Site Fidelity of Humpback Chub in Grand Canyon

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Background

Early 1990s Population estimates:

- **30-mile: 52 fish**
- **LCR inflow: ~3,500**
- **Shinumo: 57**
- **Middle Granite Gorge: 98**
- **Havasu: 13**

Genetic concerns (one population?)

Cost/benefit of sampling

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Questions

Are humpback chub in Grand Canyon one population?

What is our most efficient (i.e., cost-benefit) sampling of this endangered species?

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Methods

Humpback chub sampled in Grand Canyon 1990-2002

PIT-tagged fish>150 mm

Effort focused on LCR area, but throughout Canyon

hoop and trammel nets, electrofishing

Analysis includes fish from Lee's Ferry to Diamond Creek

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Spatial Scale

Grand Canyon scale:

- all recaptured throughout Grand Canyon
  - at least 14 days between capture and recapture

Within the LCR scale:

- only looked at fish collected and recaptured during spawn (March-May)

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Temporal scale

Fish captured in LCR in spring of one year and recaptured two, three, or four years later.

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What is site fidelity?

Recapture location in same tributary or mainstem area as capture

-Grand Canyon Scale

Capture and recapture location <1 km

-Within river scale

-temporal scale

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Statistical Analysis

Logistic regression:

Did the proportion of fish exhibiting site fidelity:

- **differ by size groups?**
- **years at liberty?**

- **known and unknown fish**
  - **known: Fish that we know left the LCR between capture and recapture**
  - **Unknown: don't know if fish ever left LCR**

Results
Grand Canyon Scale

14,671 total recaptures

- **12,865 (87.7%) recaptured in same tributary or mainstem area as capture location**
- **12,506 (85.2%) located in LCR**
- **241 (1.6%) located in mainstem within 12 km of LCR**

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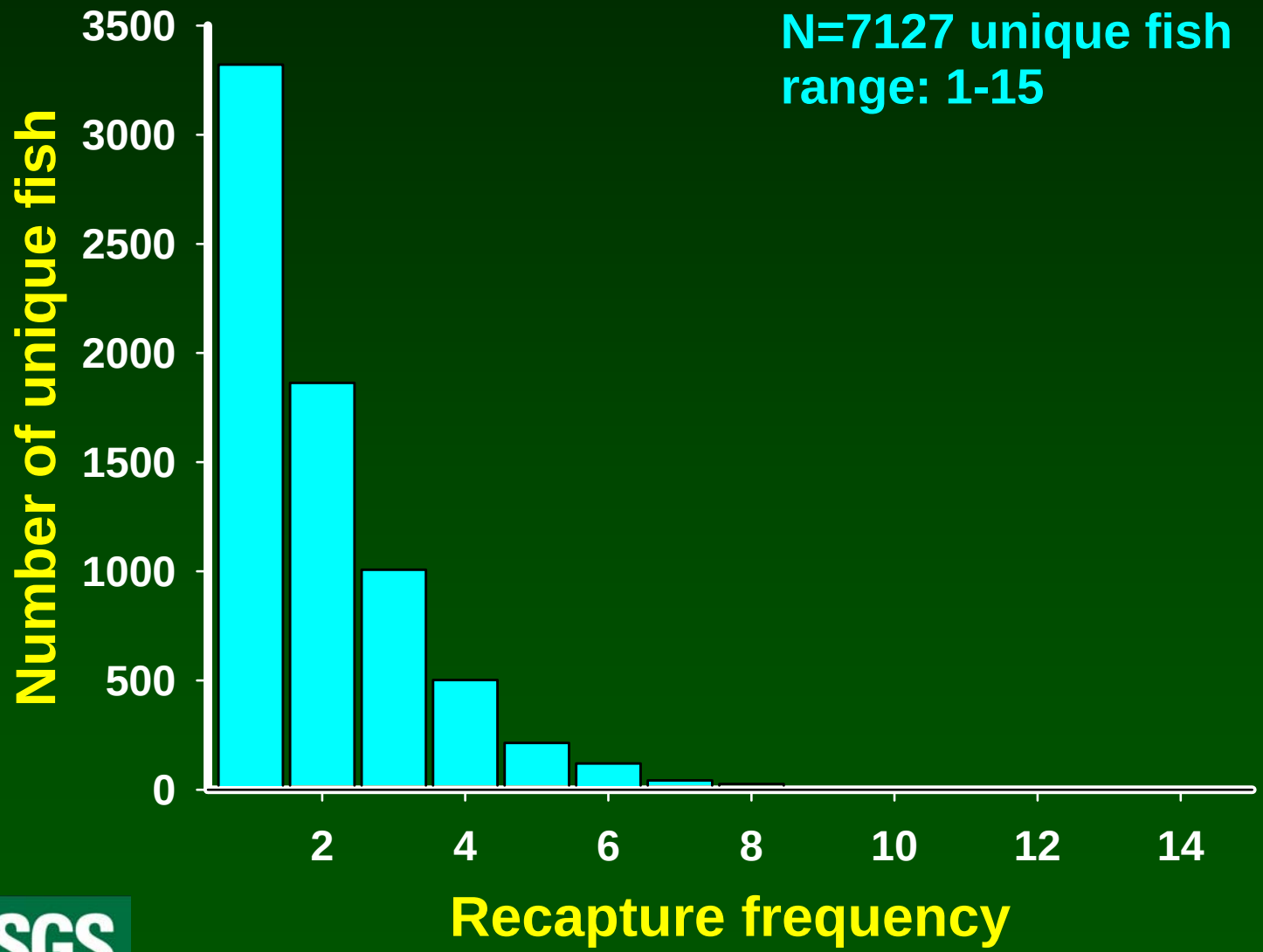
Recapture frequency



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Recapture Locations
Canyon-wide scale

Tag loc. (km)	Recapture location (km)						
	0-117	LCR 124	117-136	137-201	202-257	258-275	276-389
0-117	26	1					
LCR-124	1	12506	868	5	1	4	
117-136		909	241	3	2		
137-201		2	1	9	2		
202-257					79		
258-275					1	4	1
276-389		1				1	2

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Recaptures: Canyon-wide

98.9% of recaptures in or near LCR

Fish did move throughout canyon

- 2 fish>52 km (between LCR and upstream) within 1 year
- 5 fish> 154 km (between LCR and downstream) within 2-5 years

Is this enough movement for genetic mixing? can we manage the genetics on a Canyon-wide scale?

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Within the LCR

985 fish captured and recaptured in LCR

captured throughout lower 14.75 km

Mean distance between capture and recapture=0.5 km

420 (42.6%) exhibited site fidelity (< I km)

300 (30.5%) <0.5 km

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Within the LCR

58 (5.5%) caught in LCR and then caught in mainstem
- all within 7.1 km of LCR
- 1 fish <200 mm

60 fish captured in LCR, caught in mainstem, and caught in LCR following spring
- ‘known’ to have left LCR

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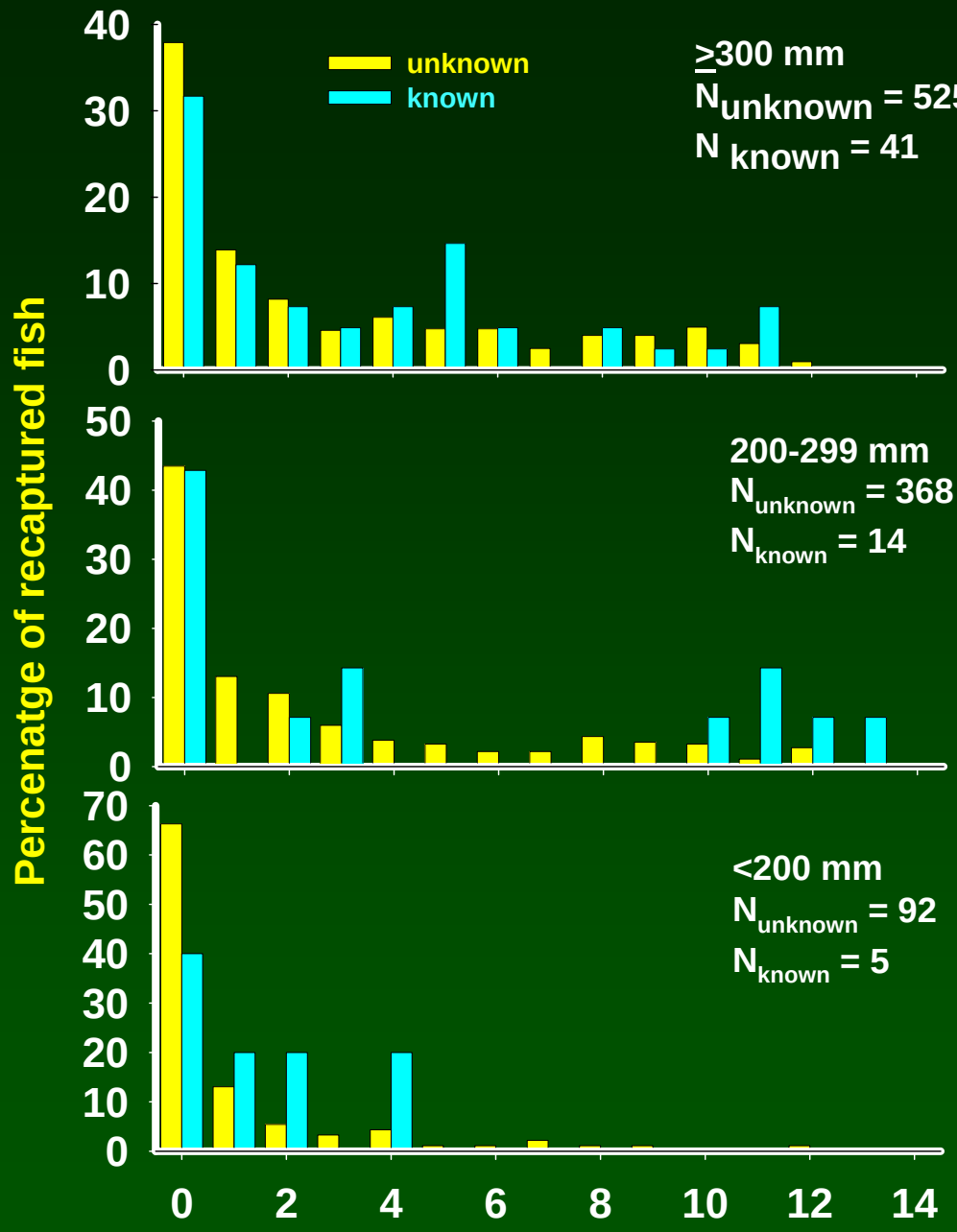

Fidelity within the LCR

No difference in displacement between known and unknown fish (Ps>0.24)

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Site Fidelity within LCR

Fish <200 mm were:

- 2.4 times more likely to exhibit site fidelity than 200-299 mm fish

- 3.1 times more likely to exhibit site fidelity than fish 300 mm or larger

Small fish may not leave LCR

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Was site fidelity expected?

Fish size (mm)	Weighted distribution		Uniform distribution		Observed fidelity
	Mean	95% CI	Mean	95% CI	
<200	17.6	17.4-17.8	19.3	19.0-19.6	66.3
200-299	16.1	16.0-16.2	19.0	18.9-19.1	43.4
≥300	18.3	18.2-18.4	19.1	18.8-19.3	37.9

Observed site fidelity was higher than what is expected by chance

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Temporal Scales

Did fish at large 1, 2, 3, and 4 years between capture and recapture still come back to the same areas if the LCR?

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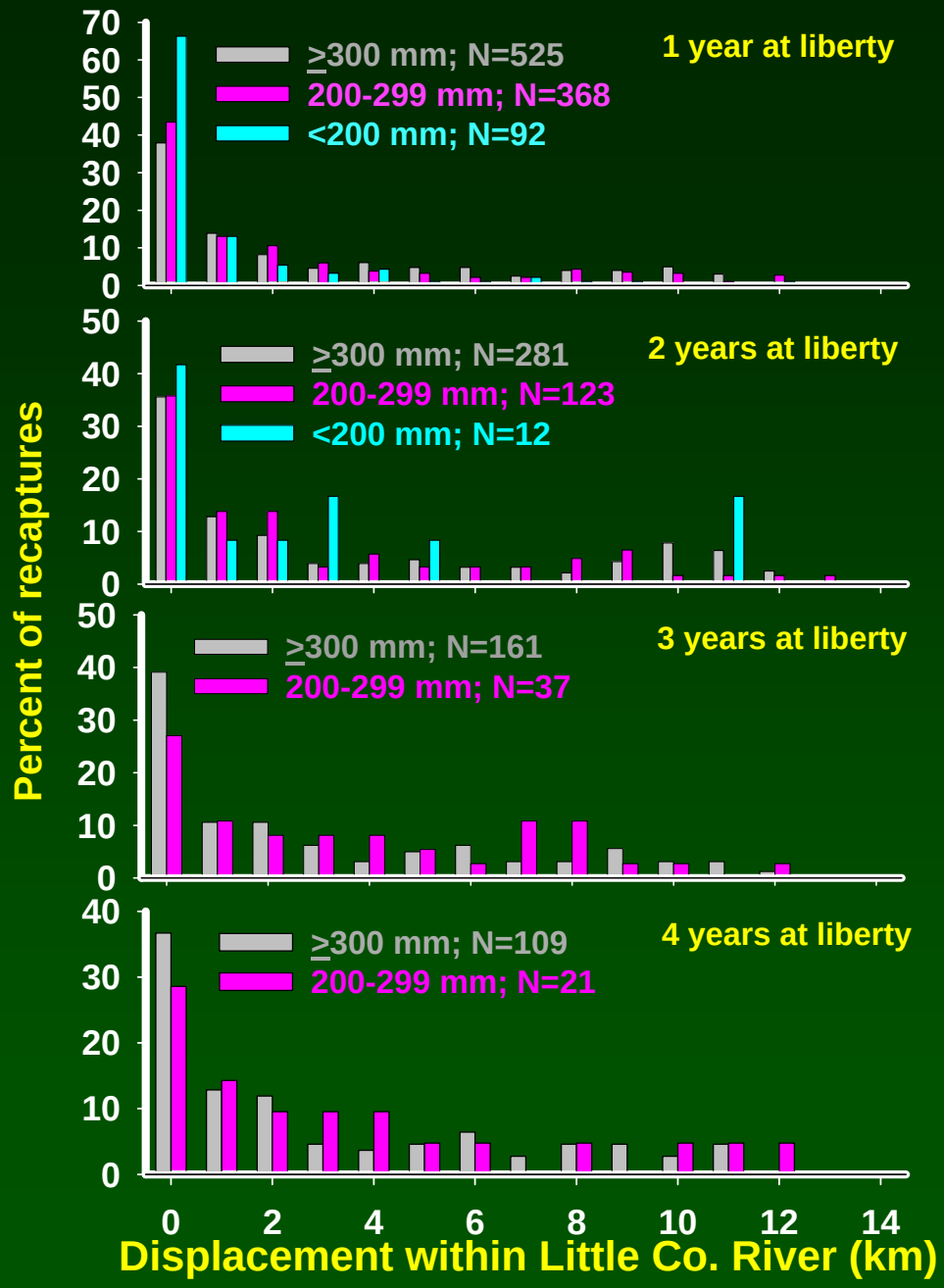

Fidelity within the LCR

Fidelity did not differ:
-among sizes (P=0.41)
-among years at liberty (P=0.07)

Overall, 39.8% of fish exhibited site fidelity, regardless of size or years at liberty

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Summary

Humpback chub exhibit strong site fidelity

- **-at the canyon-wide scale**
- **-within the LCR**
- **-across several years**

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What does this mean?

Genetically, humpback chub in Grand Canyon MAY be considered one population

- substantiate with genetic studies

Management (sampling) of population may be focused in and near the LCR

- need to maximize time and money spent

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Caveats

We don’t know where fish were between capture and recapture

This analysis in NOT a surrogate for genetics studies

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