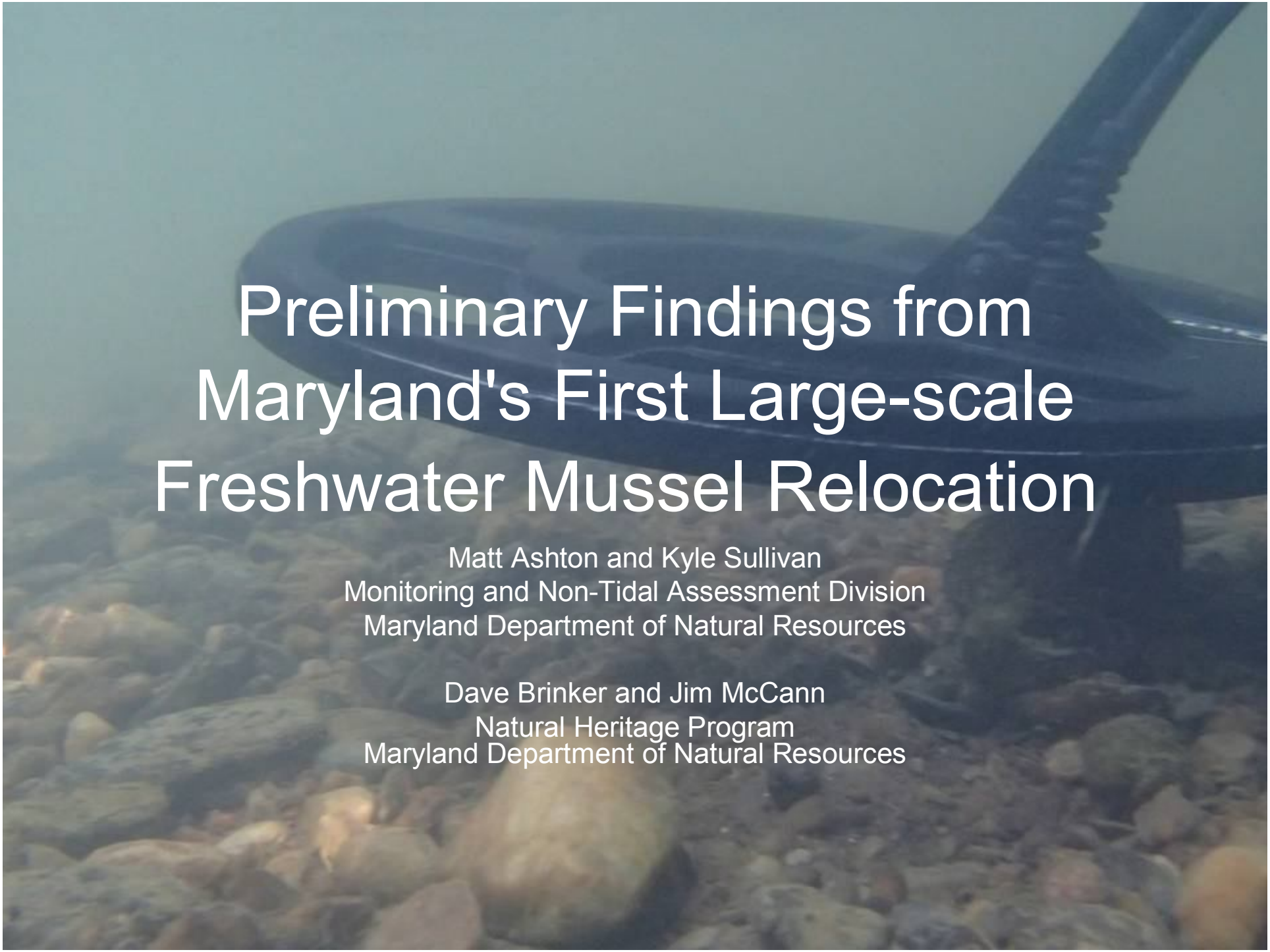

Preliminary Findings from Maryland's First Large-scale Freshwater Mussel Relocation

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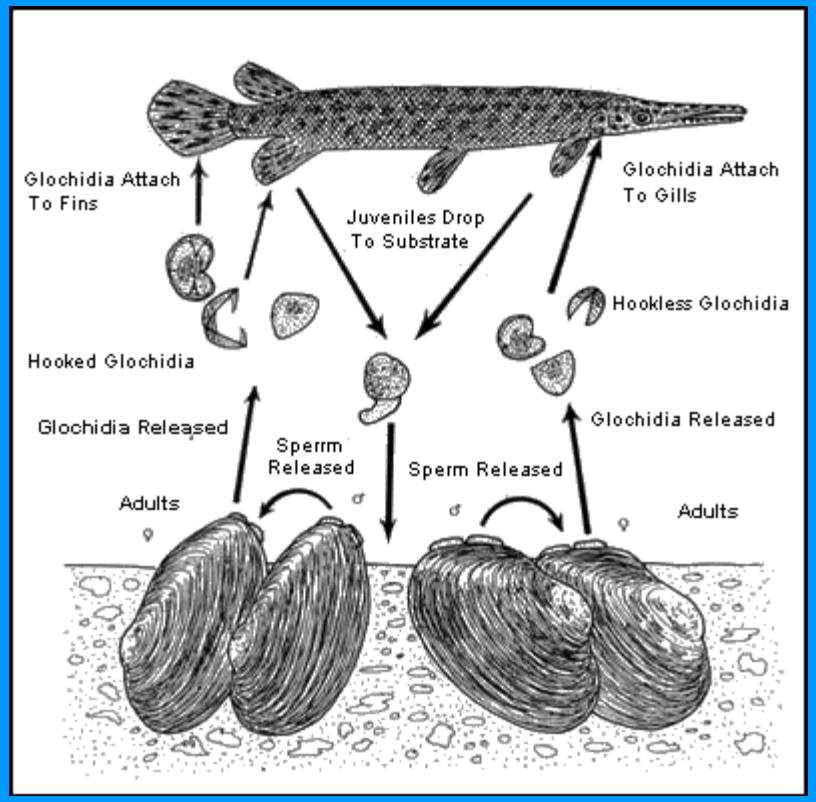
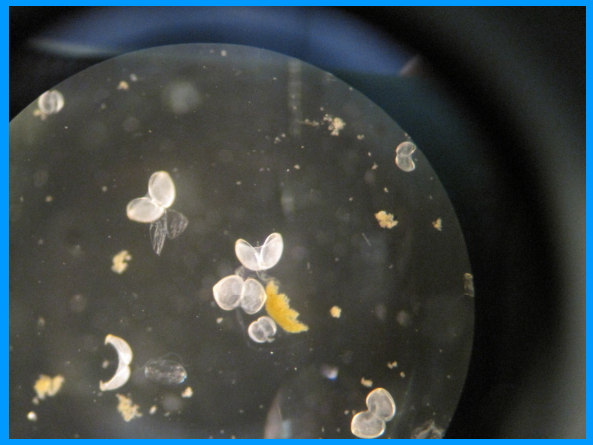
Freshwater mussels are complex

- Require a host, usually a fish, to complete their reproductive cycle
- Host-specifics vs. host-generalists
- Glochidia and juvenile mussels are especially vulnerable to environmental disturbance





Mussels are ecosystem engineers

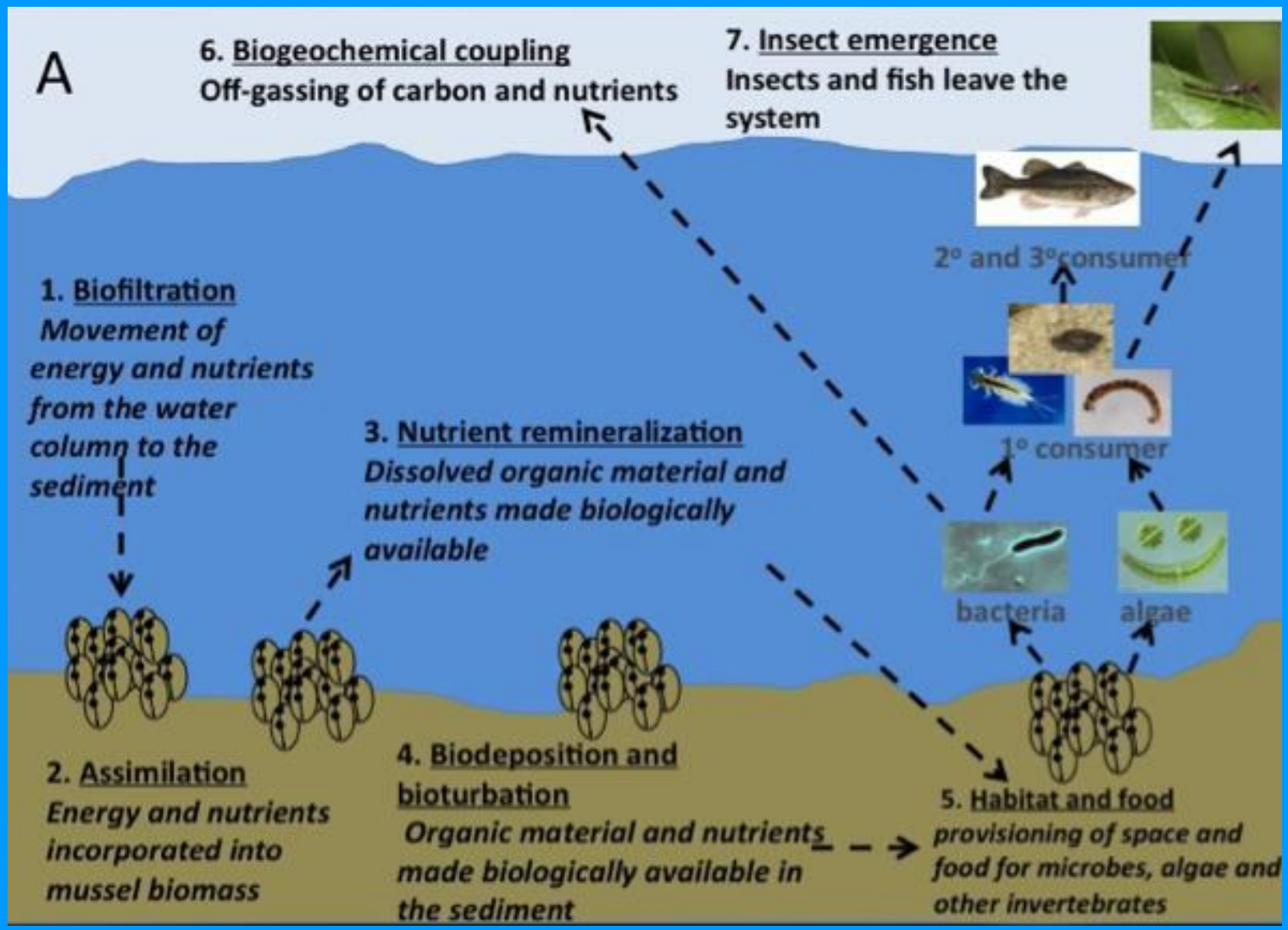
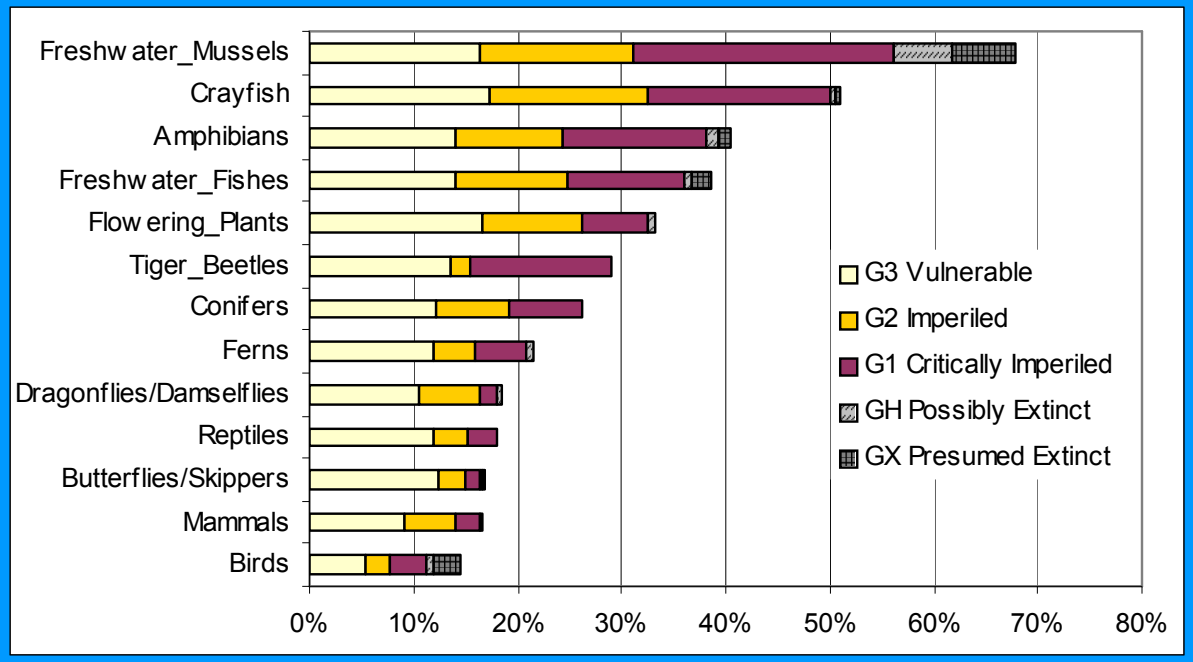


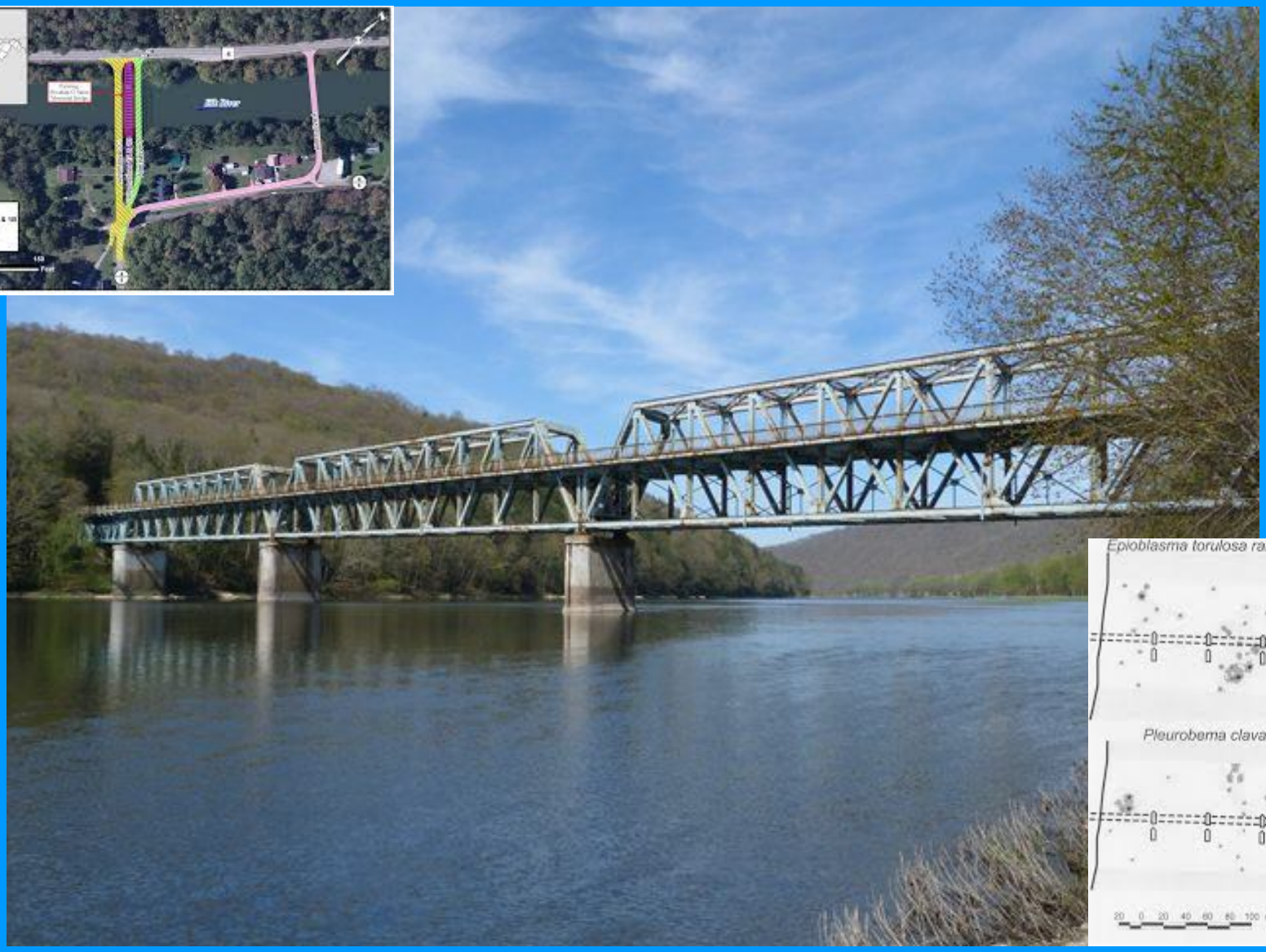
Image courtesy of Dan Spooner USGS

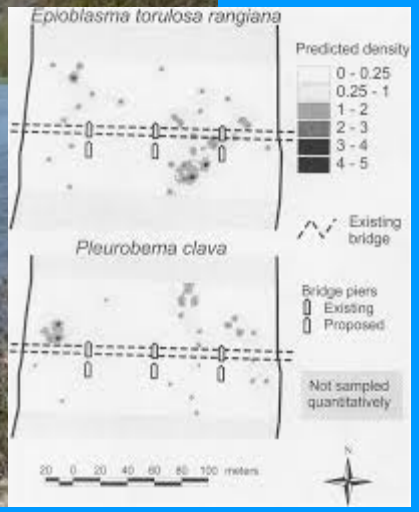
Freshwater mussels are imperiled



- **<u>The most</u>** imperiled fauna of North America
- In Maryland, 14 of 16 species are “RTE”
- Four are Endangered, two are In Need of Conservation

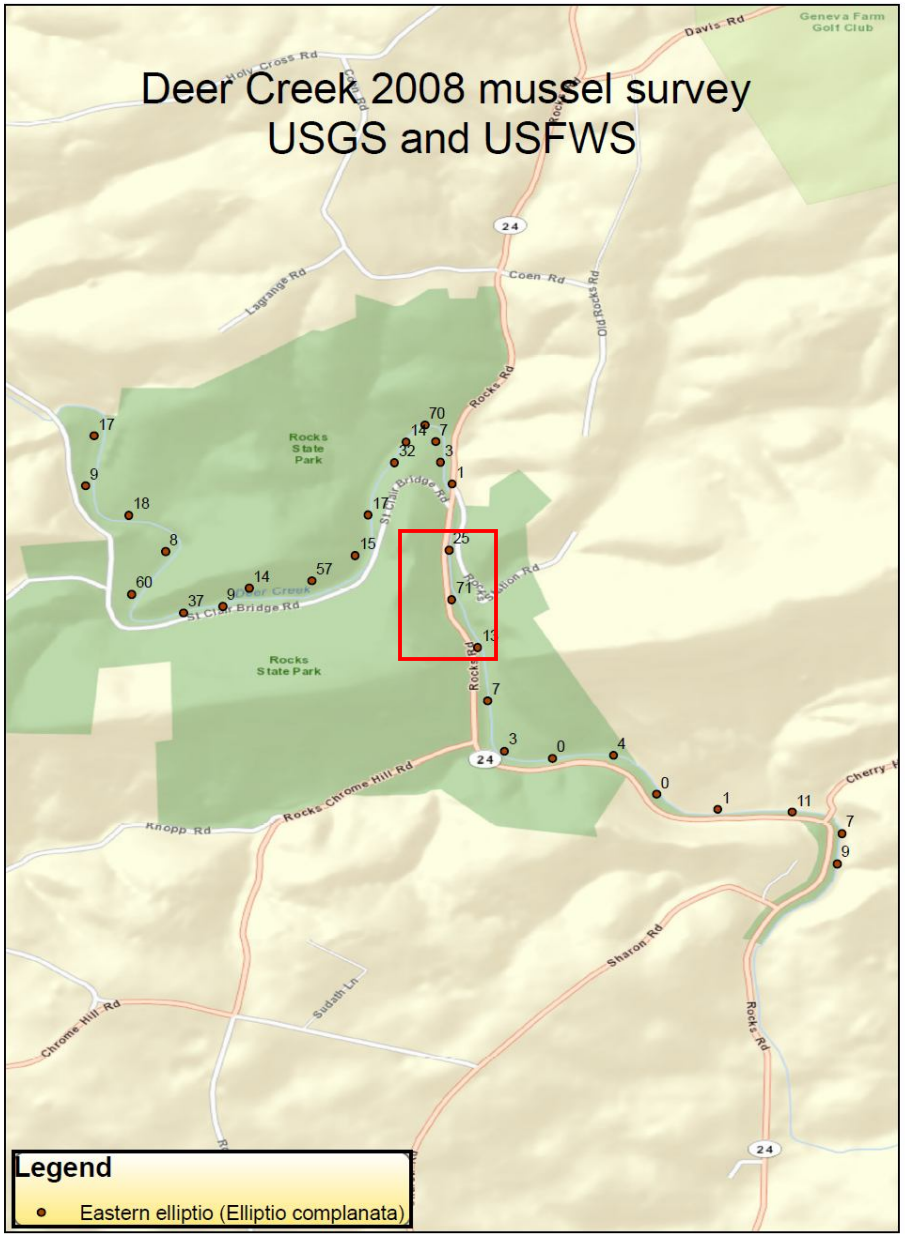
Relocation as a management tool





Need for relocation

- Past data indicated an abundant Easter Elliptio population and presence of Creeper, a RTE species
- Deer Creek is a Tier II, Use IV-P, Wild and Scenic waterway
- Alternatives had varying levels of direct and indirect impacts
- None avoided impacts to mussels and their habitat



Relocation as a management tool

- Only a few mussel relocations in Maryland waters to date
- DNR entered into agreement with SHA to relocate mussels within MD 24 project area
- Incorporate rigorous design, guided by best practices and empirical research
- Survey findings can guide future relocations

Main objective – reduce risk!

- Remove and relocate mussels
  - Multiple-pass population depletion
  - PIT tag 20+% *Elliptio* and all *Strophitus*
  - Stock in relation to abundance and spatial distribution
- Monitor relocation
  - Quantify baseline conditions
  - Replicate control and relocation sites
  - Conduct for at least three years post-relocation

Survey methods

- Timed, visual search survey
- Multiple-pass / Mark-recapture
- Same methods used at removal, translocation, and control sites

Survey design

- 10 x 10-m-wide plots
  - Manage survey logistics
  - Understand spatial distribution to inform stocking rates
  - Triggers for additional sampling if Strophitus encountered in a cell
  - Aid tag recovery?
- Example (T1, 40-m-long)
  - Collect 72 mussels
  - N_{pop} = 83±14 mussels
  - Relocate up to 249 (= N_{pop} * 3)
  - Proportional to cell abundance
  - Cells w/ 0's could receive 1-2 mussels with $P_{capture}$ = 0.65

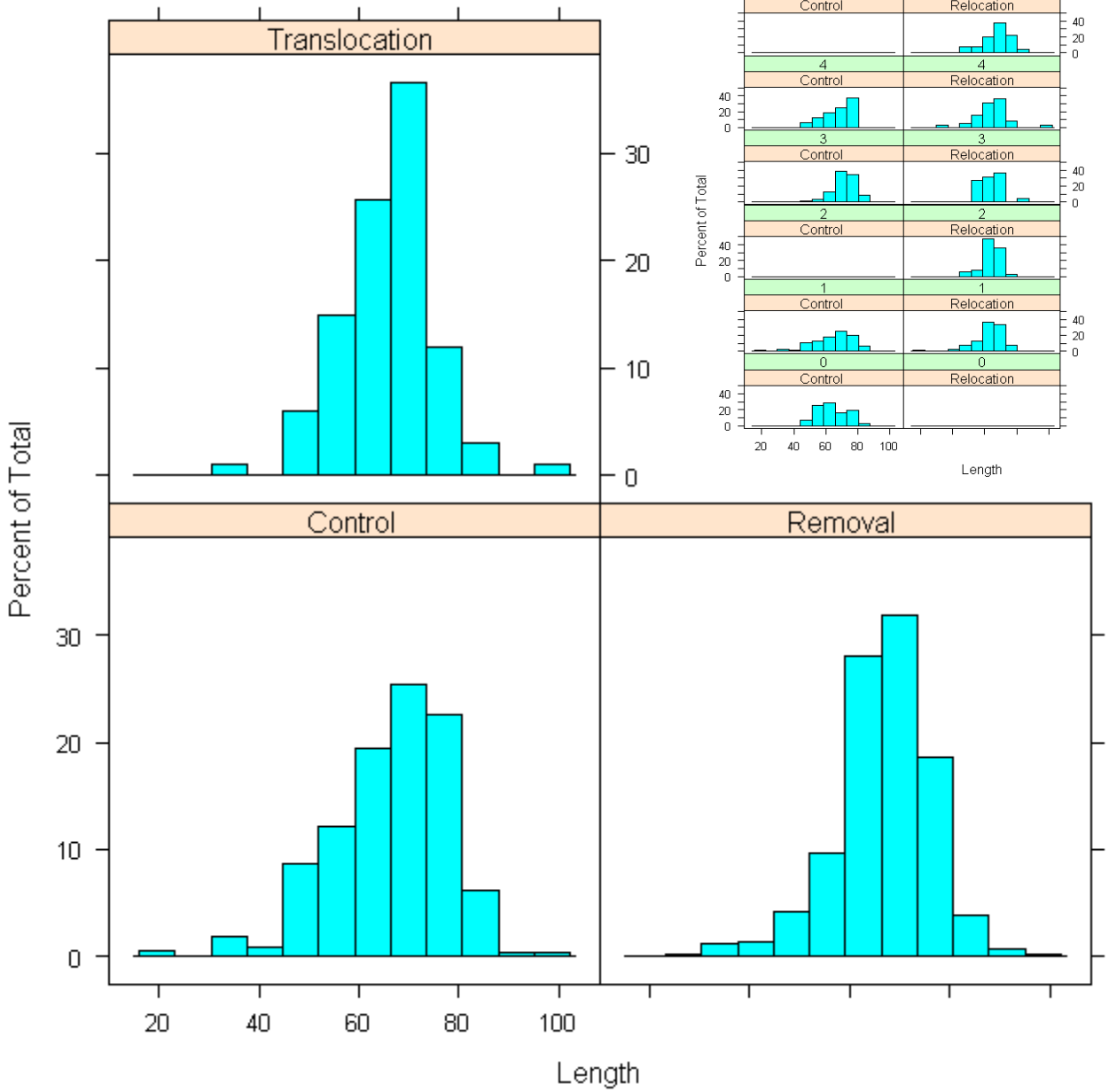
4/29/2008
T1
T2
T3
T4
T5
C4
C3
C1
C0
Image U.S. Geological Survey
Google earth
1994
Imagery Date: 1/31/2008 39°38'23.04" N 76°25'12.60" W elev 392 ft eye alt 5045 ft

And did we ever move mussels…

	Removal	Translocation	Control
Effort (person-hours)	109.92	47.27	28.33
No. mussels collected	2,349	209	334
No. Creeper collected	4	0	2
No. PIT Tagged	301	40	92
N_{pop} estimate (±CL)	2,444±169	40±9 - 83±14	0 - 275±43
Probability of capture	0.50	0.31 - 0.70	0.00 - 0.82

Site	$N_{collected}$	N_{pop} * 3	$N_{stocked}$	PIT tagged	No tags
T1	72	249	248	53	0
T1 – T2	---	409	485	63	377
T2	36	120	125	28	0
T2 – T3	---	87	87	17	0
T3	22	135	133	21	0
T3 – T4	---	215	222	3	43
T4	39	225	224	55	0
T4 – T5	---	545	602	0	602
T5	40	147	145	60	0
UP T5	---	N/A	74	0	74

For sites in between translocation sites a more conservative X = 2 for N_{pop} stocking rate was used


Translocation
Control
Removal
Percent of Total
Length
0
10
20
30
20
40
60
80
100

5
4
3
2
1
0
Control
Relocation
Percent of Total
Length
0
20
40
60
80
100

Survey data comparisons

Past

- Many Eastern Elliptio
- Greatest #'s along MD 24
- Evidence of recruitment
- Abundance highly patchy
- A few Creeper
- Mussels throughout most of Deer Creek in Rocks SP

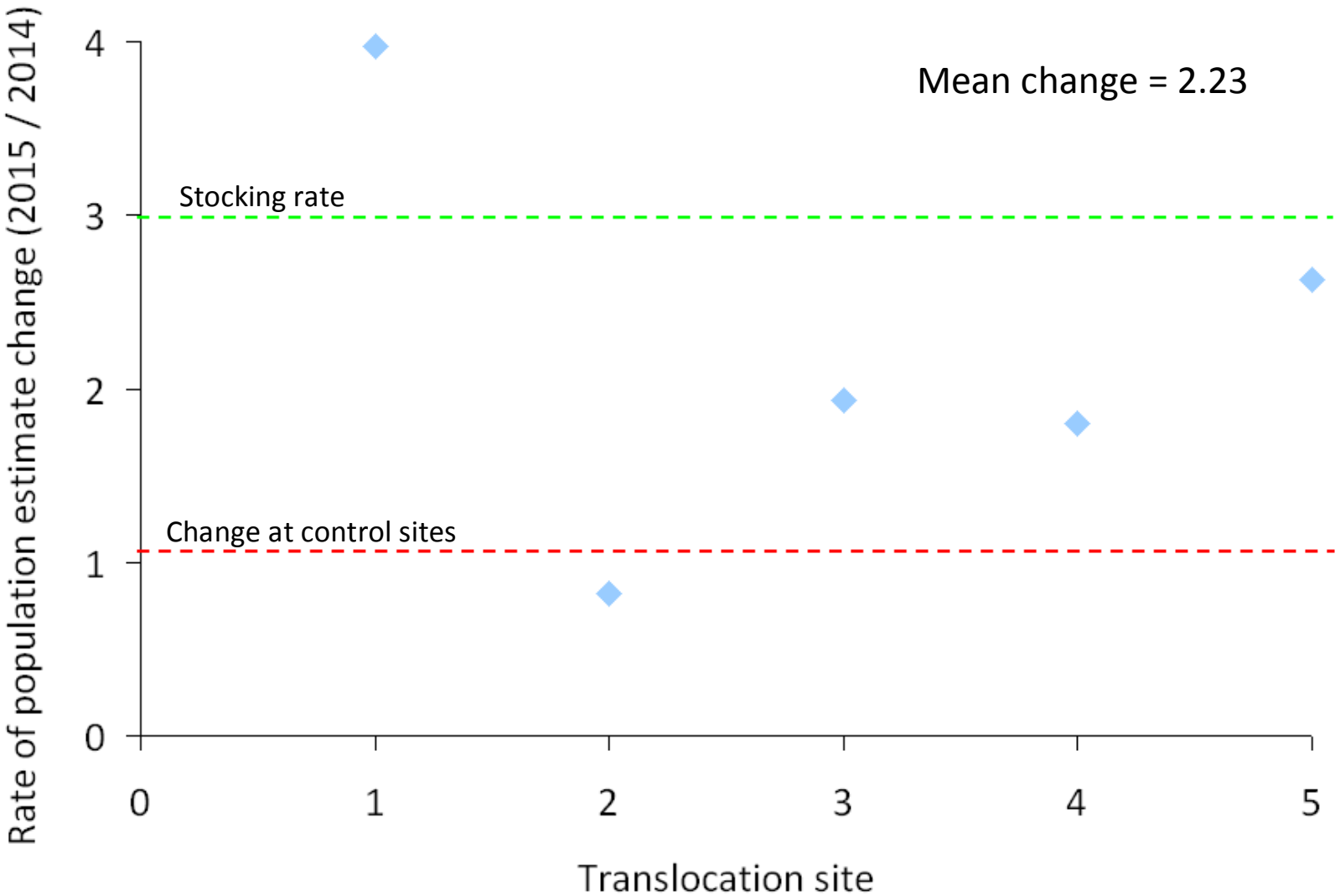
Current

- Many (more) Eastern Elliptio
- Greatest #'s along MD 24
- Evidence of recruitment
- Abundance highly patchy
- A few Creeper
- Mussels throughout most of Deer Creek in Rocks SP

2015 – Year 1 monitoring

- Methods
  - Same 2-pass surveys at 4 Control and 5 Translocation sites
  - Tag ‘new’ mussels at C and T sites
  - 2-pass survey within direct impact area (i.e., left half)
- Assess
  - Change in population estimate
  - Rate of survival
  - Rate of growth
  - Movement
  - Recruitment

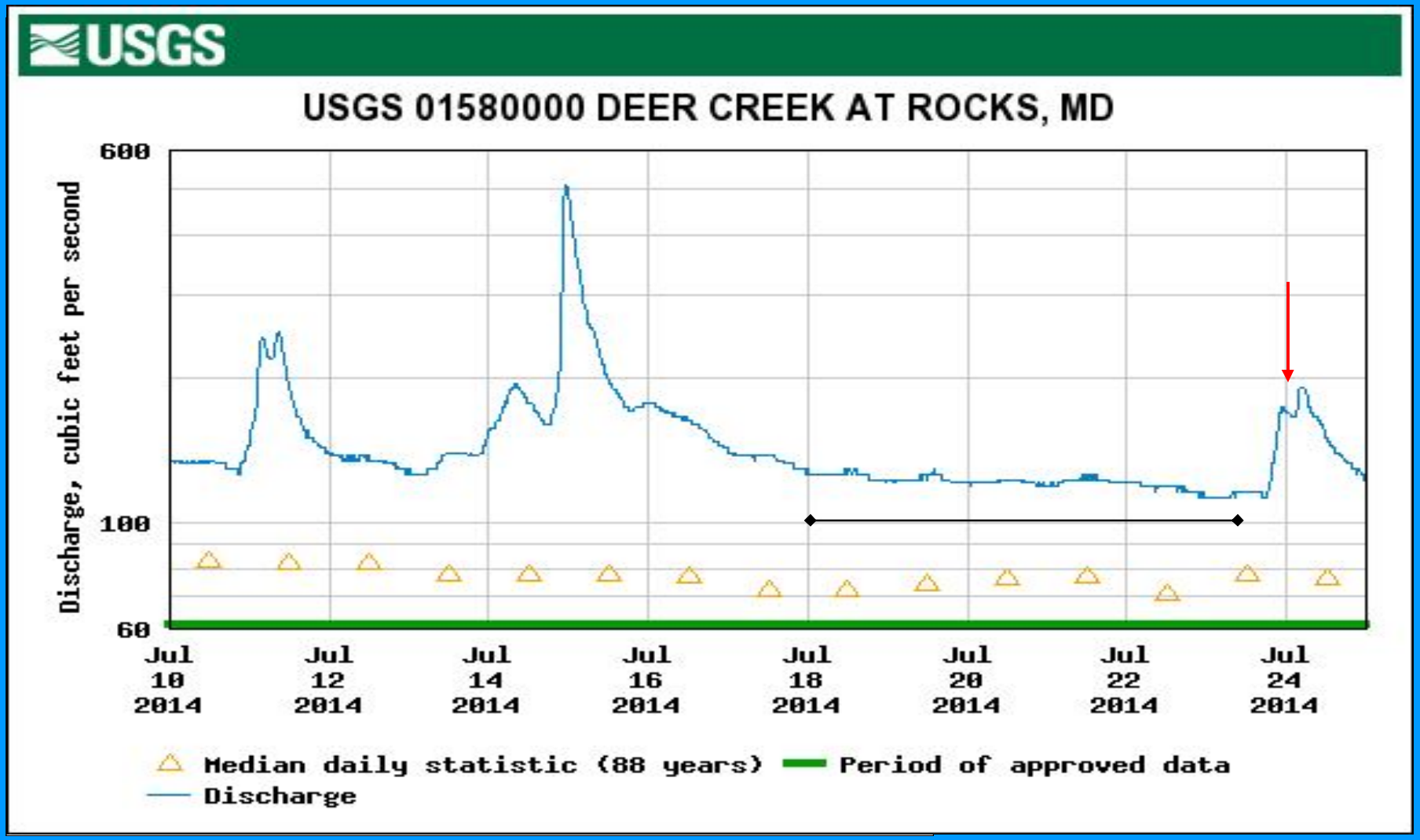
2015 – Year 1 monitoring: abundance



2015 – Year 1 monitoring: recapture

Site	No. collected 2014	No. stocked	No. collected 2015	No. recaptured (%)
T1	72	248	269	129 (52)
T2	36	125	30	21 (17)
T3	22	133	55	31 (23)
T4	39	224	162	68 (30)
T5	40	145	102	52 (36)
C0	31	---	40	8 (20)
C1	220	---	200	86 (43)
C3	66	---	126	36 (29)
C4	17	---	44	4 (24)

2015 – Year 1 monitoring: movement



Initial findings

- Little direct evidence of mortality
- Recapture rate and site fidelity appear high

- Recolonization of mussels into removal site
- Mussels still abundant in patches of removal site

- T2 may be poor relocation site
- C4 may be poor monitoring site
- PIT tag reader provided minimal return as a supplemental survey method vs. additional effort

Early hypotheses

- T2 had a very small population
- Stream discharge was lower in 2015
- Habitat altered at T2 by creation of a wing dam

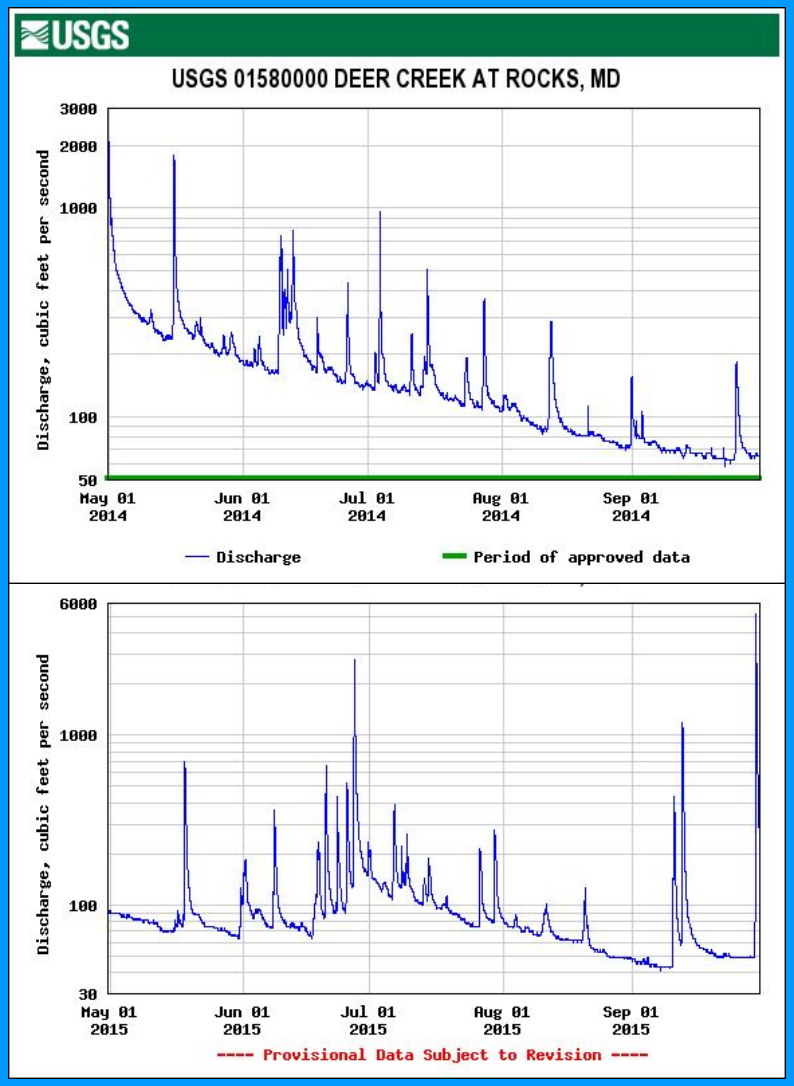
- Shallow areas with less suitable habitat in 2014 were made shallower or dry in 2015. These can be difficult to survey. Mussels may have also migrated or buried in response to changes.

To do

- Determine movement and growth for recaptured mussels within and among sites
- Model rates of survival, growth, movement, and reproduction
- Plan for 2016 and future Deer Creek relocations

Challenges for relocation surveys

- Temperature
  - Affects behavior of mussels and surveyors
- Flow
  - Can effect mussel position (surface vs. sub-surface)
  - Can effect survey methods, detection probability
- Suitable habitat
  - Having enough to meet objectives
  - Influences relocation success



Lessons

- Abnormal conditions pose challenges
  - Re-allocated removal effort in response
  - Consider all possibilities
- Have a plan B for relocation sites
  - Mussels exceeded initial estimate by 2x!
  - Most available habitat was marginal
  - Consider other streams?
- Experience matters
  - Variable detection, catch-rates
  - Relocated mussel movement
- Is PIT tag telemetry data useful?
  - Probably not at this scale with mussels

Thanks to
Martha Stauss – DNR
Kaitlyn Sandy – AFS Hutton Intern
Maryland State Highway Administration
Maryland Parks Service
U.S. Fish and Wildlife Service
Volunteers