



American Eels in Virginia Mountain Streams

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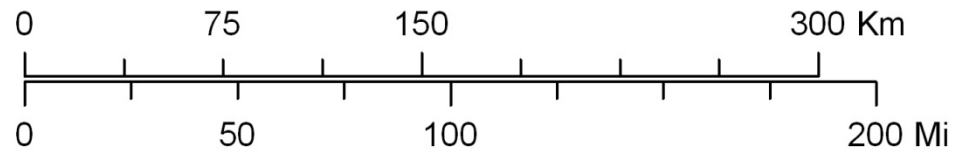
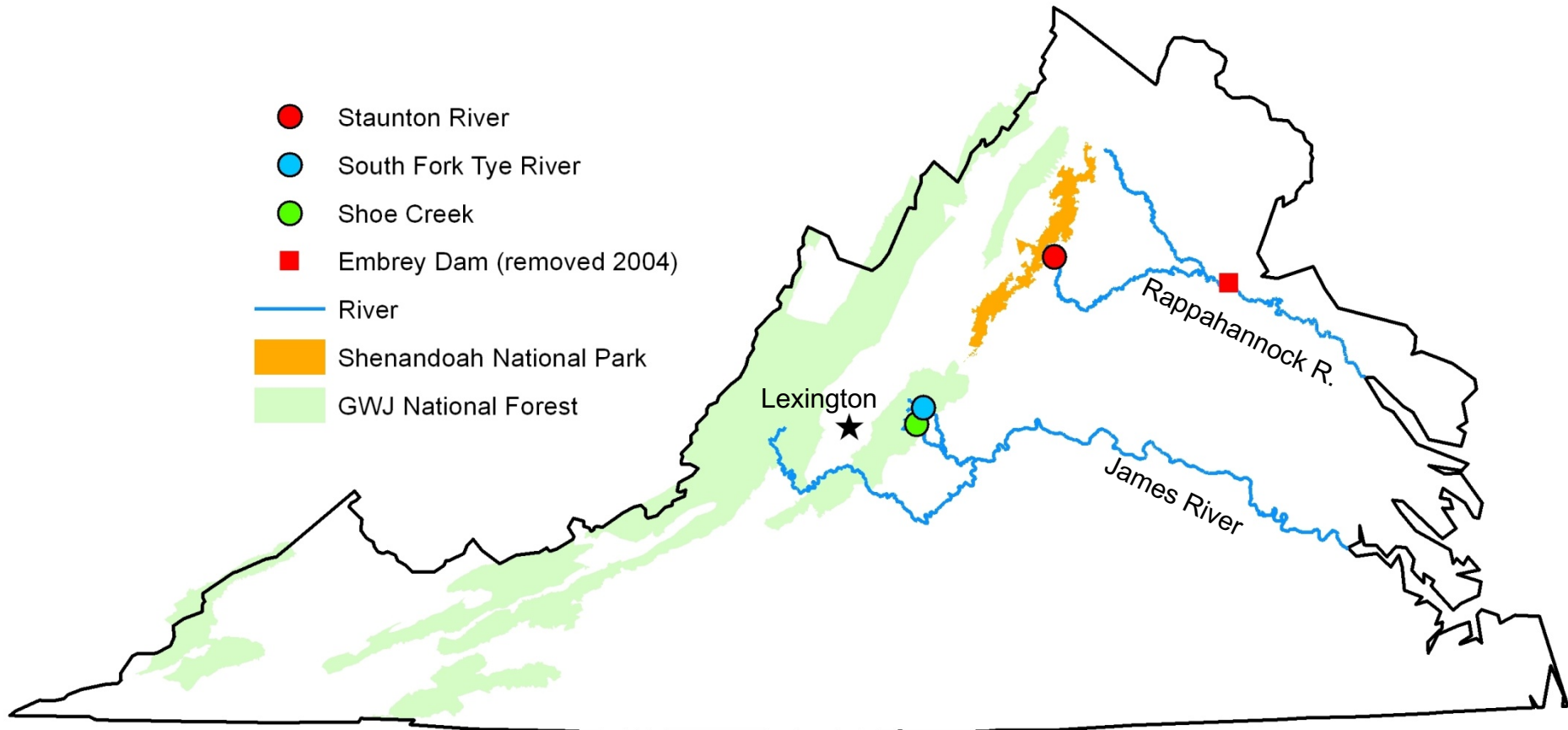


Background/Objectives

- **1999: US Forest Service & VDGIF**
 - Headwater stream eel survey on USFS lands
 - Eels found in several streams in summer
 - Gone in fall – where did they go??
- **2000 – 2001: P. A. Strickland, Virginia Tech**
 - Thesis 2002
 - Habitat preference, pop. density, growth, movement
- **2002 – Present: US Forest Service & VDGIF**
 - Annual sampling for long-term monitoring of growth & movement

Study Sites

- Staunton River
- South Fork Tye River
- Shoe Creek
- Embrey Dam (removed 2004)
- River
- Shenandoah National Park
- GWJ National Forest



S.F. Tye River



Stream Description

Habitat

- pool, riffle
- gravel, cobble, boulder
- gradient 5%
- Avg. width 8 m

Fish

- American Eel
- Blacknose Dace
- Bluehead Chub
- Brook Trout
- Central Stoneroller
- Longnose Dace
- Mountain Redbelly dace
- Rosyside Dace
- Torrent Sucker
- *and others*

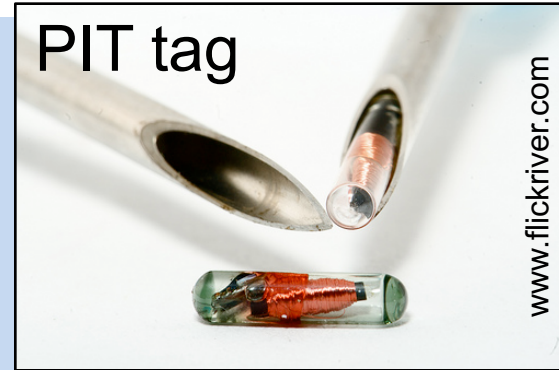
Shoe Creek



Methods

- **2000-2001 P. A. Strickland**

- 2 km reaches, 3 streams
- Multiple pass efishing for population est.
- Radio telemetry for movement & habitat preference
- PIT (passive integrated transponder) tagging for growth estimates



- **2002-Present USFS**

- 2 km reaches, 2 streams
- Single pass efishing in summer
- PIT tagging
- Location, length, & weight





P. A. Strickland's Results (2000-2001)

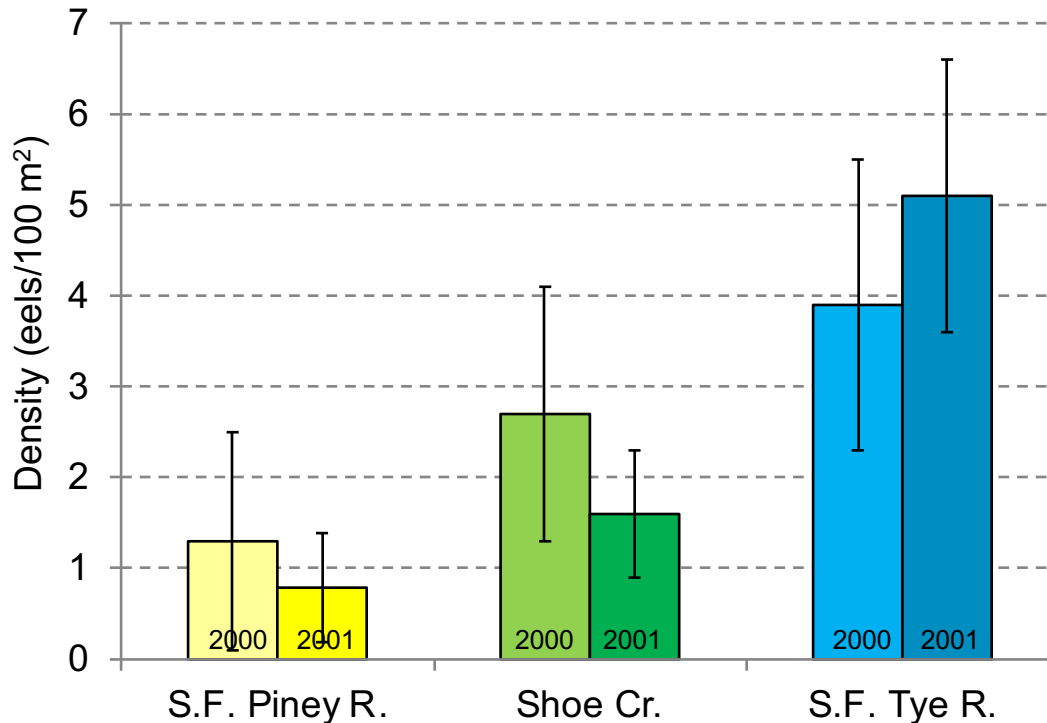
- Habitat Preference (telemetry)
 - Deep pools; large substrate
- Movement (telemetry)
 - Greatest in summer, least in winter
 - Daily activity greatest at night
 - Mid-fall to mid-spring, eels moved very little, burying in substrate and under stream banks
- Density estimates, population estimates, growth rates

Strickland, P.A. 2002. American eel distribution and growth in selected tributaries of the James River. MS Thesis, Virginia Polytechnic Institute and State University, Blacksburg.
<http://scholar.lib.vt.edu/theses/browse/>



P. A. Strickland's Results (2000-2001)

USFS continues monitoring in Shoe Cr. & Tye R. b/c of high densities.



Comparison Data:

<2 eels/100 m² in James R. & Shenandoah R. drainage streams
(Smogor et al. 1995, Goodwin and Angermeier 2003)

Strickland & USFS Results (1999-2018)

Results:

- PIT tagging
- Size
- Growth
- Range
- Recapture rates





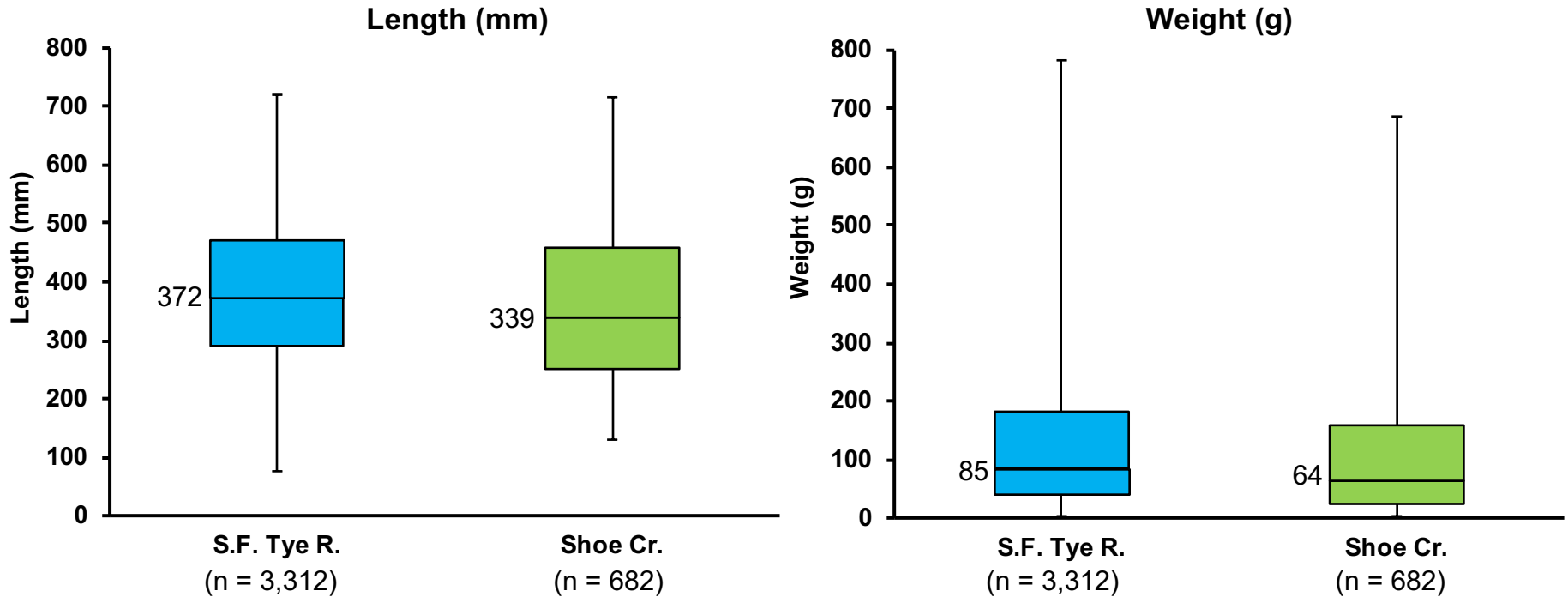
Tagging Summary

	S.F. Tye River	Shoe Creek
# Tag Yrs.	18 (2000 – 2018*)	6 (1999 – 2004)
# Recap. Yrs.	17 (2001 – 2018*)	11 (2000 – 2010)
# Captured (new eels only)	1,978	543
# Tagged	1,748	283
# Recaptured (no duplicates)	770 (44%)	115 (41%)

*Did not sample in 2011

Size

Length and weights typical for VA streams.



Comparison Data:

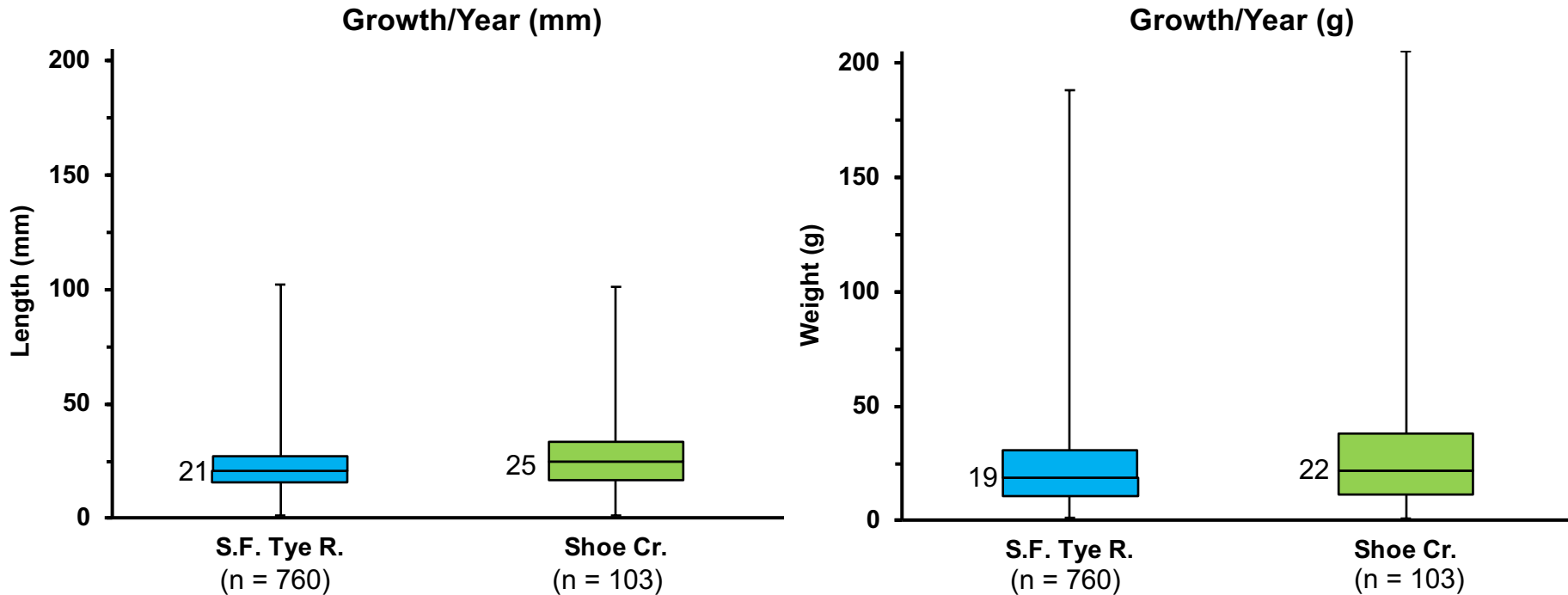
Adults **220 – 1,000 mm** (Jenkins and Burkhead 1993)

Lower Potomac tribs, **76 - 820 mm** (Goodwin and Angermeier 2003)

Shenandoah drainage, **292 – 1,023 mm** (Goodwin and Angermeier 2003)

Annual Growth

Growth variable; comparisons difficult.



Comparison Data:

Shenandoah drainage, **43 mm/yr.** (Goodwin 1999)

Coastal GA streams, **57-62 mm/yr.** (Helfman et al. 1984)

Coastal RI streams, **23-33 mm/yr.** (Oliveira 1999)

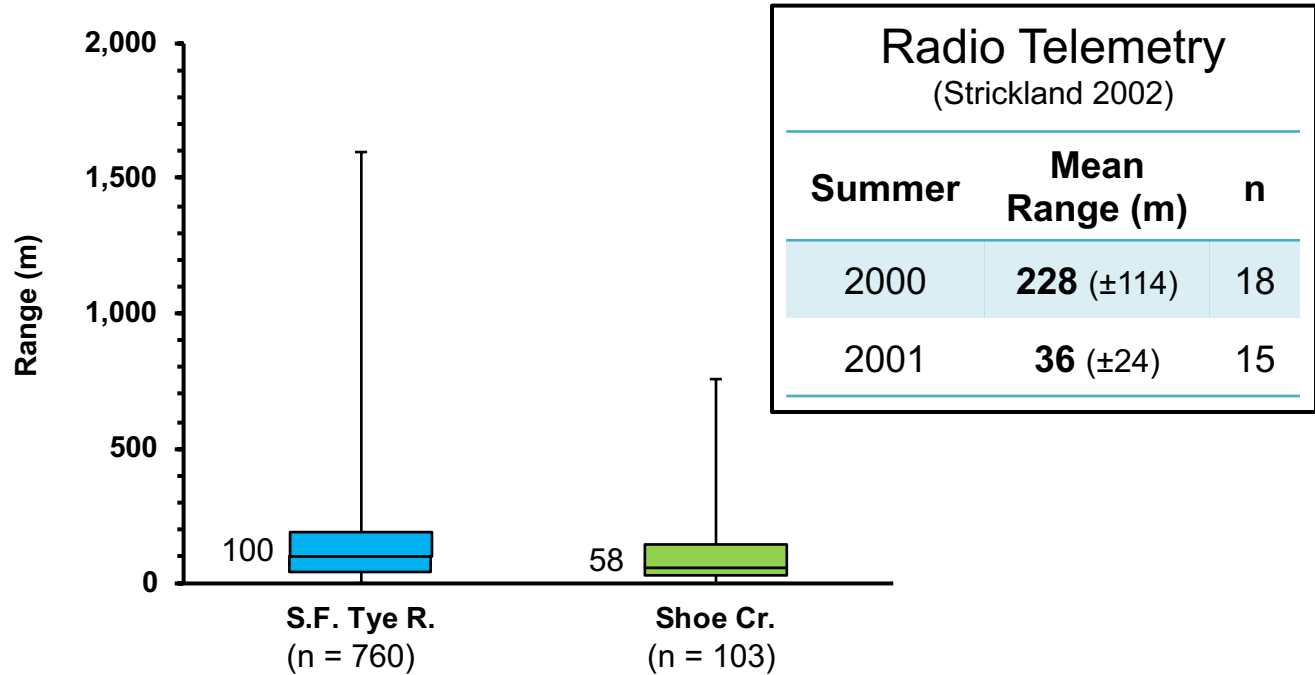
Coastal ME rivers, **18-32 mm/yr.** (Oliveira and McCleave 2002)



Range

i.e. the difference between min. & max. capture distance

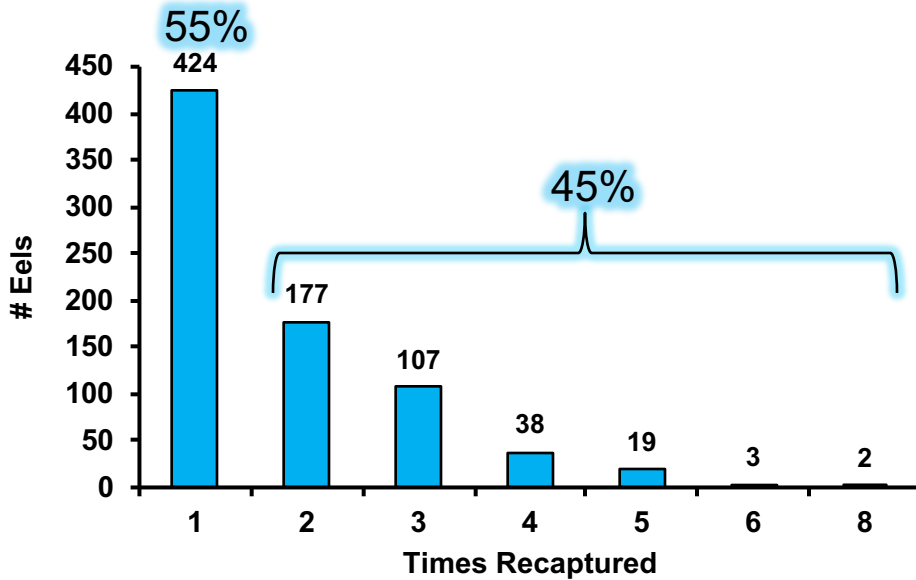
When recaptured, the majority of eels were very close to the location they were 1st captured at 1-17 years earlier.



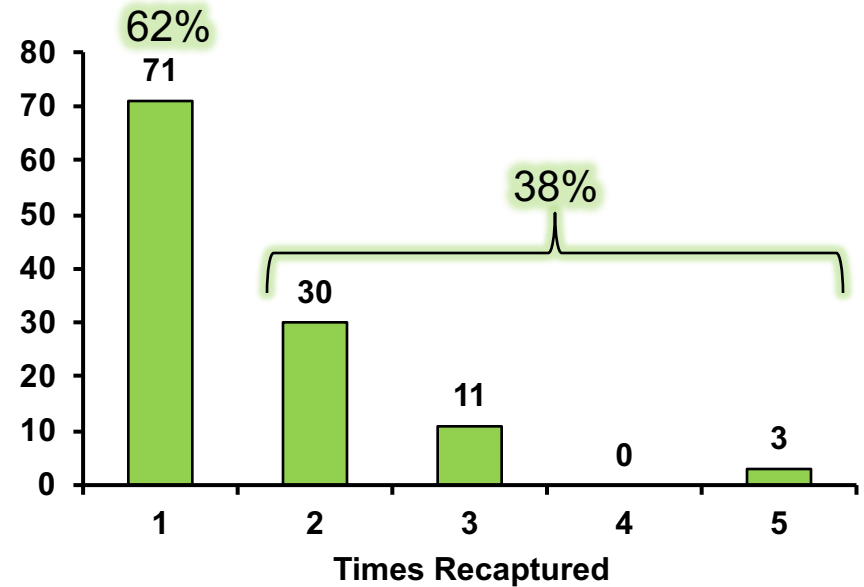
Multiple Recaptures

~40% of recaptured eels were recaptured 2 or more times.

S.F. Tye River (1,748 tagged, 770 recap.)



Shoe Creek (283 tagged, 115 recap.)





New Recaptures

Every year we sample, we often catch eels that have never been recaptured before!

New Recaptures per Sample Year

	Tag Year	Total Tagged	New Recaptures per Sample Year																	
			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2013	2014	2015	2016	2017	2018
S. F. Tye River	2000	279	97	32	11	8	7	6	4	4	2	5	1	2	1		1	1		
	2001	225	97	65	43	45	32	24	18	16	14	14	7	4	2	1	1	1	0	
	2002	149																		
	2003	76																		
	2004	116																		
	2005	72																		
	2006	49																		
	2007	61																		
	2008	67																		
	2009	62																		
	2010	88																		
	2012	98																		
	2013	38																		
	2014	73																		
	2015	47																		
	2016	59																		
	2017	112																		
Shoe Creek	1999	68	22	5	1	2	1	1												
	2000	93		19	7	3	4	1	1	1	2	1								
	2001	41			3	4	2	1	1	3										
	2002	22				2	3	1	2	1	1									
	2003	16					2	1		1		1	1							
	2004	43						1	5	3	4		1							



New Recaptures

If you sample once after tagging, the % recaptured is low.

	Tag Year	Total Tagged	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2013	2014	2015	2016	2017	2018	Total New Recaps	% Recaps at 1st Sample Yr.	Total % Recaps	
S. F. Tye River	2000	279		97	32	11	8	7	6	4	4	2	5	1	2	1		1	1		182	35%	65%	
	2001	225			56	18	15	10	3	4	5	2	4			3					120	25%	53%	
	2002	149				25	16	8	8	3	4	2	4	1						1	72	17%	48%	
	2003	76					11	8	3	1	4	1	3	4	1	1		1		1	39	14%	51%	
	2004	116						21	8	3	6	7	4	10	4	3		1	1		68	18%	59%	
	2005	72							10	5	8	5	3	3	1	1			1	1	38	14%	53%	
	2006	49								6	6	2	2	4			1				21	12%	43%	
	2007	61									8	5	2	7	4			1	2	3	1	32	13%	52%
	2008	67										4	6	8	1	2		1		4	26	6%	39%	
	2009	62											10	5	1	6	1	2	1		26	16%	42%	
	2010	88												13	4	6	4	3	5		35	15%	40%	
	2012	98													8	8	6	9	7	4	42	8%	43%	
	2013	38														3	3		3	1	10	8%	26%	
	2014	73															5	10	4	4	23	7%	32%	
	2015	47																1	5	3	9	2%	19%	
	2016	59																	9	3	12	15%	20%	
	2017	112																		15	15	13%	13%	
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Shoe Creek	1999	68	22	5	1	2	1		1												32	32%	47%	
	2000	93		19	7	3	4	1		1	1	2	1								39	20%	42%	
	2001	41			3	4	2	1	1	3											14	7%	34%	
	2002	22				2	3	1	2	1	1										10	9%	45%	
	2003	16					2	1		1	1	1	1								6	13%	38%	
2004	43						1	5	3	4		1								14	2%	33%		
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New Recaptures

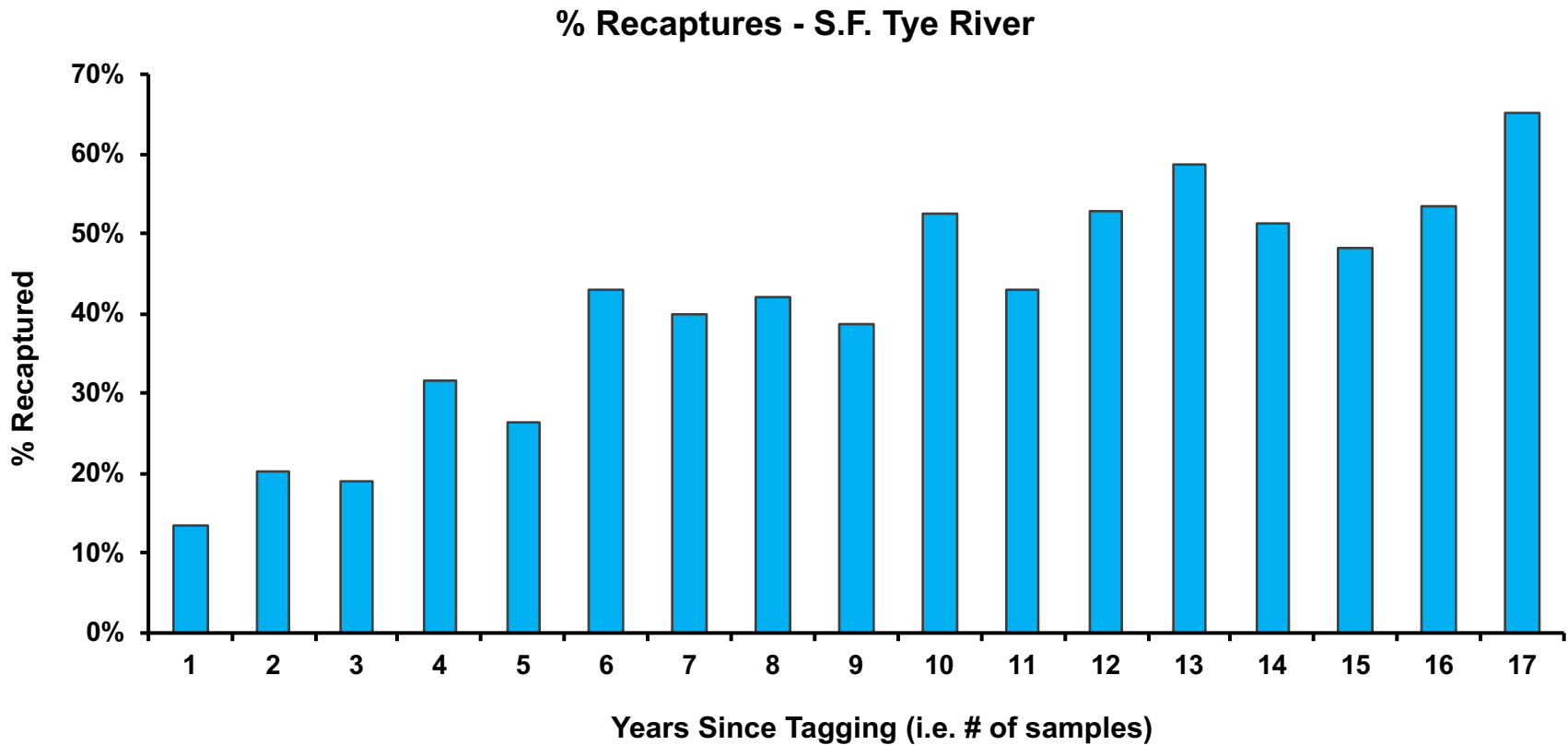
Additional sample years increases % recaptured.

	Tag Year	Total Tagged	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2013	2014	2015	2016	2017	2018	Total New Recaps	% Recaps at 1st Sample Yr.	Total % Recaps	
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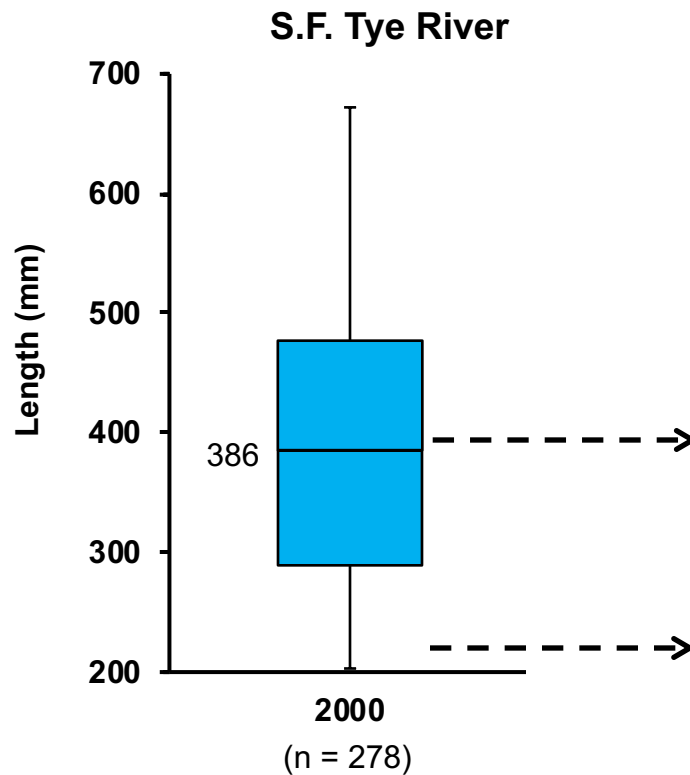
Recapture Rates

The more years we sample, the higher the % recaptured.



Eels Recaptured 10 Years Later

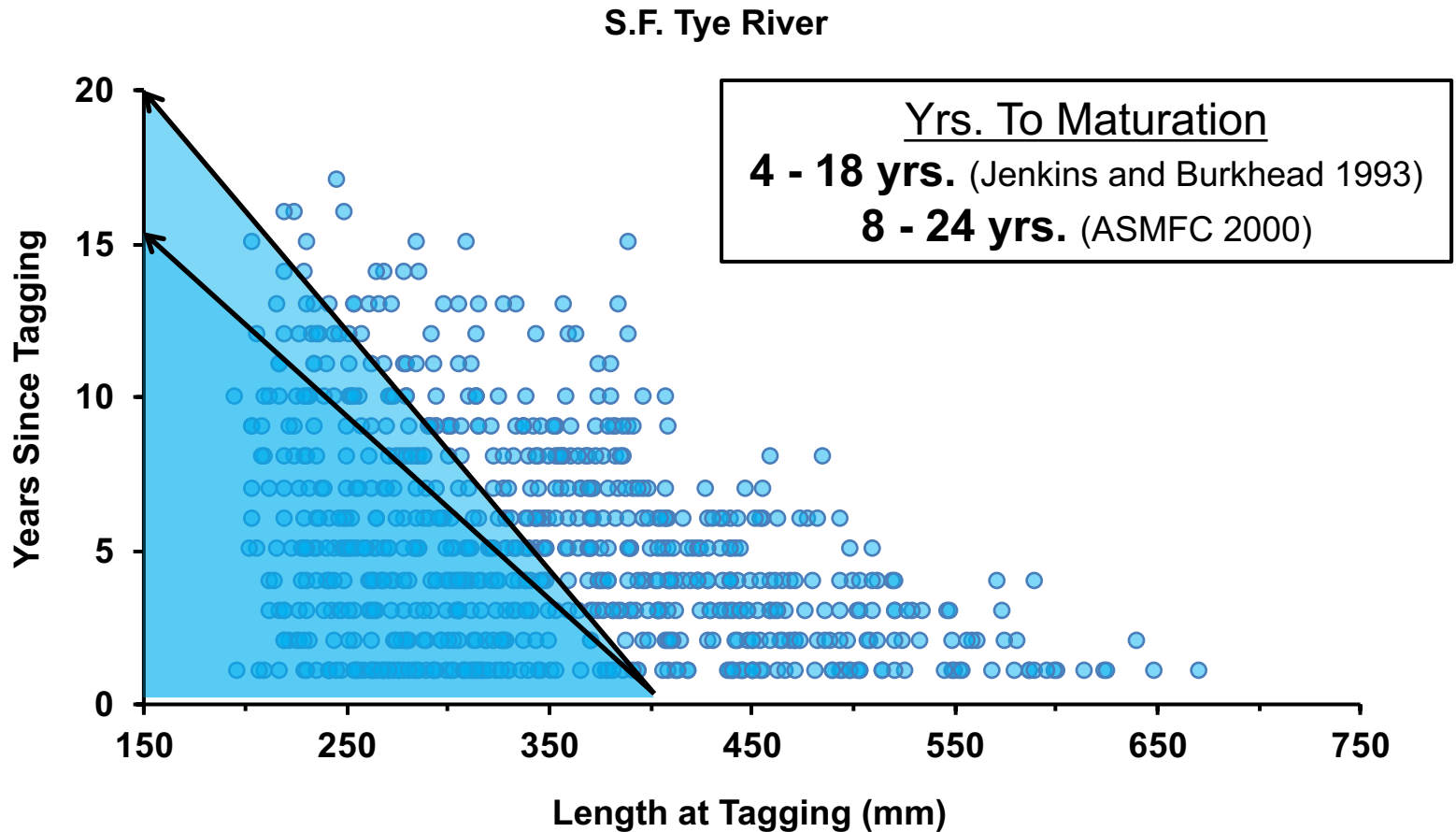
Tagging small eels offers long-term recapture possibilities.



Eels recaptured 10 yrs. later were <400 mm when tagged.

Eel Length vs. Years Since Tagged

Estimated 15 – 20 years of recapture data for eels tagged when <400 mm.



Study Sites



Staunton River



Stream Description

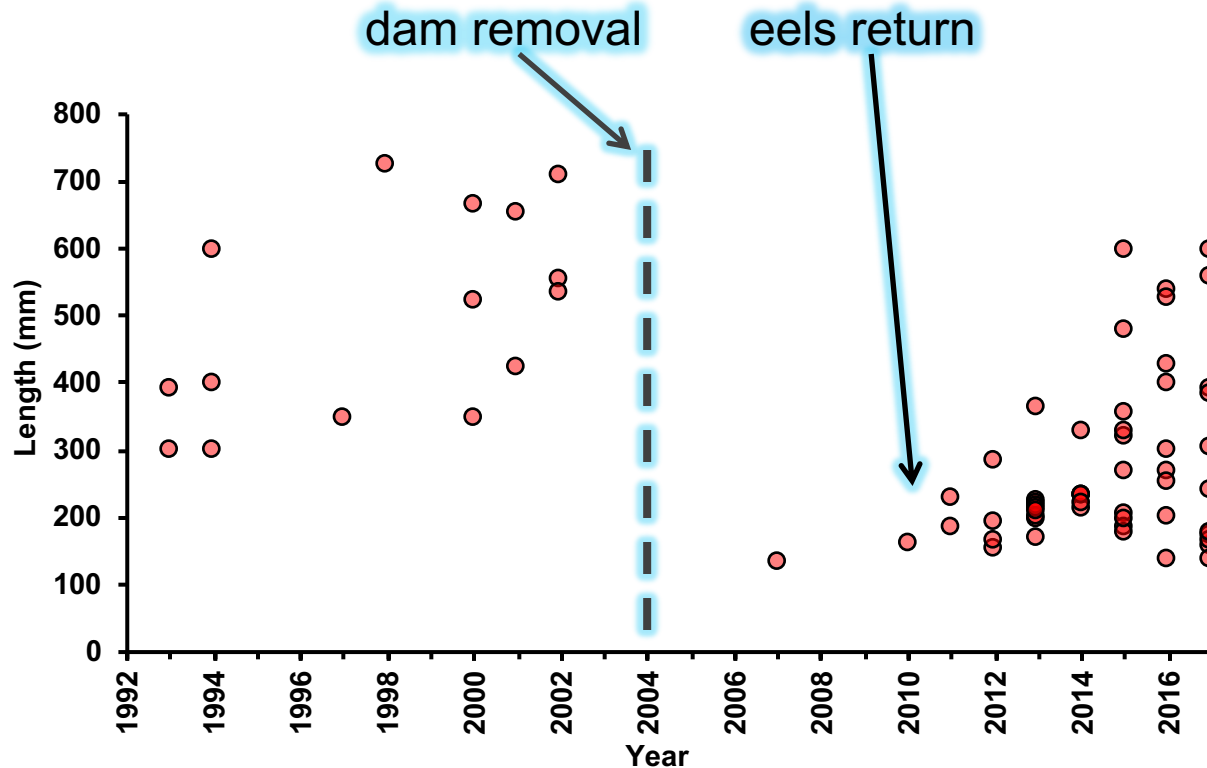
Habitat

- pool, riffle
- gravel, cobble, boulder
- gradient 10%
- avg. width 3.5 m

Fish

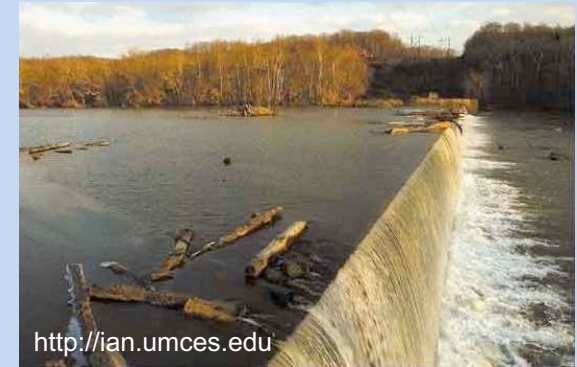
- American eel
- Blacknose dace
- Bluehead chub
- Brook trout
- Common shiner
- Fallfish
- Longnose dace
- Mottled sculpin
- Mountain redbelly dace
- Rosyside dace
- Smallmouth bass
- Torrent sucker
- White sucker

Eels in the Staunton River



Embrey dam removed 2004

- 6.7 m high (22 ft)
- Located 153 km (95 mi) downstream of Staunton R.



Hitt et al. also found an increase small eels after the removal of Embrey dam.

Nathaniel P. Hitt, Sheila Eyler & John E. B. Wofford (2012): Dam Removal Increases American Eel Abundance in Distant Headwater Streams, Transactions of the American Fisheries Society, 141:5, 1171-1179



Conclusions

- Highly mobile or highly sedentary depending on life stage
- Don't move much in headwaters
- Stay a long time
 - Local conditions important
- Long-term studies have great benefits
 - High recapture %
- Small eels return in Staunton



Future Work

- Continue annual sampling
- Additional data analysis
 - Annual mortality
- Expand PIT tagging to Rapidan headwaters?
- Any PIT monitoring downstream on James River?

