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Natal Origins of Rainbow Trout: Glen Canyon and Marble Canyon

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Natal Origin - Study Objectives

1. Quantify extent of rainbow trout movement from Lees Ferry into Marble Canyon and LCR inflow
2. Determine factors that drive trout movement (density, food, growth, turbidity, HFEs, etc.)
3. Quantify extent of local reproduction below Lees Ferry.
4. Estimate abundance of rainbow trout in LCR inflow reach for FWS Biological Opinion and ‘Trigger’
5. Continue monitoring juvenile humpback chub abundance, growth, and survival in the LCR inflow reach (BioOp/trigger)
6. Relate chub survival and growth to trout abundance and temperature (critical uncertainty)

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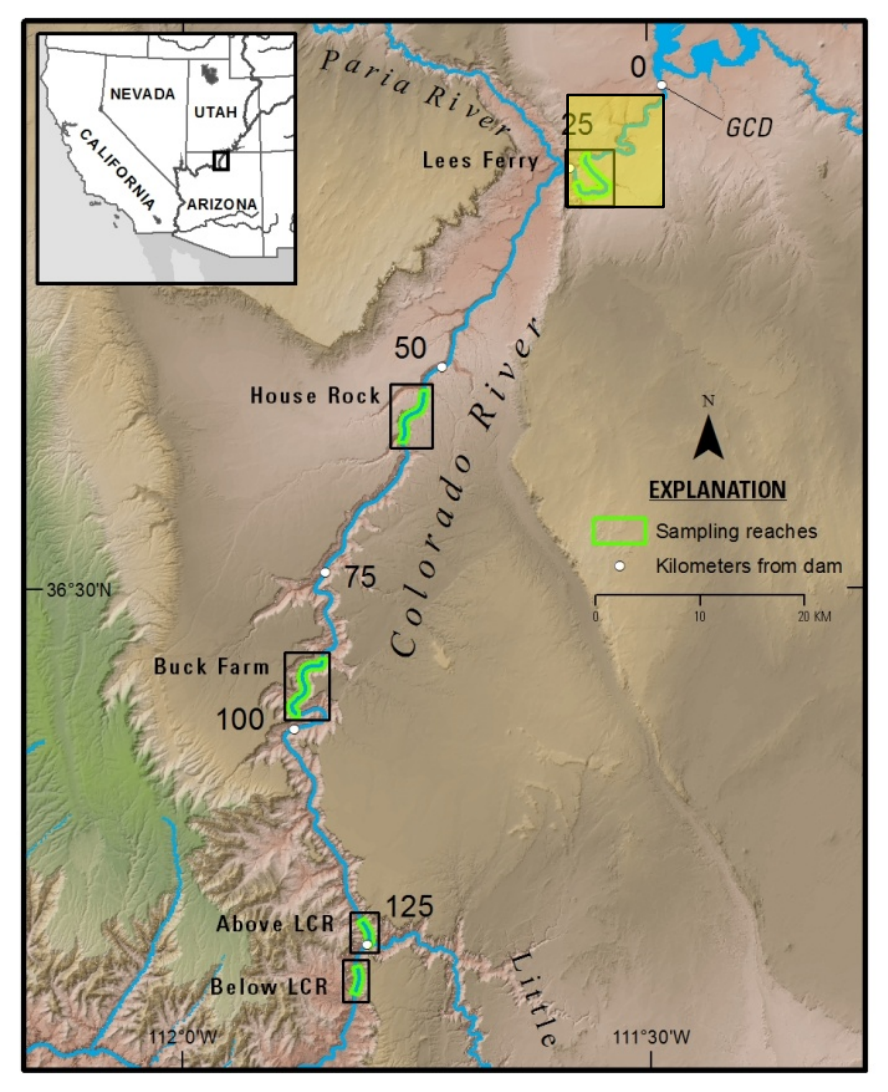
Sampling Design



- **GCD to Lees Ferry marking and tag recovery**
  - Tag trout >75 mm
  - ~ 10,000 marked/yr
  - 2 trips per year
  - Nov. ‘11, Oct & Dec ‘12, ’13, ‘14
- **Quarterly trips for marking and tag recovery by reach**
  - Apr, Jul, Sep, Jan
  - LEES FERRY (I, -5.5 to -2.1 RM)
  - HOUSE ROCK (II, 17.2-20.6 RM)
  - BUCK FARM (III, 38.2 to 41.6 RM)
  - ABOVE LCR (IVa, 60.2 to 61.2 RM)
  - BELOW LCR (IVb, 63.4 to 64.9 RM)

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Summary of RBT Catch and PIT Releases

	Total Catch	PIT Tag Releases					
Name:	**All Reaches**	**GLC**	**GLC**	**UMC**	**MMC**	**LMC**	**DSCLR**
Reach:	**GLC-IVb**	**excl. RD I**	**RD I**	**RD II**	**RD III**	**IVa**	**IVb**
Nov-11	16,440	10556	929				
Apr-12	11,775		529	552	549	317	119
Jul-12	11,641		675	795	848	339	197
Sep-12	17,897		536	788	842	305	229
Oct-12	22,381	4783	305				
Dec-12	12,490	3976	278				
Jan-13	12,167		625	776	987	347	336
Apr-13	9,765		716	1,010	879	367	135
Jul-13	8,437		734	828	882	428	279
Sep-13	13,787		994	1,068	741	478	351
Oct-13	12,512	5576	262				
Dec-13	8,175	5226	310				
Jan-14	8,742		437	1,209	1,198	554	398
Apr-14	7,109		615	1,147	1,155	387	195
Jul-14	6,585		760	1,162	933	428	390
Sep-14	13,156		1047	1,395	1,155	681	456
Oct-14	17,530	6,670	685				
Dec-14	12,739	6,765	629				
Total	223,328	43,552	11,066	10,730	10,169	4,631	3,085
	Total Tags	83,233		Total Tags in Lees Ferrry		54,618	

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Summary of PIT Recaptures

Name:	GLC	GLC	UMC	MMC	LMC	DSCLR
Reach:	excl. RD I	RD I	RD II	RD III	IVa	IVb
Nov-11	262	52				
Apr-12		91	145	206	149	42
Jul-12		117	220	315	137	60
Sep-12		72	196	213	124	60
Oct-12	334	41				
Dec-12	167	52				
Jan-13		110	204	202	132	66
Apr-13		103	256	229	133	43
Jul-13		132	201	234	135	59
Sep-13		112	179	128	126	41
Oct-13	538	32				
Dec-13	287	46				
Jan-14		56	245	216	120	94
Apr-14		52	188	215	125	48
Jul-14		79	222	160	93	52
Sep-14		96	1			
Oct-14	333	35				
Dec-14						
Total	1,921	1,278	2,057	2,118	1,274	565
	Total Recaptures	9,213		Percent of Tags Recaptured		11.1%

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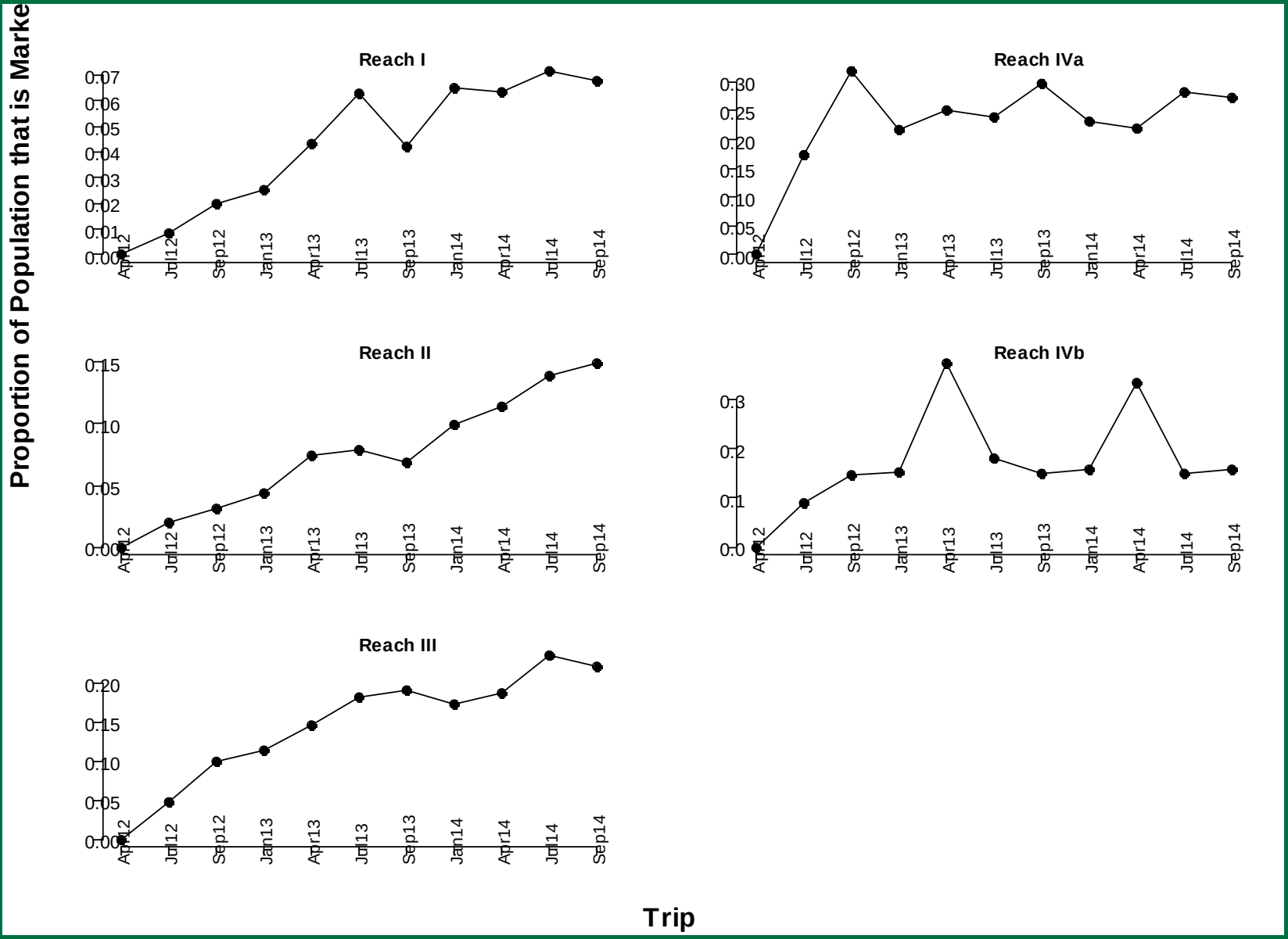
Proportion of Population that is Marked



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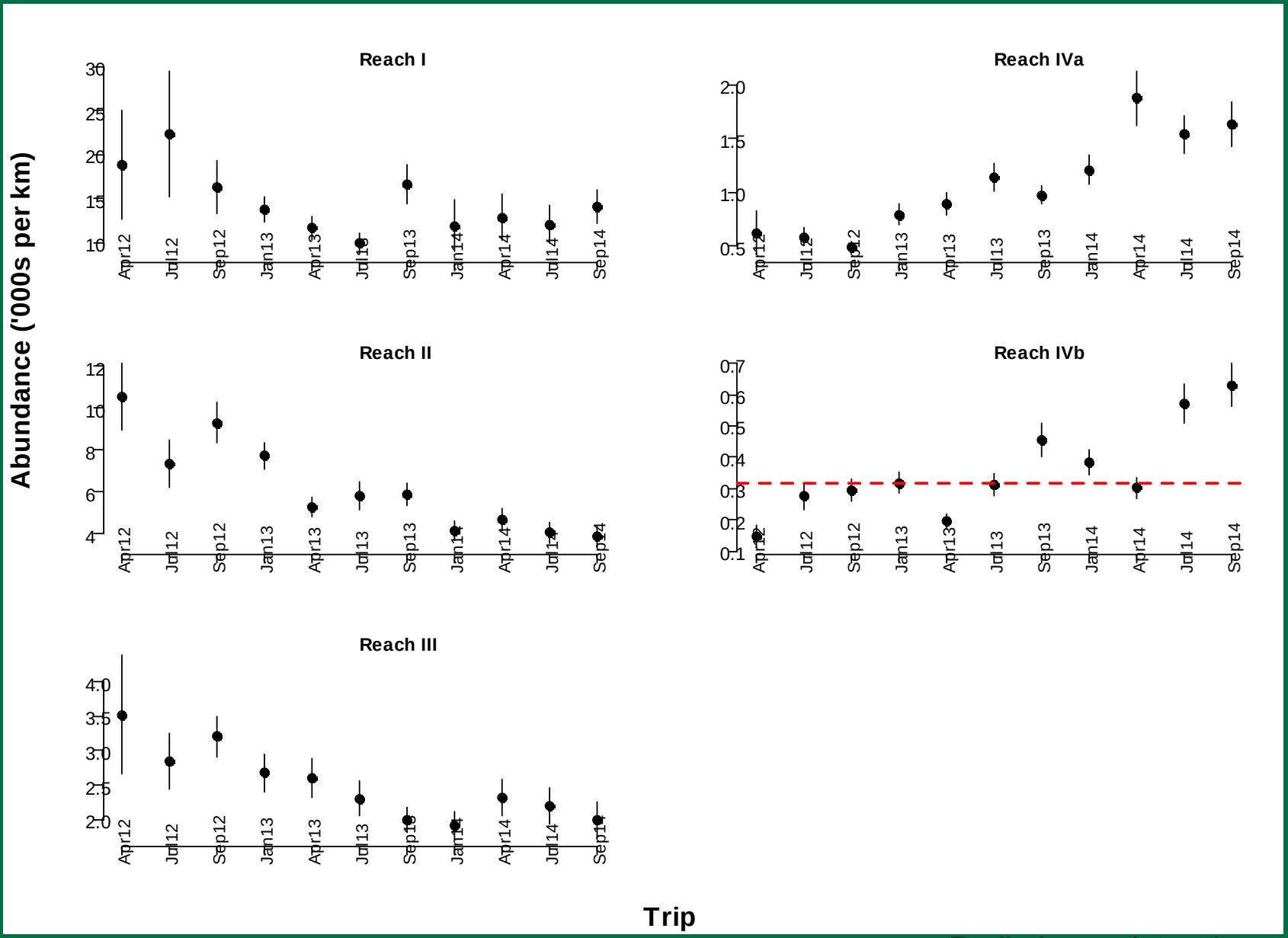
Abundance By Reach



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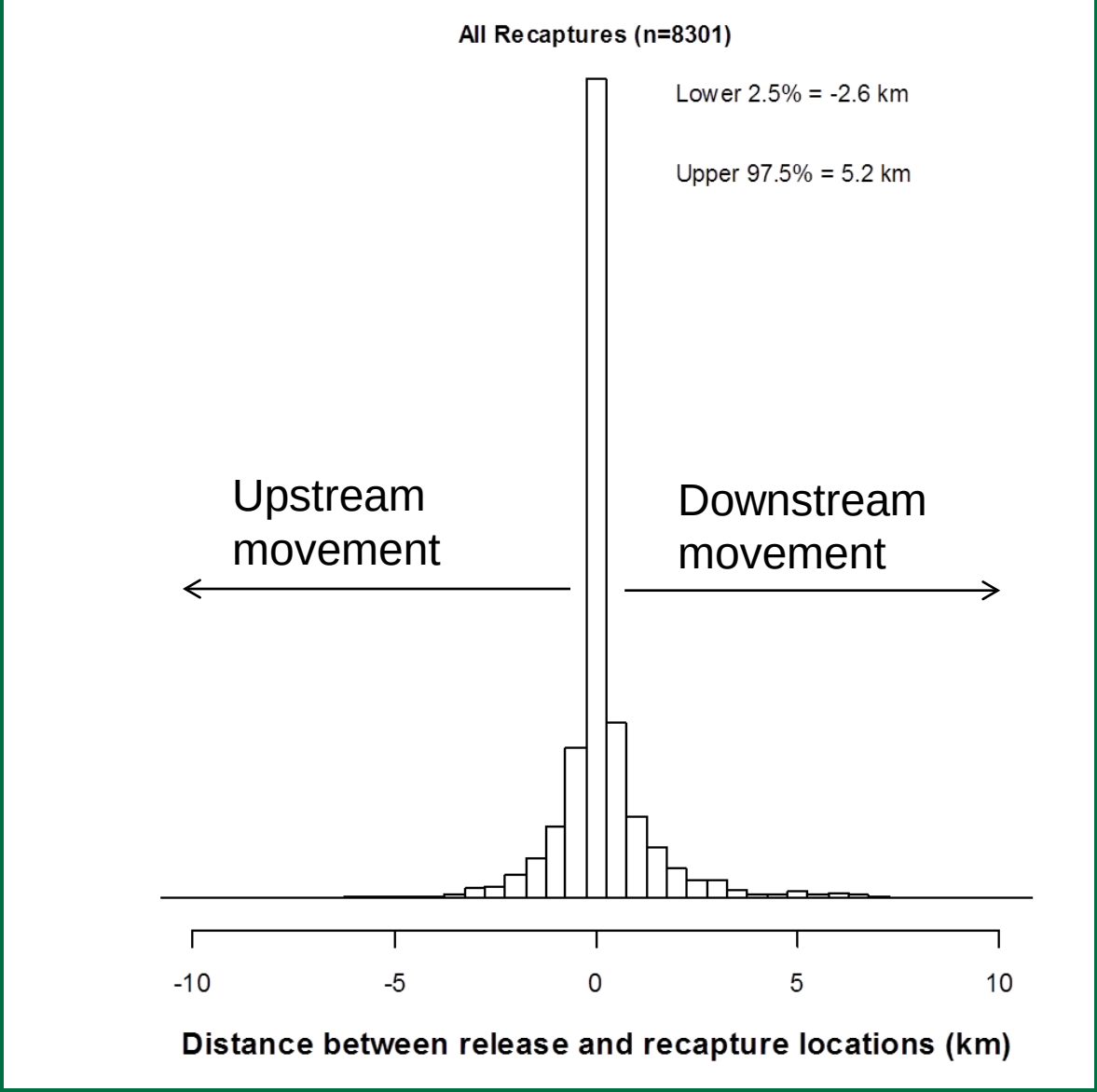
Movement



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Movement from Lees Ferry

- 54,618 trout PIT-tagged in Lees Ferry.
- Of 2,239 recaptures of trout released in Lees Ferry (up to and including Sep14), only 11 have been recaptured in downstream reaches.
- 8 of 11 (73%) recaptures were from Nov. 2011 cohort, which represents only 21% of trout PIT-tagged in Lees Ferry.
- Thus a higher proportion of 2011 cohort that was marked moved downstream compared to cohorts marked in later years.
- The proportion of trout emigrating from Lees Ferry is variable and may be higher for very abundant cohorts.

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Longer Distance Movement Among Reaches

		Recapture Reach					Outside of Release Reach	
		GC	II	III	IVa	IVb	# of Recaps	% of Recaps
Release Reach	GC	2228	8	1	0	2	11	0.5%
	II	13	1999	12	8	6	39	1.9%
	III	1	8	2087	10	7	26	1.2%
	IVa	0	0	2	1153	67	69	5.6%
	IVb	1	0	1	11	541	13	2.3%

Recaptures from Sep 2014 Trip

		Recapture Reach					# of Recaps Outside of Release Reach	% of Recaps in Sep2014 to Total
		GC	II	III	IVa	IVb		
Release Reach	GC	214	2	1	0	1	4	36.4%
	II	5	590	8	4	4	21	53.8%
	III	0	3	365	4	3	10	38.5%
	IVa	0	0	0	201	15	15	21.7%
	IVb	0	0	0	4	71	4	30.8%

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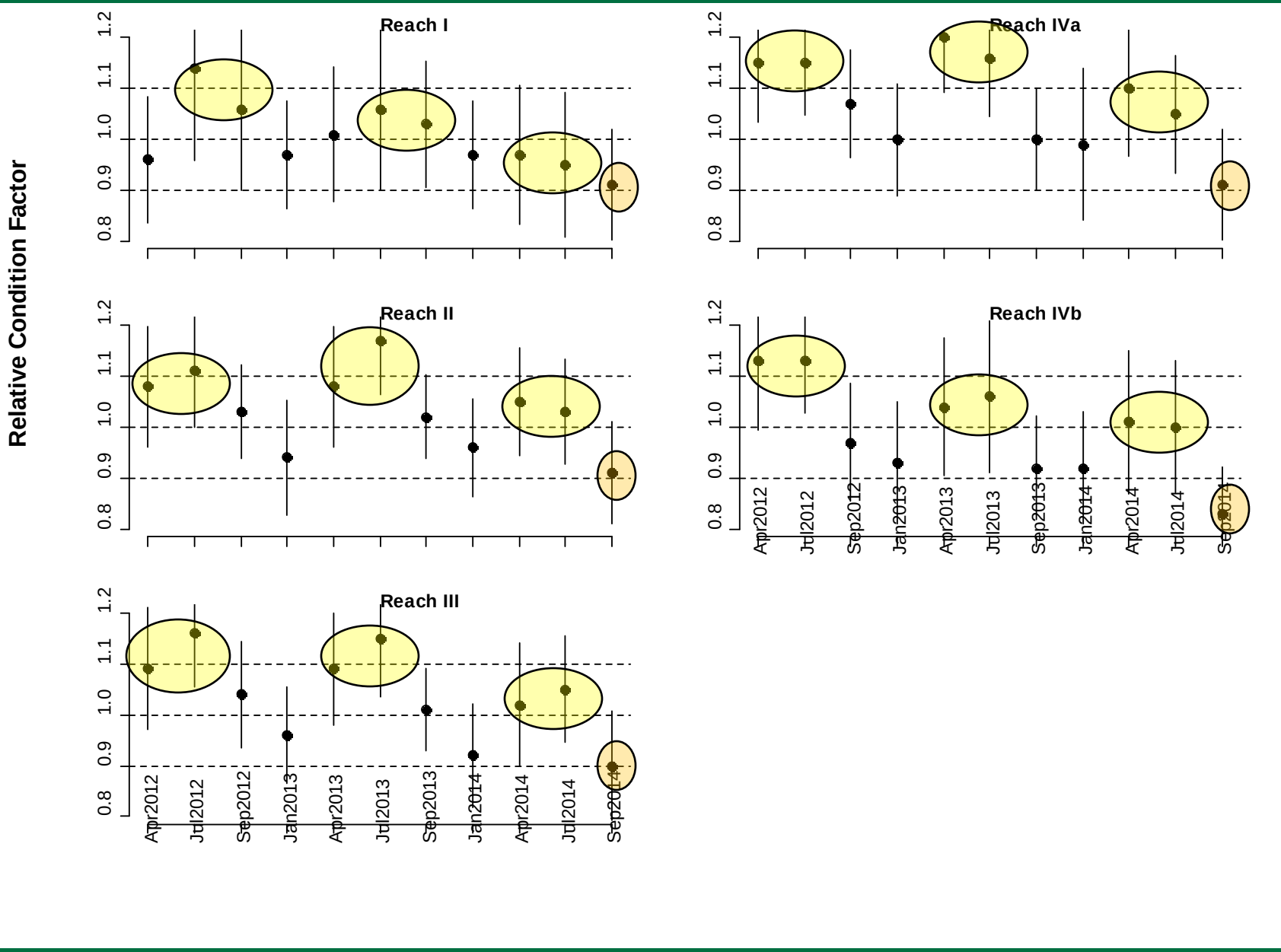
Trends in Condition Factor



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Estimated Percentage Movement from Lees Ferry and Marble Canyon Reaches to LCR Reaches

%		Destination Reach	
		IVa	**IVb**
Source Reach	**I**	0.01	0.02
	II	0.14	0.05
	III	0.20	0.18

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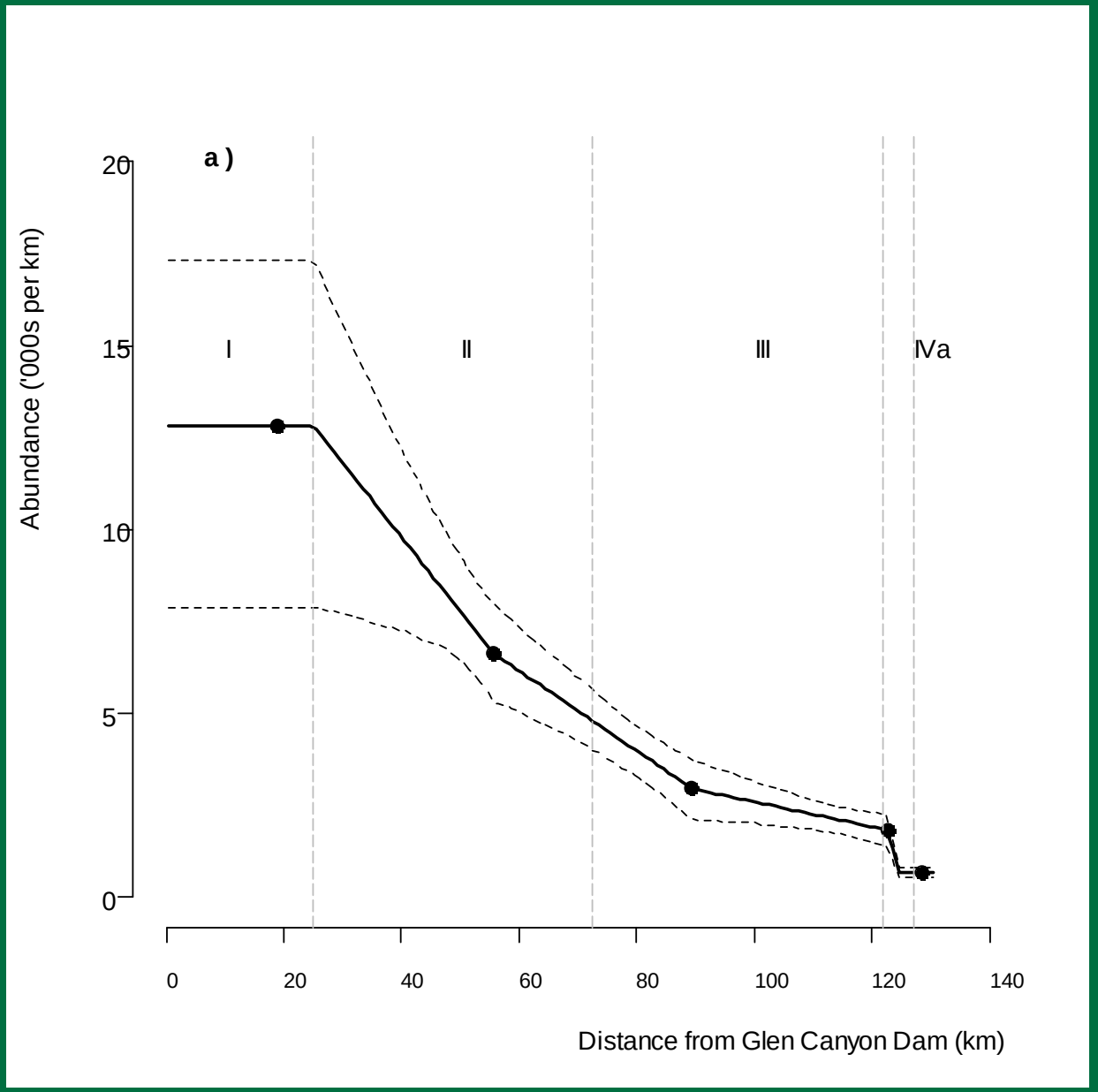
Interpolated Abundance GCD-IVb



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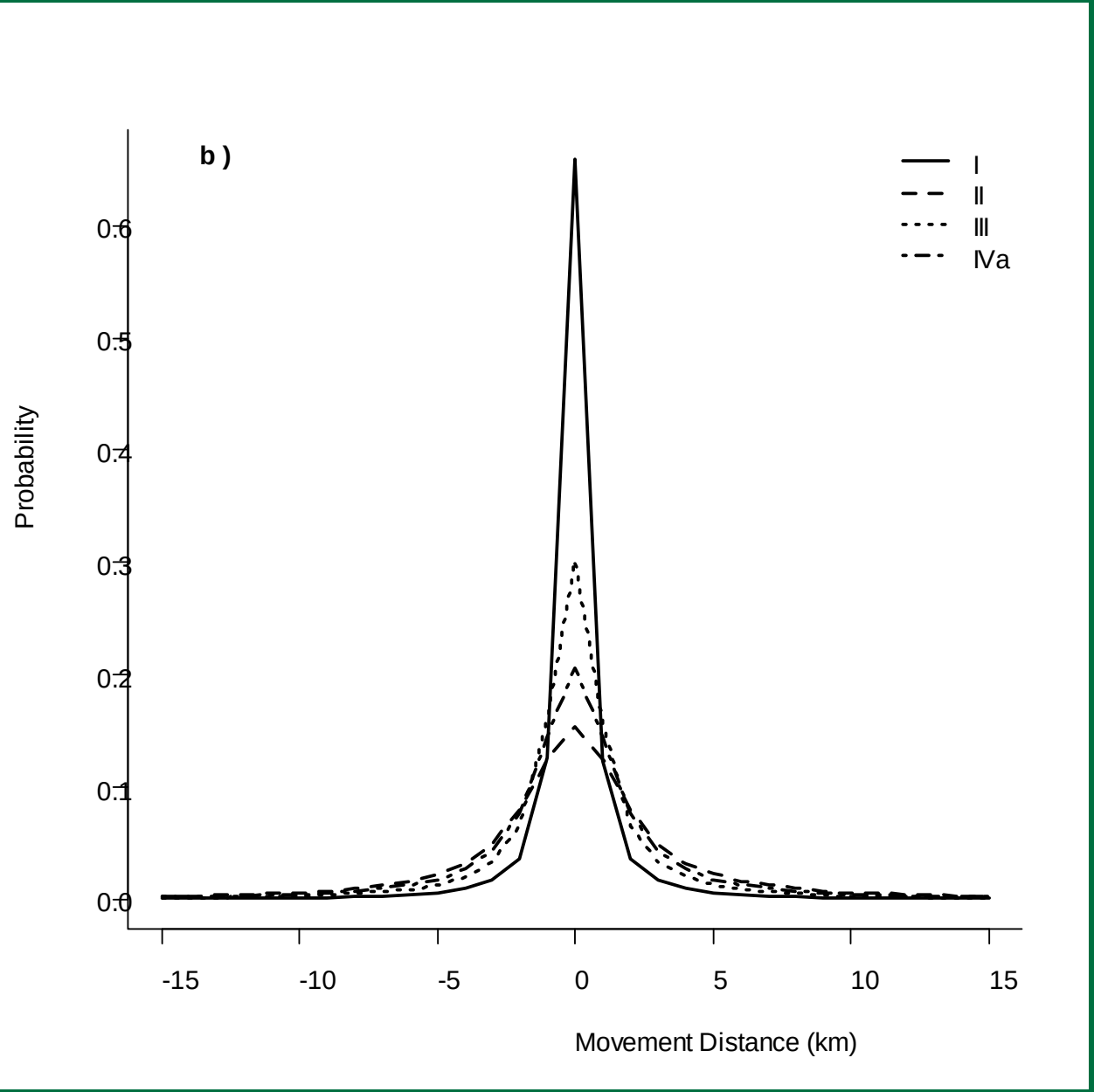
Movement Distributions from Source Reaches



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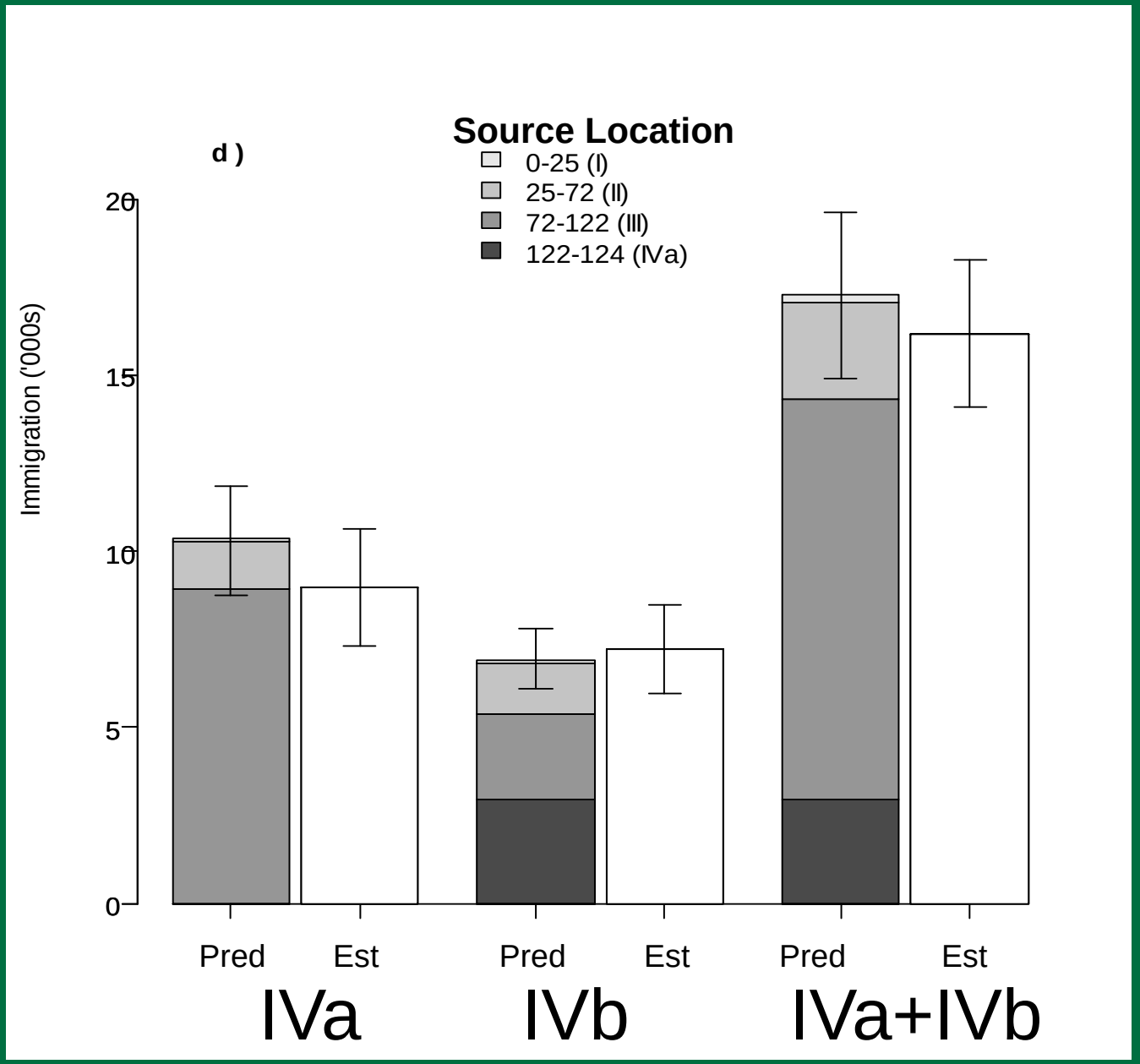
Predicted Immigration to LCR Reaches



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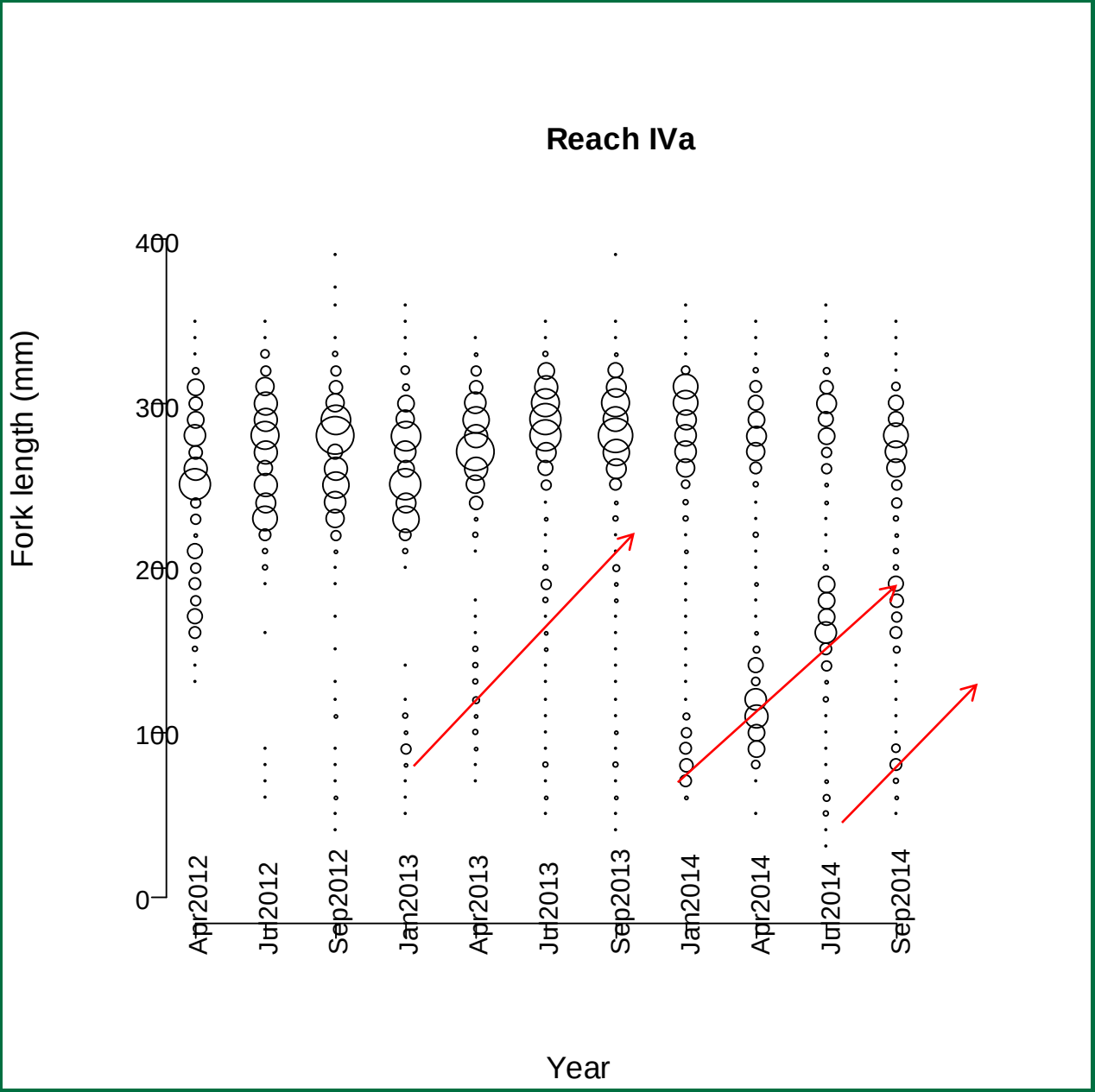
Local Recruitment



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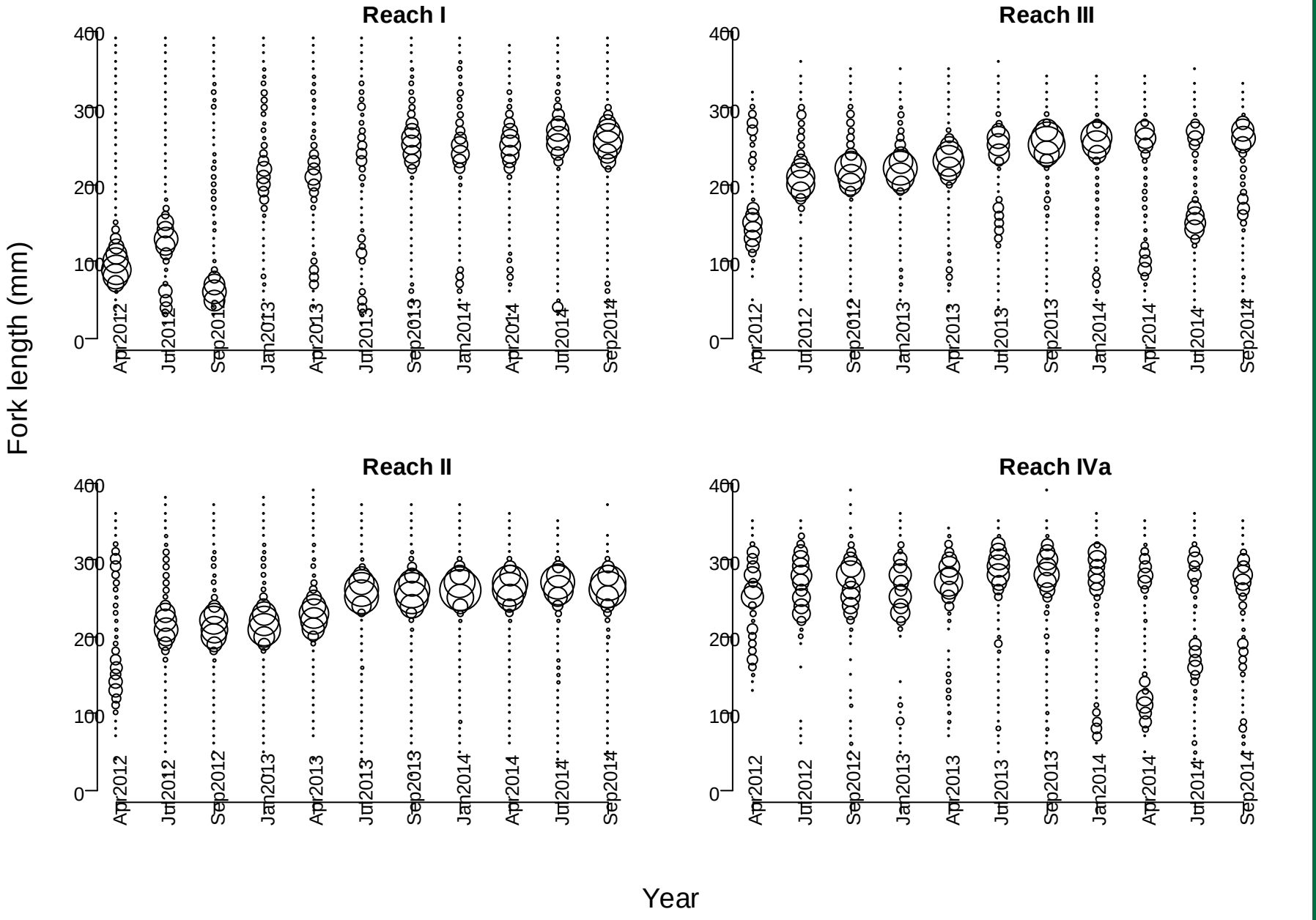

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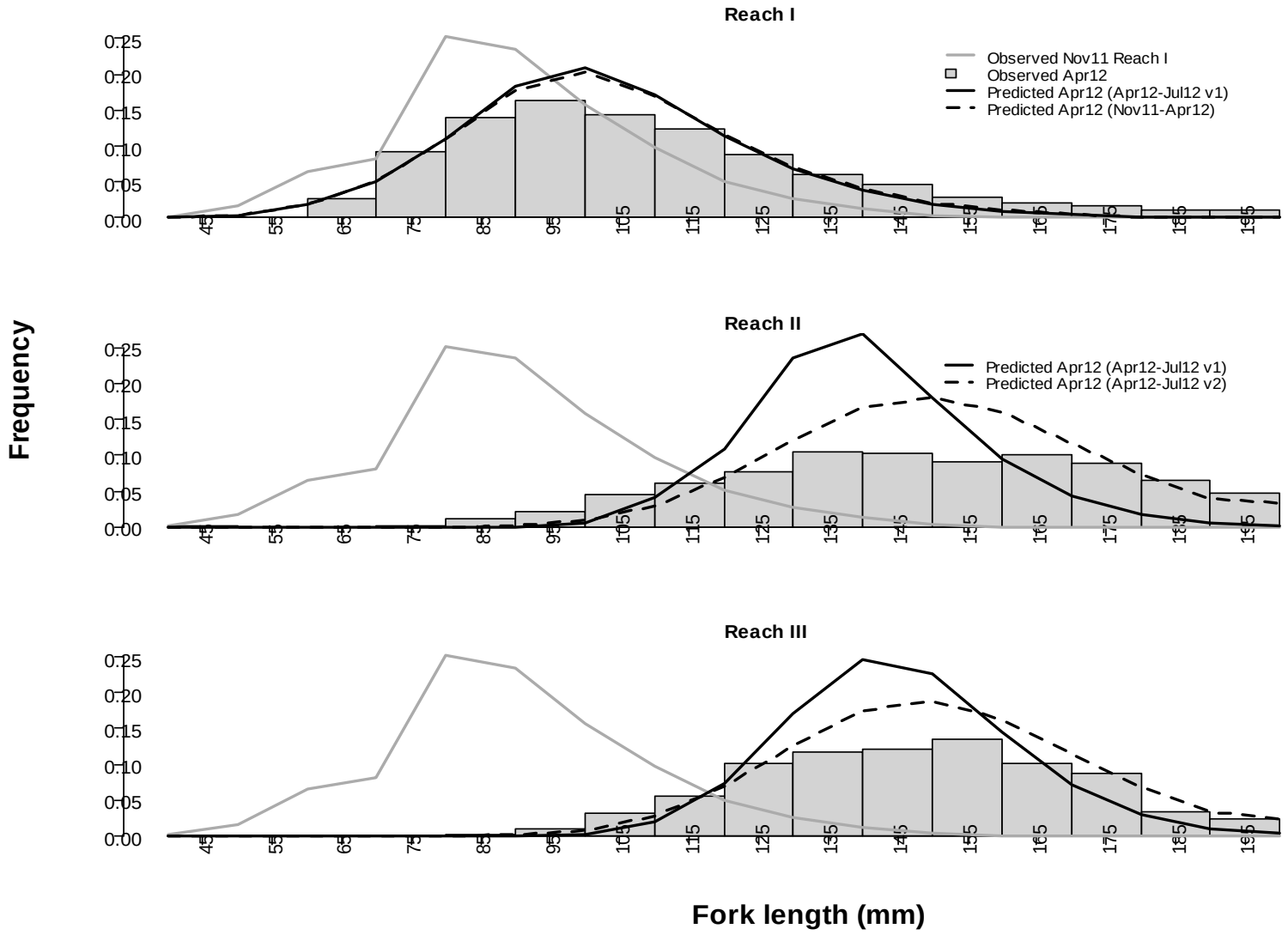
Origin of 125-200 mm Trout in Upper and Middle Marble Canyon on Apr12 Trip



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Conclusions

1. **Abundance**
   a) High abundance in Lees Ferry and Upper Marble Canyon
   b) Much lower abundance near LCR
   c) Declining abundance in upstream reaches and increasing abundance at LCR reaches
2. **Movement**
   a) Very limited movement for the vast majority of tagged fish
   b) The small fraction of fish from upstream reaches that move downstream are sufficient to explain the increasing trend in abundance at the LCR

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Conclusions

2. Movement (con't)

c) Movement of trout from Lees Ferry to Marble Canyon can be episodic, and most fish had probably emigrated before our study began.

d) Recaptures show that both small (age-0) and large (older) trout can move from Lees Ferry to Marble Canyon

e) Recent increased downstream movement may be driven by poor condition of fish

f) There is local reproduction in middle and lower Marble Canyon that is variable across years. May sustain periods of high abundance after immigration rates from upstream sources decline.

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Conclusions

3. Management

a) Reducing magnitude and frequency of large annual cohorts in Lees Ferry may be best way to reduce emigration to Marble Canyon. This may also help maintain quality of fishery and avoid cyclical patterns in abundance and condition

b) Recruitment to LCR depends on upstream abundance and movement. Thus reducing upstream abundance will reduce immigration.

c) There is local reproduction in Marble Canyon that is variable across years. Uncertain whether it is an important component of recruitment near LCR. Keeping abundance in MC low will likely lower probability of significant local recruitment.

d) Pro's and con's of improving trout conditions in Marble Canyon via regular floods (may increase condition and reduce movement).

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