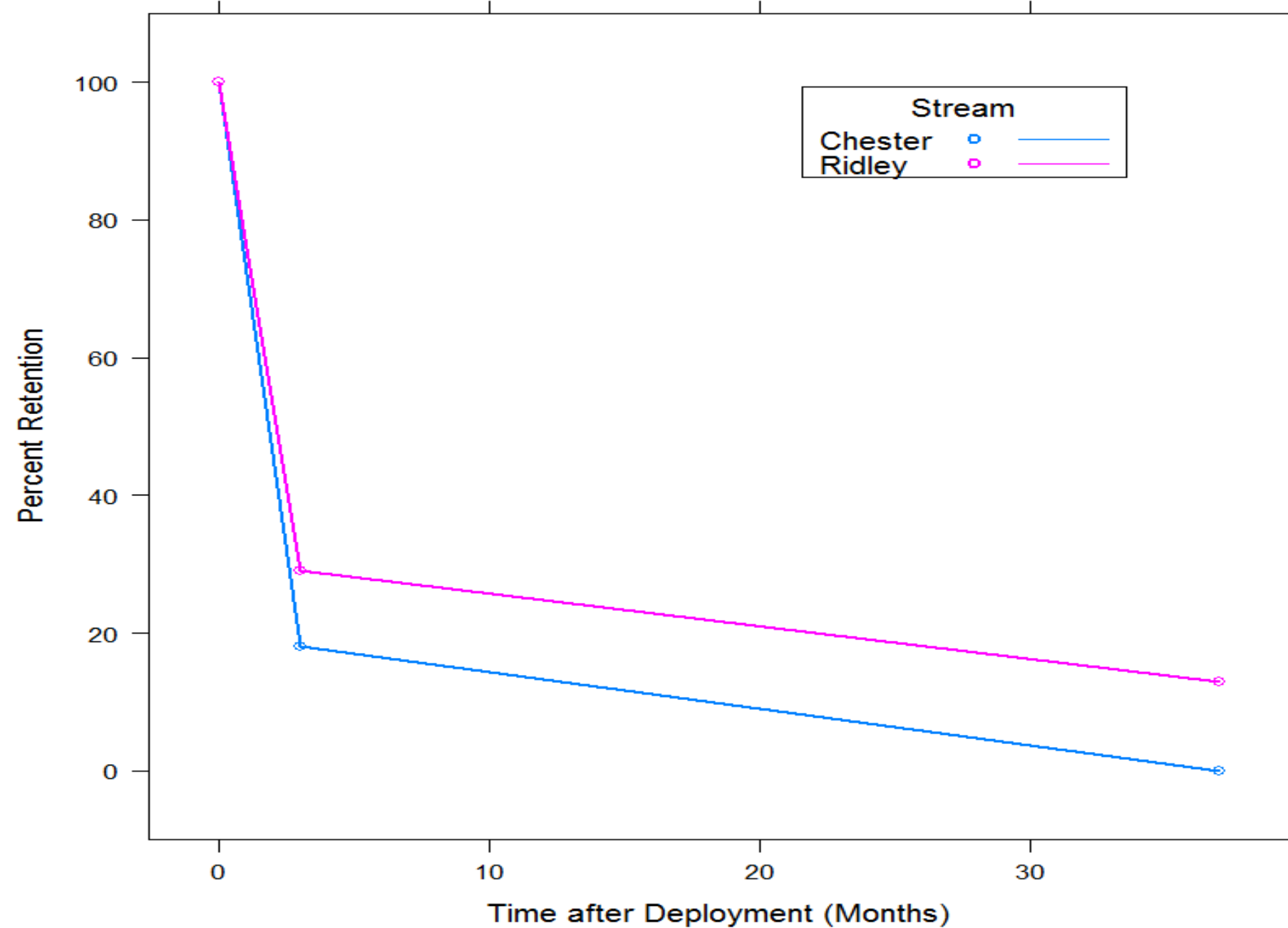
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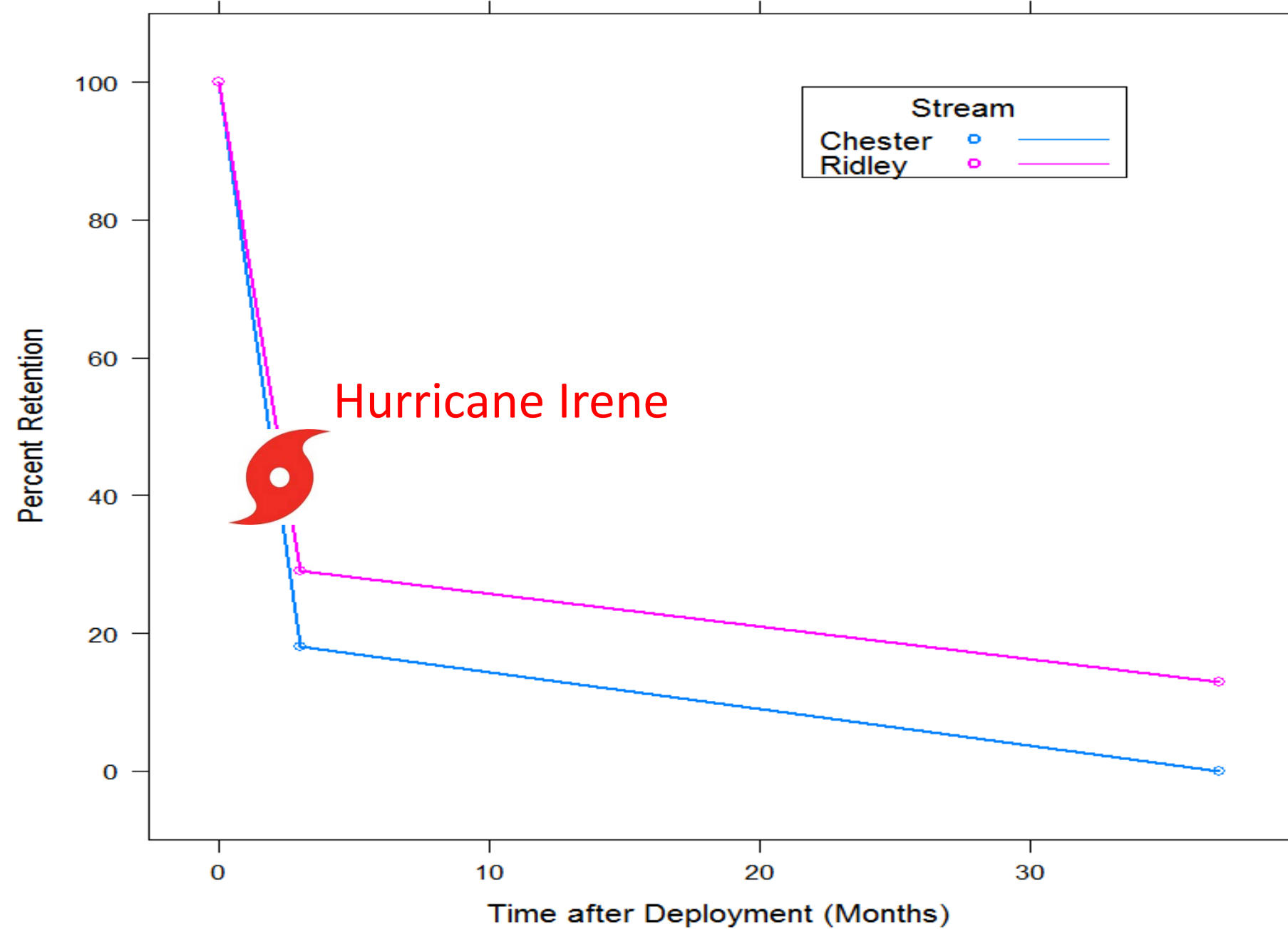
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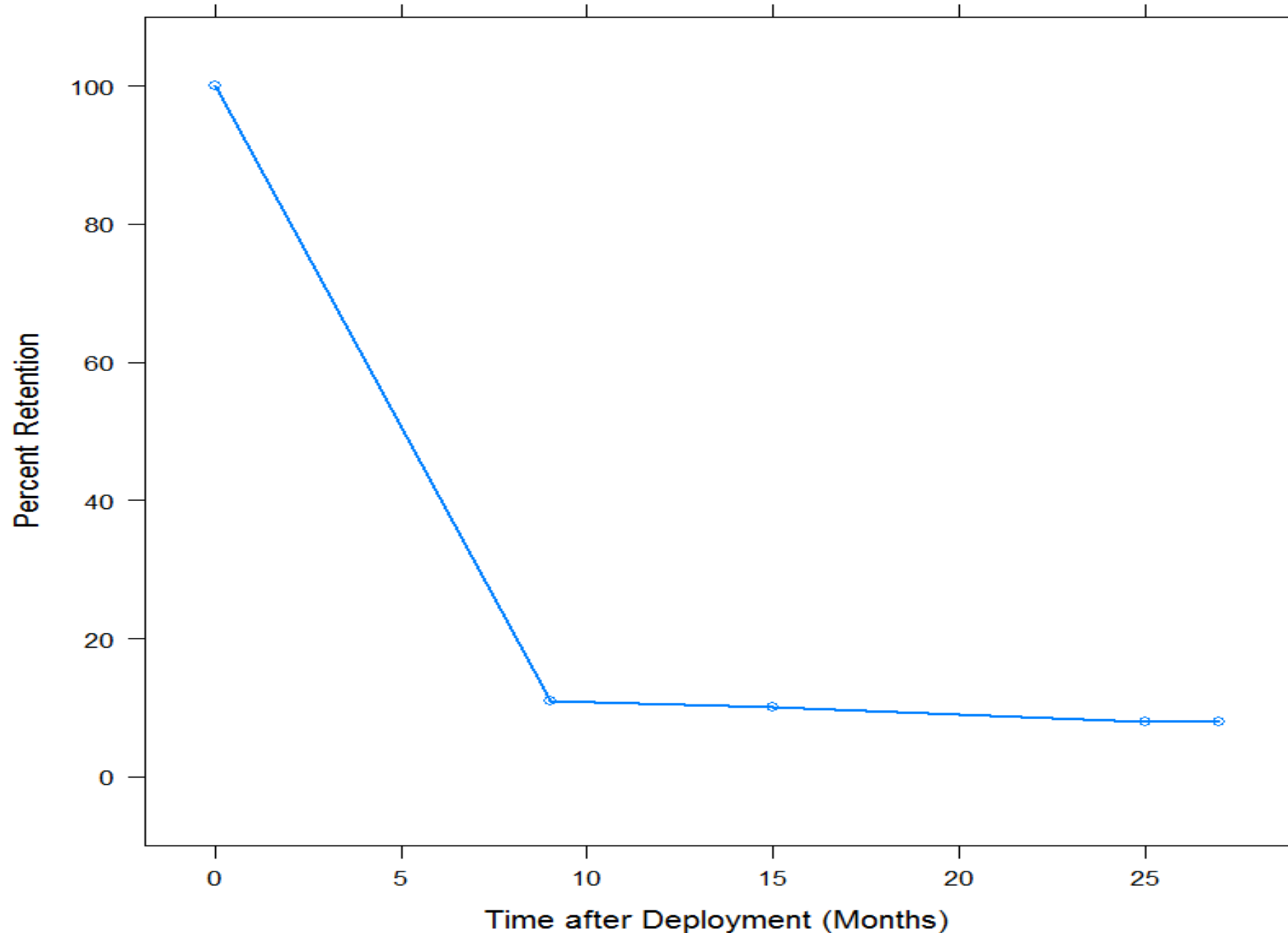
Retention of Mussels in Ridley and Chester Creeks



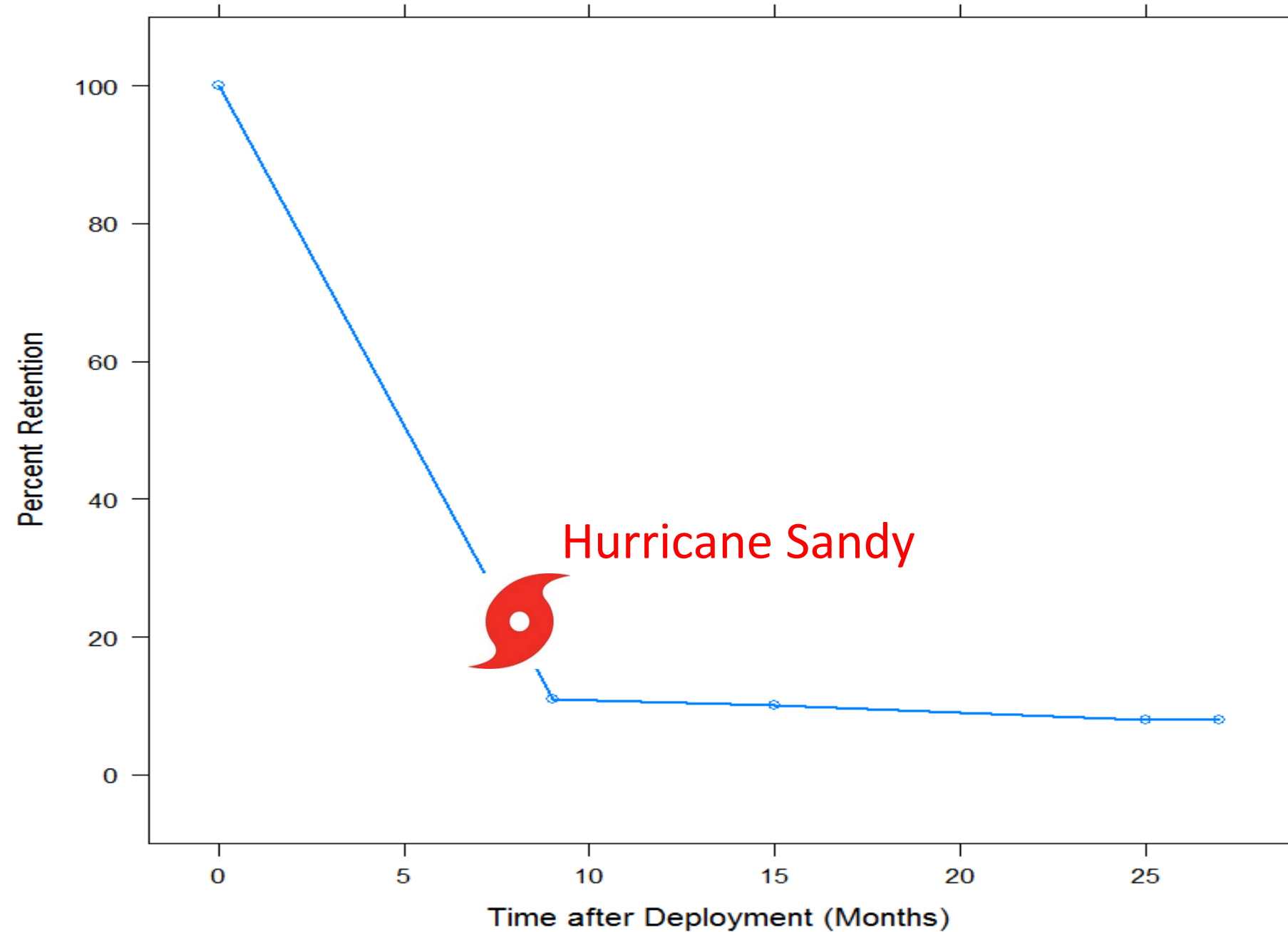
Retention of Mussels in Ridley and Chester Creeks



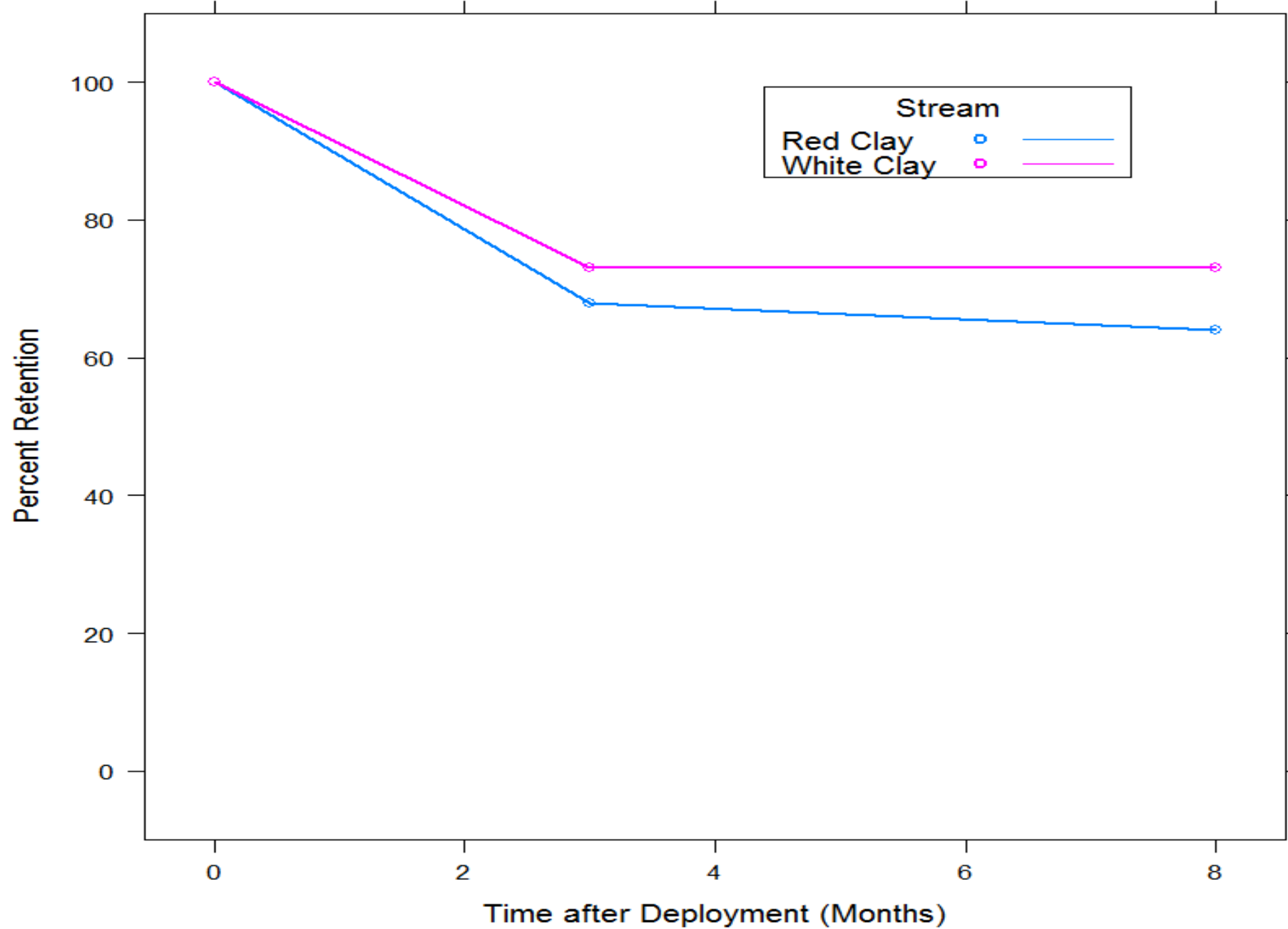
Retention of Mussels in Skippack Creek



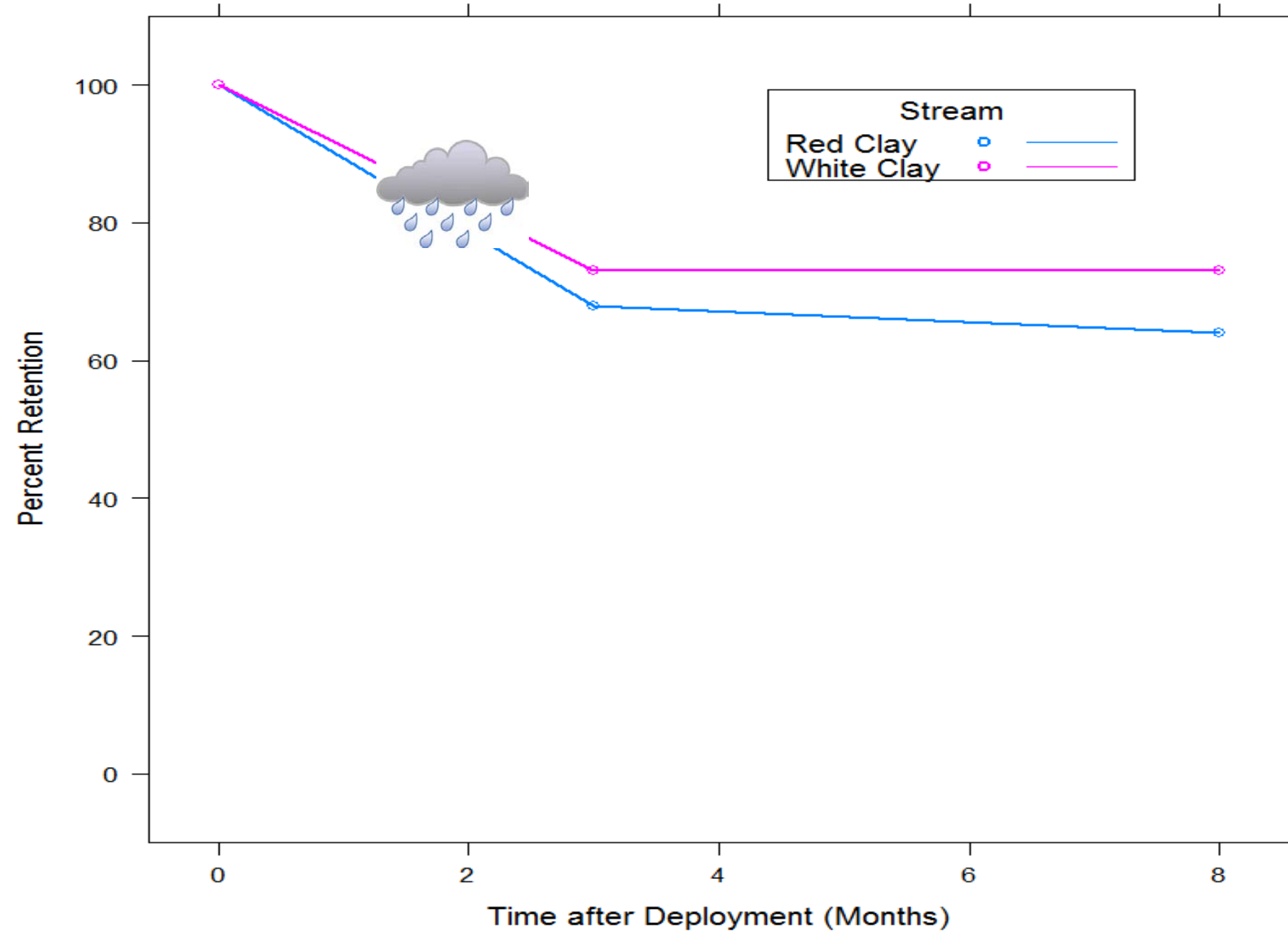
Retention of Mussels in Skippack Creek



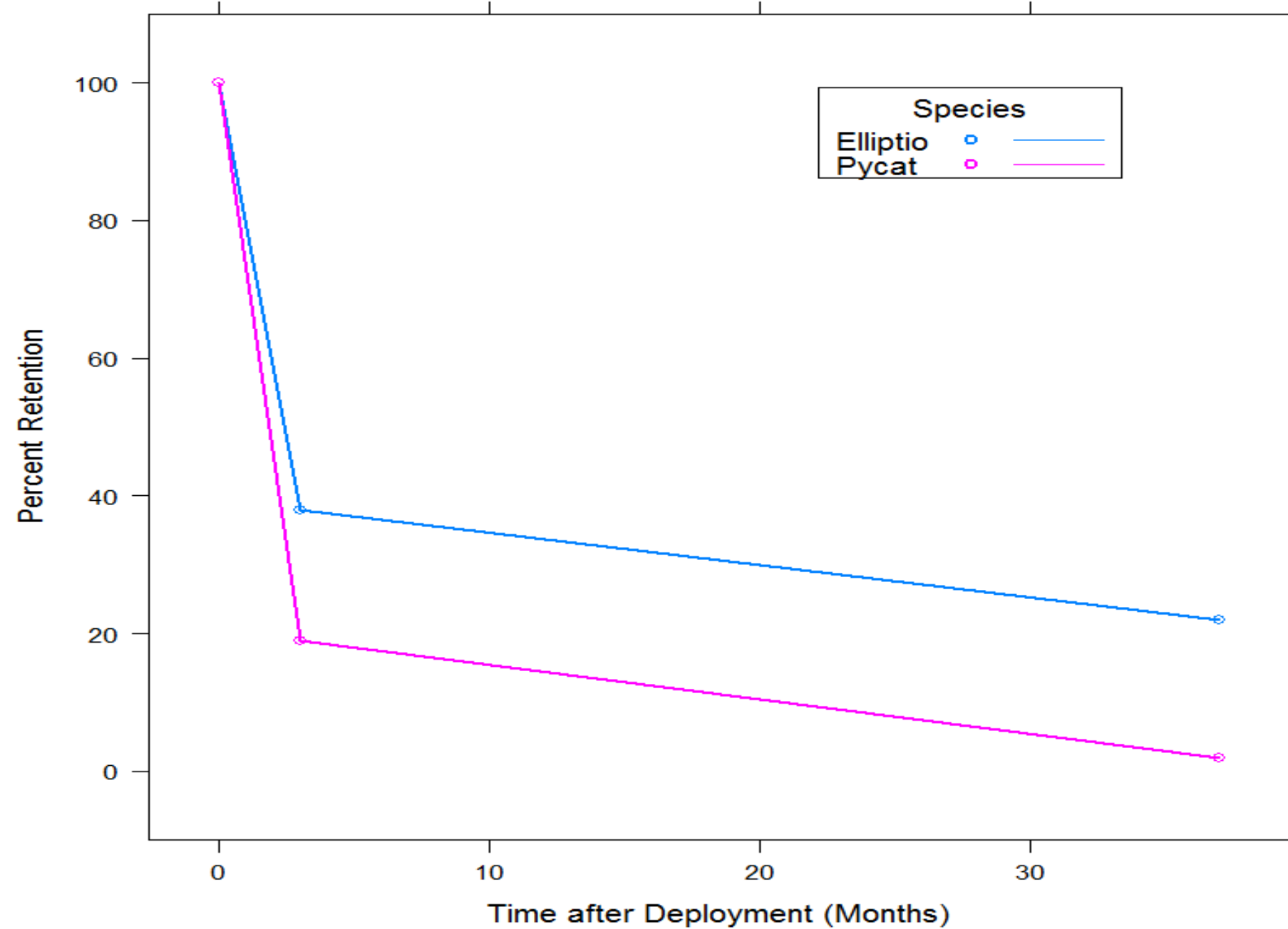
Retention of Mussels in Red Clay and White Clay Creeks



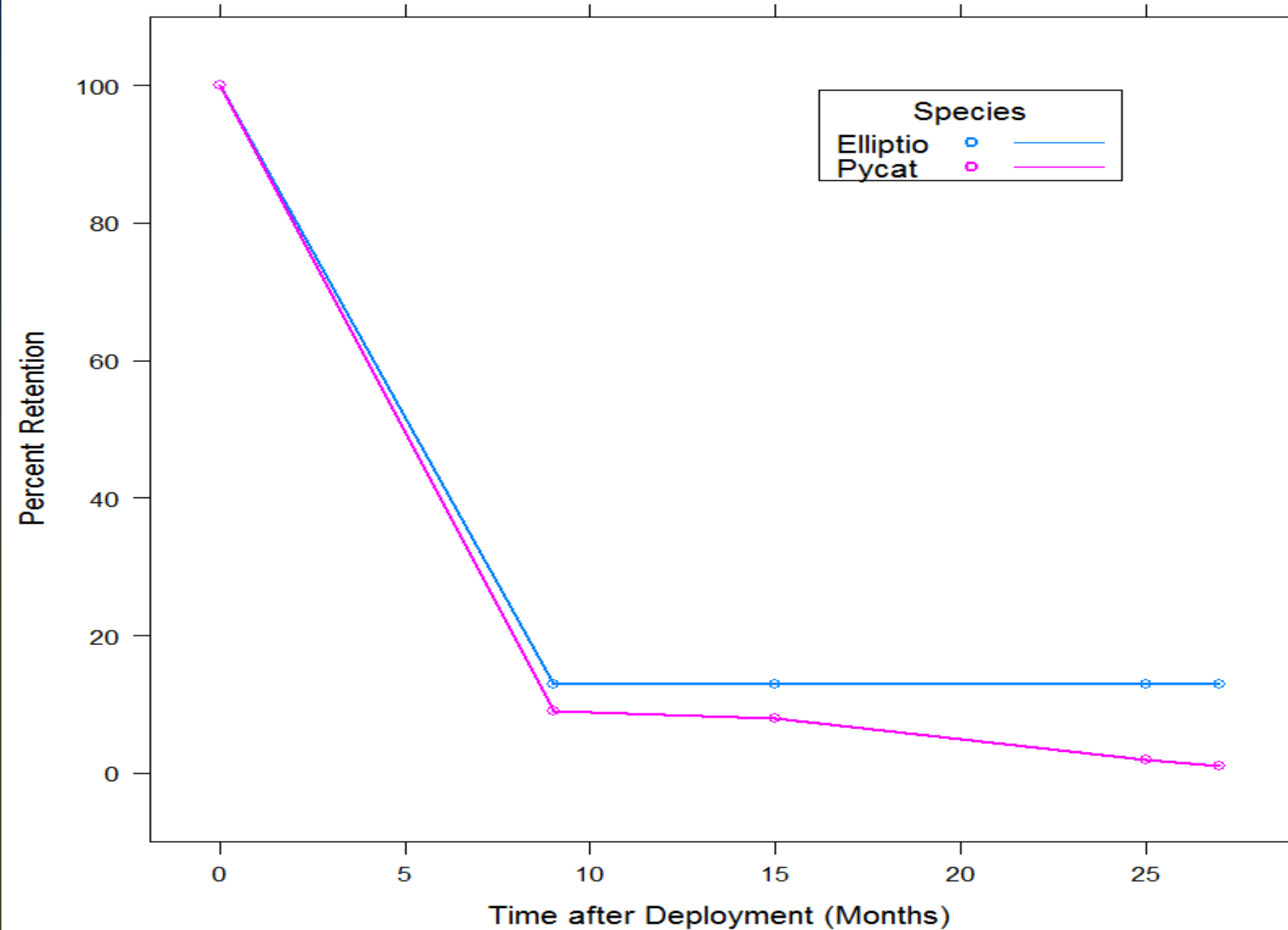
Retention of Mussels in Red Clay and White Clay Creeks



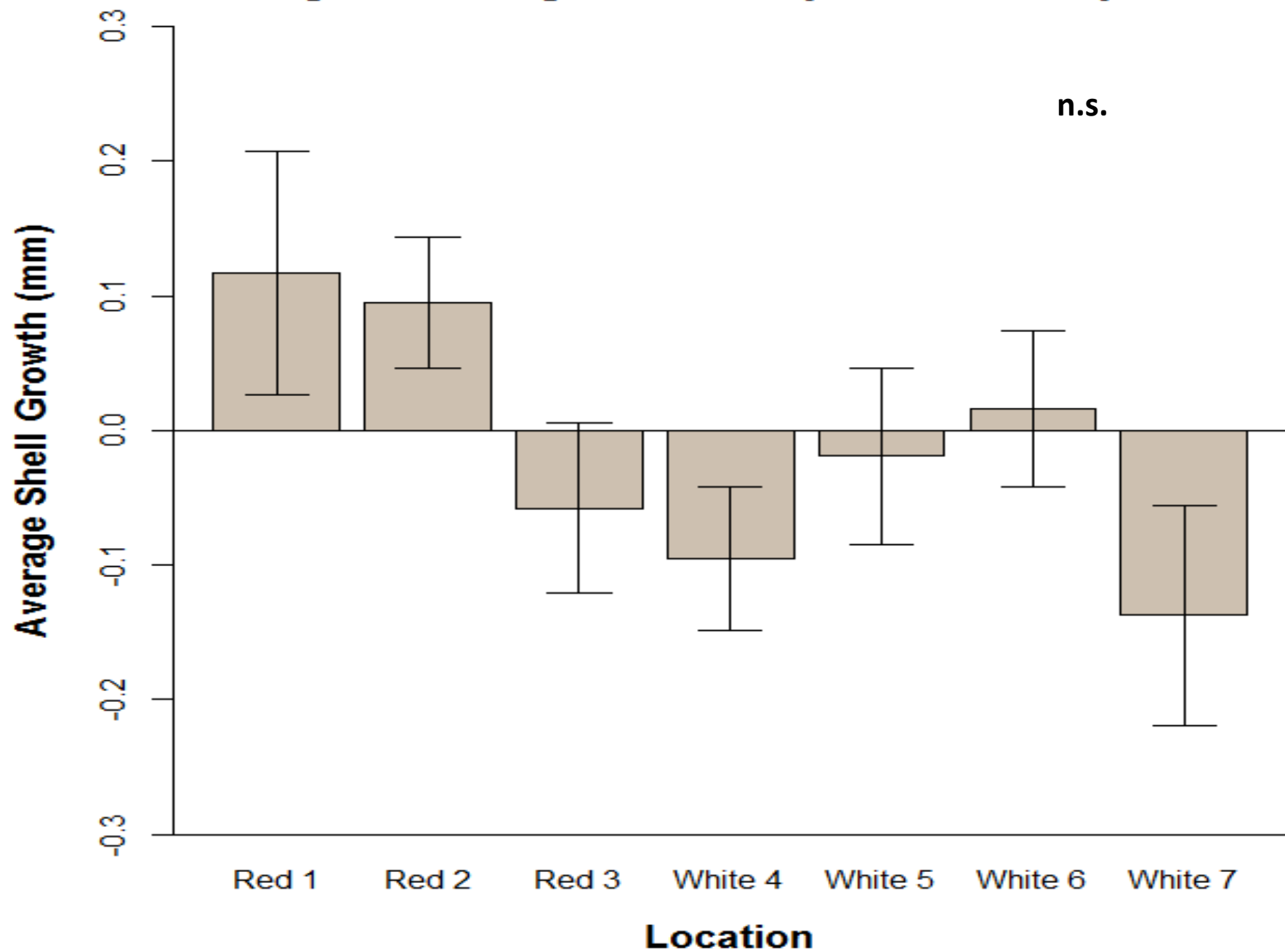
Retention of Mussels in Ridley Creek



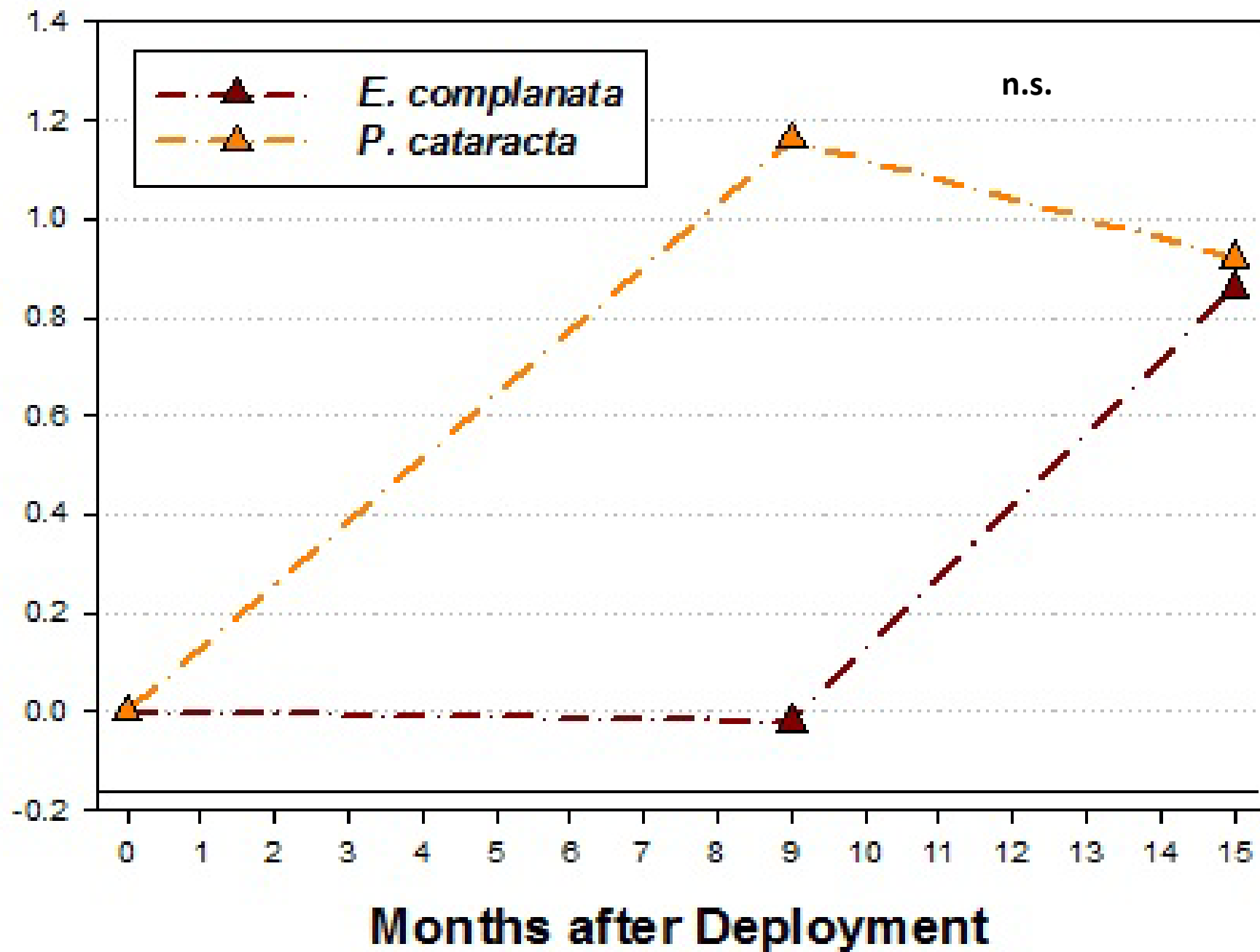
Retention of Mussels in Skippack Creek



Average Shell Length in Red Clay and White Clay Creeks



Change in Shell Height (%)



Summary

Reintroduction Stream	State	# Deployed	Mussel Retention		Shell Growth
			Retained %	Time Deployed (years)	
Christina River	DE	101	73%	0.5	-
Red Clay Creek	DE	90	73%	0.75	+0.05%
Shellpot Creek	DE	75	67%	0.5	-
White Clay Creek	DE	120	64%	0.75	-0.09%
Chester Creek	PA	115	0%	3	-
Delaware River	PA	85	49%	0.5	-
Ridley Creek*	PA	112 / 87	13% / 73%	3.1 / 0.5	+1.00%/ -
Skippack Creek*	PA	196 / 50	13% / 92%	2.25 / 0.5	+1.64%/ -
Tacony Creek	PA	52	81%	0.5	-
		1083	54%		+0.64%

* Multiple reintroductions; 1st Reintro data / 2nd Reintro data

Summary

- Mussels still present in 8 of 9 study streams
- Positive mussel growth observed for mussels deployed 2+ years
- Storms are unfortunate
- Species may be different in flood disturbance tolerance

Next Steps

- Continue monitoring reintroduced mussels
 - Growth data
 - Long term bed retention
- Additional reintroductions in new streams
- Identify new sources of freshwater mussels for reintroductions
 - E.g. hatchery propagation
 - Salvage mussels in harm's way

Acknowledgements

Funders

Delaware Clean Water Advisory Council

DuPont Clear into the Future

Lower Salford Township Authority

Pennsylvania Coastal Zone Management Program

United States Environmental Protection Agency: National Estuary Program

Field Crews & Volunteers

Tagging & Collection

Kyle Applebaum
Shaun Bailey
Melissa Bittner
Jessie Buckner
Lance Butler
Kelley Chase
Mat Colip
Steve Donahue
Karen Forst
Debbie Heaton
Elizabeth Horsey
Cheryl Jackson

Melanie Mills
Brynn Monaghan
Joshua Moody
Eric Newman
Brian Poe
Jocelyn Robinson
Dee Ross
Sari Rothrock
Brent Sparks
William Whalon
Gus Wolfe
Lisa Wool

Deployment & Monitoring

Priscilla Cole
Elena Colon
Alex Cooper
Steven Dench
LeeAnn Haaf
Robin Irizarry
Alexandra Leszczynski
Patrick Millilo
Paul Overbeck
Kat Smith





QUESTIONS?

The image shows an underwater scene with a sandy and rocky seabed. A large blue thought bubble is centered in the upper half of the frame, containing the word "QUESTIONS?" in white, bold, sans-serif capital letters. Three smaller blue circles lead from the bottom of the main bubble down towards the bottom right corner of the image.