Annual Reporting Meeting – Day 2 (January 19, 2011)

List of Presentations

No.	Title of Presentation	Author / Presenter
1	GCMRC Logistics and Permitting Program 2010	GCMRC
2	NSE Project Update January 2011, Year 2 of 4, Trips 8 of 12	Colton Finch, Mike Dodrill, and Brandon Gerig
3	Tailing the chub: combining natural tags and growth to assess the impacts of steady flows	Todd A. Hayden, Karin E. Limburg, and William E. Pine
4	An Overview of Humpback Chub Translocating and Chute Falls Monitoring During 2010	Arizona Fish and Wildlife Conservation Office
5	Humpback Chub Translocation Efforts in GRCA: 2010 Update	Brian Healy, Emily Omana, and Melissa Trammell
6	Will Translocations Augment Colorado River HBC Aggregations?	
7	Bright Angel Creek Trout Reduction Project	Brian Healy, Emily Omana, and Melissa Trammell
8	An Overview of Humpback Mark-Recapture Trips in the Little Colorado River During 2010	Arizona Fish and Wildlife Conservation Office
9	Little Colorado river Lower 1200 m Monitoring 1987-2010	Brian C. Clark
10	BIO 4.M2. Monitoring Lees Ferry Fishes	Luke Avery
11	Grand Canyon Fish Community Monitoring	Aaron J. Bunch
12	Progress on Processing 2009 High-Resolution Airborne Imagery	Philip A. Davis and Laura E. Cagney
13	Data Acquisition and Management Systems (DAMS)	Glenn Bennett
14	GIS Support for Integrated Analysis and Projects	USGS
15	A Prospectus to Evaluate Tradeoff and Decision Support Methods for GCDAMP	AMP Science Advisors

GCMRC Logistics and Permitting Program 2010

- Safety
- Cost effectiveness
- Efficiency

USGS

What We Do

Rain (snow) or shine the show must go on……

- Planning
- Permitting
- Scheduling
- 21 River Trips in 2010
- Lees Ferry Trout Research
- Diamond Creek & LF AQFB sampling
- Rim Support
- LCR Helicopter Support
- Food packing
- Shuttle Drives/Vehicles
- Fix broken equipment and fix it again………………..

USGS

River Trip Cost

How do we spend logistics funding?

USGS

2010 Project Support

- Aquatic Foodbase
- Nearshore Ecology
- Monitoring Lees Ferry Fish
- Mainstem Fishes
- Integrated Quality of Water Monitoring
- Little Colorado river Humpback Chub Monitoring and Translocation
- Cultural Research and Development of Core Monitoring
- Survey Control Network
- Kanab Ambersnail Monitoring
- Campsite/Sandbar Area Monitoring
- Nonnative Fish Monitoring-Multigear Sampling Pilot
- Tribal River Trip Support

USGS

Our Partners

- USGS/GCMRC Scientists and staff
- Grand Canyon National Park
- AMP Tribal Participants
- Federal and State Cooperators
- University Cooperators
- HSS: Boat Operators
- Volunteers
- VIP's
- GCY: Youth Volunteers

USGS

GRAND CANYON Youth

"Partners in Science"

USGS

An innovative partnership linking GCMRC and Grand Canyon Youth Inc.

The objective of the "Partners in Science" program is to provide the opportunity for youth to experience the educational power of participating in hands-on science, completing service projects in support of the GCMRC science mission and participating on a river trip to travel not as tourists, but as working partners in the mission of providing scientific understanding of the cultural, physical and biological resources of the Grand Canyon.

Grand Canyon Youth

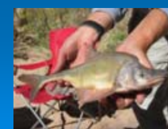
KIDS • RIVERS • EDUCATION • TRANSFORMATION

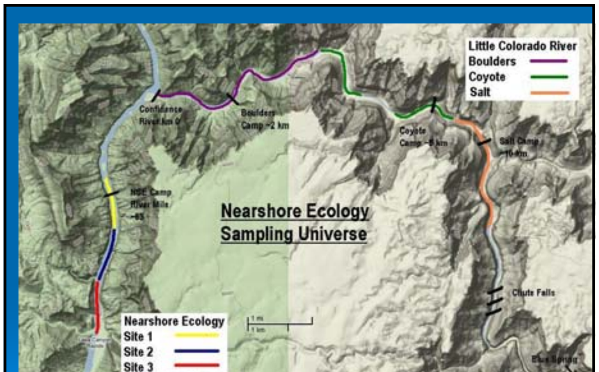

Since 2004 GCY has been an informal cooperative partner with the Grand Canyon Monitoring and Research Center. Through this partnership, youth have a successful history of working collaboratively with GCMRC scientists to collect field data for multiple projects included in the GCDAMP annual work plan, some examples include:
Backwater Habitat Measurements
Pit tagging native fish
Backwater Seining
Kanab Ambersnail monitoring at Vaseys Paradise
Hoopnet Sampling
Weather Station Maintenance
USGS


Thanks
and what's next in 2011?
HFE?
NN Removal Project?
….there's always more to learn
USGS

Nearshore ecology project (NSE)

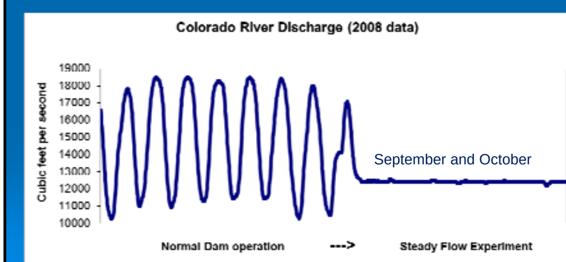
- We designed the NSE project to assess fish population responses to fall steady flow experiment
  - Direct response metrics: fish growth, survival, abundance
  - Indirect responses: habitat use, movement, selection
- Fill key data gaps in native fish ecology
  - Timing of immigration from LCR to mainstem
  - Residency in LCR & mainstem





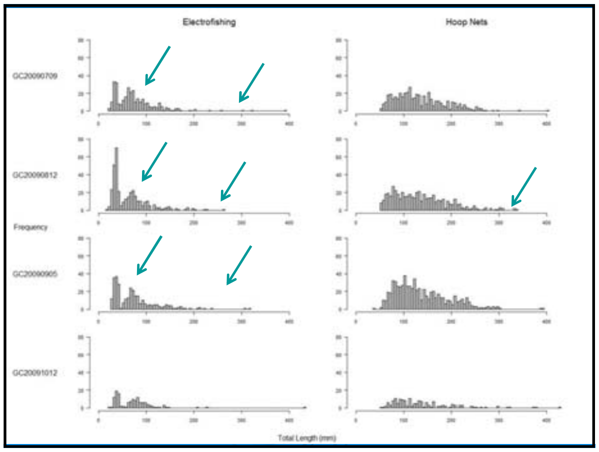
Nearshore Ecology Study

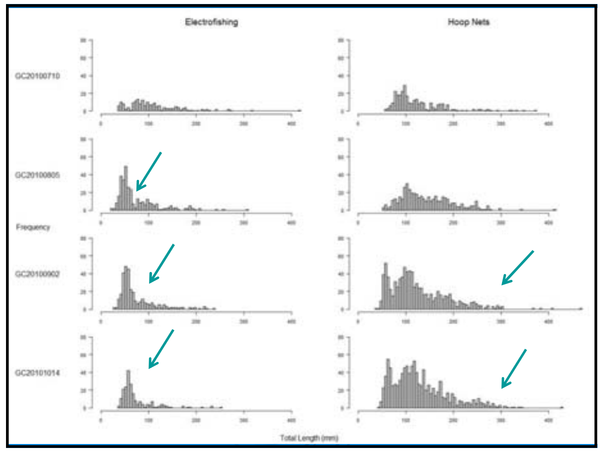
- Habitat use and selection of fish
- Capture probability by habitat type
- Abundance of all fish species
- Predation rates (habitat and flow)
- Survival
- GROWTH

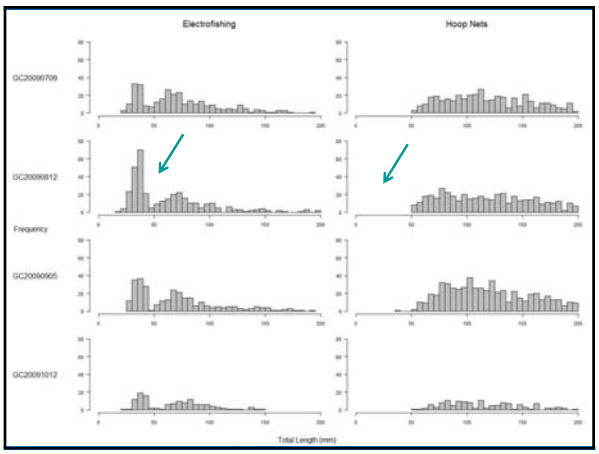


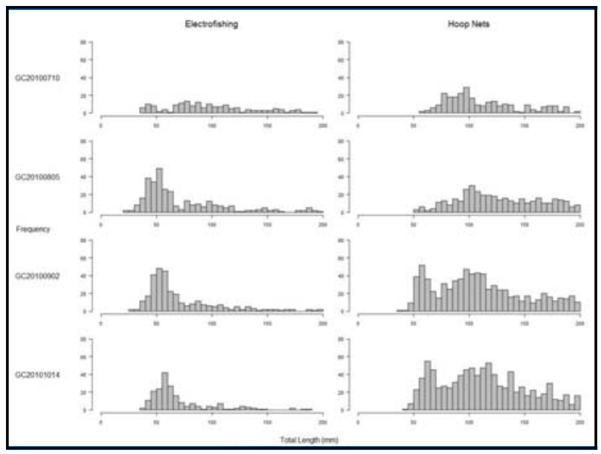
Mark-Recapture Sampling Framework (four trips annually)

NSE HBC size structure





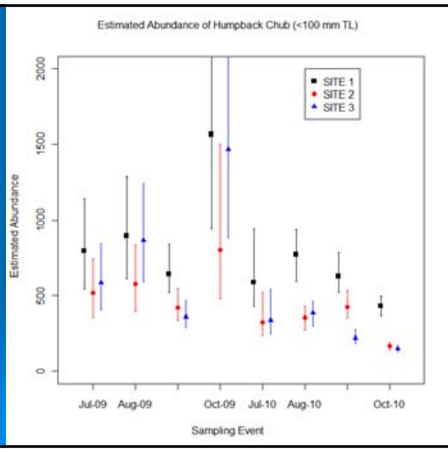


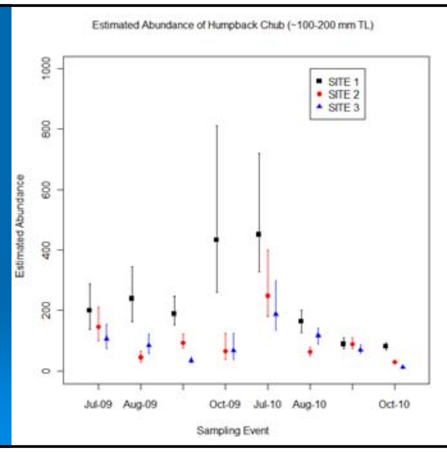


Key NSE Finding 1

- NSE project catches small native fish
  - Smaller fish collected via EF than hoopnets (key size difference fish < 50-mm TL)
  - NSE electrofishing is much slower (8 sec/m) than other electrofishing efforts (1.2 sec/m)
  - Targets shoreline habitats
  - Larger fish may avoid NSE electrofishing

NSE HBC preliminary abundance estimates

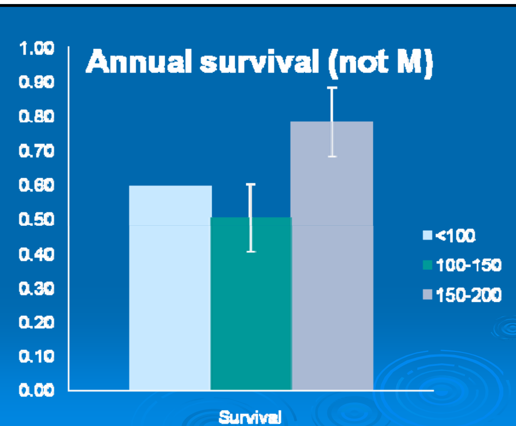




Key NSE Finding 2

- NSE project can estimate abundance of small fish
  - Across both years we have been able to estimate abundance of small HBC
  - 40-100 mm TL fish from VIE marks
  - 100+mm TL fish from PIT tags
  - Smaller size/younger age than ASMR
- No obvious chances in abundance occurring during flow experiment

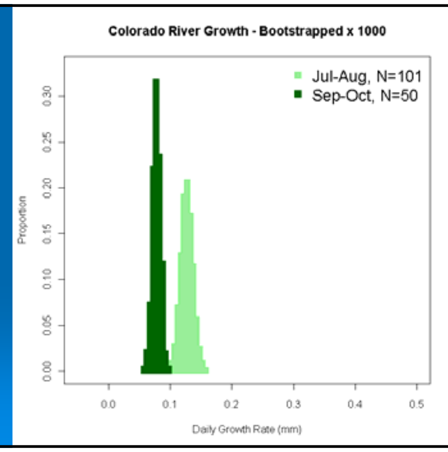
NSE HBC preliminary survival estimates

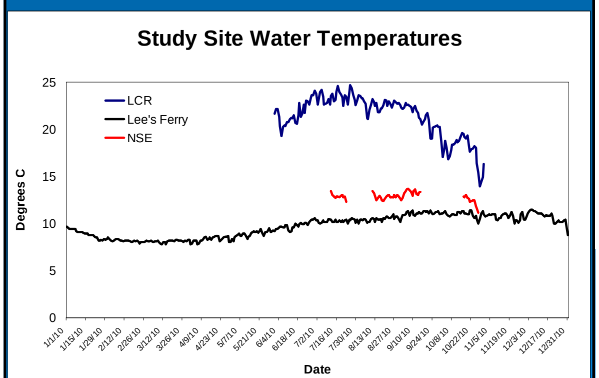


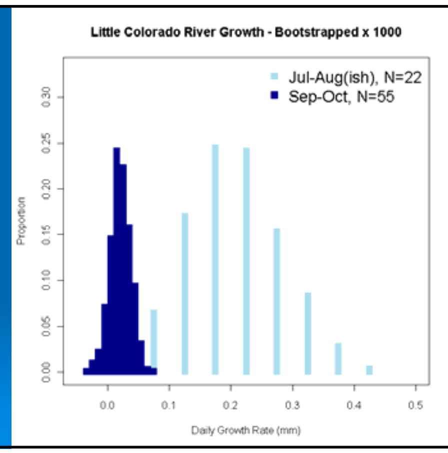
Tagged cohorts persist through time

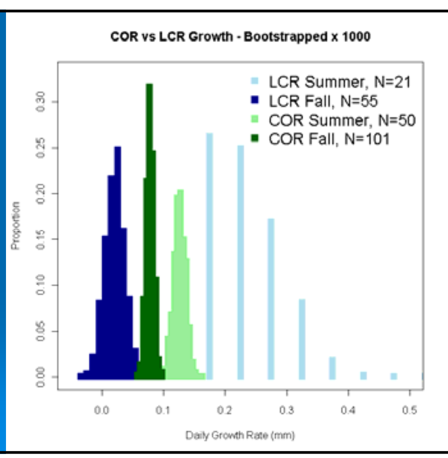
	July_09	Aug_09	Sept_09	Oct_09	July_10	Aug_10	Sept_10	Oct_10
	T1	T2	T3	T4	T5	T6	T7	T8
M	R	R	R	R	R	R	R	R
278	27	48	49	21	35	26	33	42
307		36	55	24	30	27	29	55
329			47	19	25	43	42	59
132				7	13	10	13	18
203					25	32	34	45
279						47	84	53
517							90	95
434								100

NSE HBC preliminary growth estimates









Counterintuitive Result

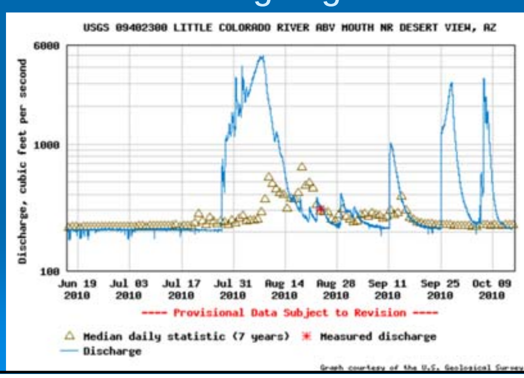
- Fish growth rate actually *declined* during fall (steady flows) from summer (fluctuating flow)
- Colorado River, dL/dt 0.13 ⇨ 0.08 mm/d
- Little Colorado River, 0.21 ⇨ 0.02 mm/d

More clues on growth and movement from otoliths….

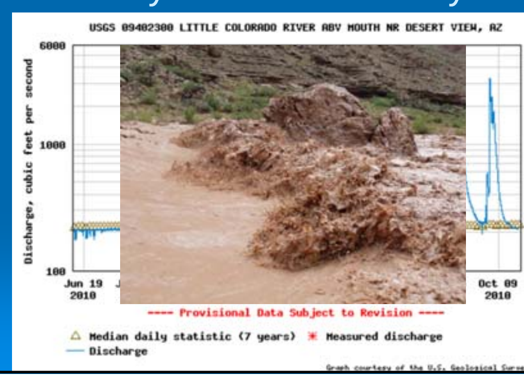
Dr. Todd Hayden, SUNY-ESF

What's going on?

What's going on?



Steady flow not so steady…



What NSE does really well…

- **Direct estimates of juvenile native fish abundance, growth, and survival**
  - At earlier age than ASMR estimates
    - Improved age-at-first-capture estimates via otoliths + ASMR
  - Could become part of core monitoring program to assess juvenile fish population responses to experiments
- Habitat use information
  - Limited to our small study reach
  - Working to link with physical science program
- Surprises from Todd and Karin
  - Growth, movement patterns, timing of outmigration from LCR

Is there a native fish response to current flow experiment?

- Not likely at the current flow contrast level
  - Bigger hammer – increase the magnitude of change
- Switching time periods of flow experiment?
  - Maximized insolation rates would occur in June/July
  - Fewer tributary inputs?
- What next?
  - Steady flows planned in 2011 and 2012
  - NSE project field work planned in 2011 only
  - Is the flow experiment still the primary question of interest?

NSE Research Questions

- "The primary goal of this project is to understand how river flow, through its interaction with physical habitat structure, influences the survival rates of juvenile native and non-native fishes in the Colorado River in Grand Canyon. Nine research questions related to this goal have been identified in the RFP (RFP pages 27-28). (Pine et al. 2008)"

Two fundamental research questions

- (RQ1) Do steadier flows during summer and/or fall increase survival rates of juvenile native and non-native fish?
- (RQ2) To what extent does physical habitat structure (e.g., sand bars and backwaters), in conjunction with flows during these periods, influence survival rate?

Tailing the chub: combining natural tags and growth to assess the impacts of steady flows

Todd A. Hayden[1], Karin E. Limburg[1], William E. Pine, III[2]

[1]State University of New York College of Environmental Science and Forestry

[2]Department of Wildlife Ecology and Conservation , Program in Fisheries and Aquatic Sciences, University of Florida

Otolith Chemistry

- $CaCO_3$, protein
- No reabsorption
- Sequential growth- Otolith core = larval lifestage
- Trace elements incorporate into otolith from water- time, location specific marker (Sr:Ca, Se:Ca, $\delta^{13}C$)

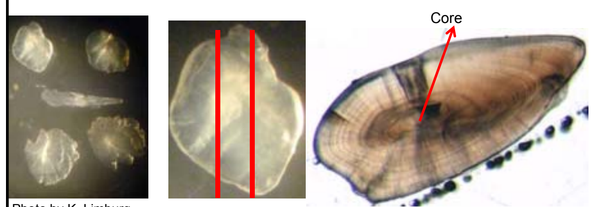
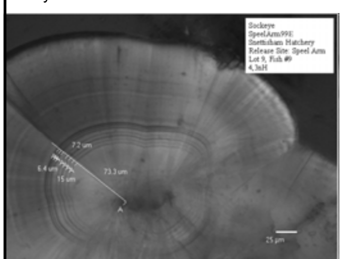


Photo by K. Limburg

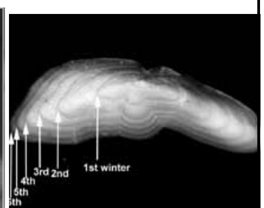
Quantifying Fish growth

Daily increments:



(ADGF 3 degrees, 24 hrs)

Annual increments:



(Photo by Steven Campana)

Project objectives

- Identify natural markers- HBC migration, movements (LCR, COR)-
- Otolith based- age/growth of HBC-
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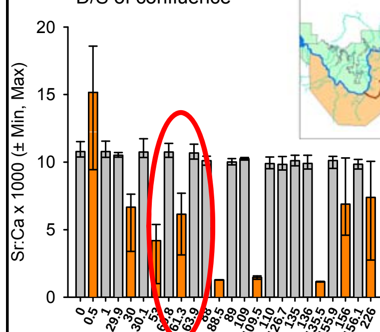
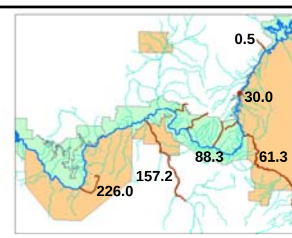
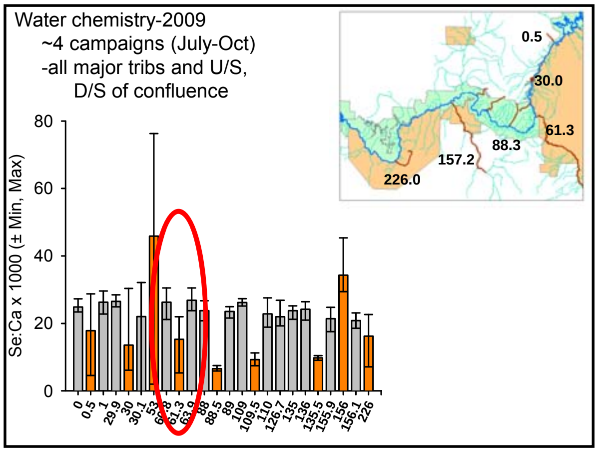
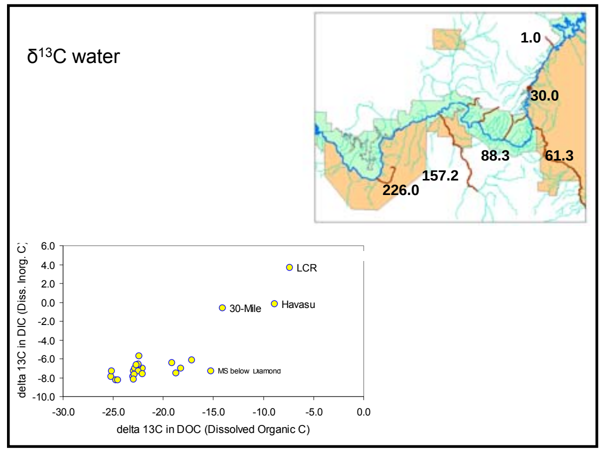
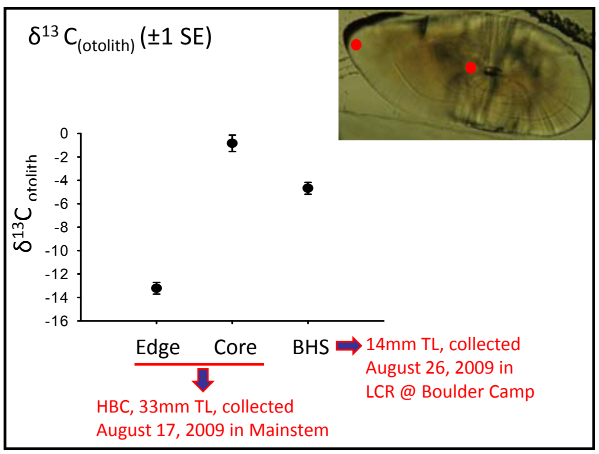
Water chemistry-2009
~4 campaigns (July-Oct)
-all major tribs and U/S, D/S of confluence

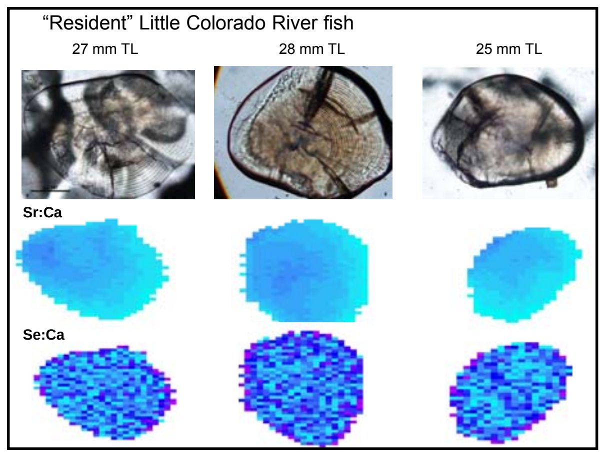


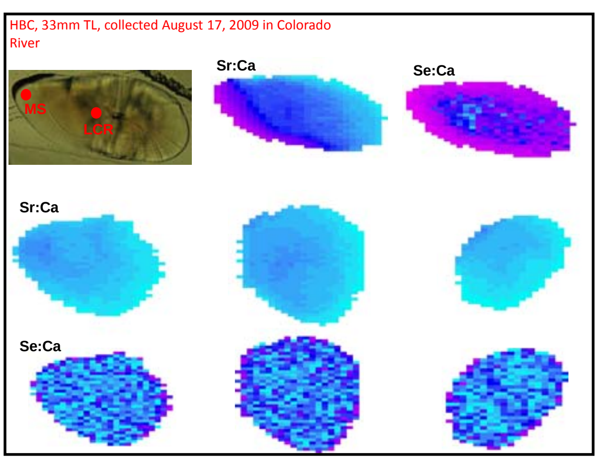


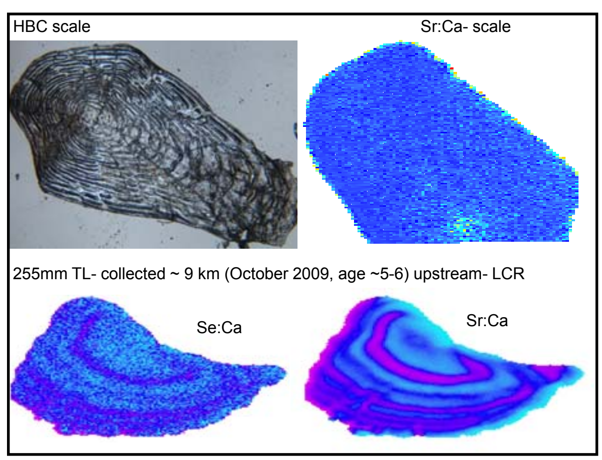

Water chemistry-2009
~4 campaigns (July-Oct)
-all major tribs and U/S,
D/S of confluence
Se:Ca x 1000 (± Min, Max)
0.5
30.0
61.3
88.3
157.2
226.0


δ13C water
1.0
30.0
61.3
88.3
157.2
226.0
LCR
30-Mile
Havasu
delta 13C in DOC (Dissolved Organic C)


δ13 C(otolith) (±1 SE)
δ13C otolith
Edge
Core
BHS
14mm TL, collected
August 26, 2009 in
LCR @ Boulder Camp
HBC, 33mm TL, collected
August 17, 2009 in Mainstem


"Resident" Little Colorado River fish
27 mm TL
28 mm TL
25 mm TL
Sr:Ca
Se:Ca


HBC, 33mm TL, collected August 17, 2009 in Colorado
River
MS
LCR
Sr:Ca
Se:Ca
Sr:Ca
Se:Ca


HBC scale
Sr:Ca- scale
255mm TL- collected ~ 9 km (October 2009, age ~5-6) upstream- LCR
Se:Ca
Sr:Ca

Project objectives

- Identify natural markers- HBC migration, movements (LCR, COR)- Sr:Ca, Se:Ca high in MS, δ13C low in MS, scales- not helpful
- Otolith based- age/growth of HBC
- Link natural markers and growth- impacts of Glen Canyon steady flow on HBC.

Project objectives

- Identify natural markers- HBC migration, movements (LCR, COR)- Sr:Ca, Se:Ca high in MS, δ13C low in MS
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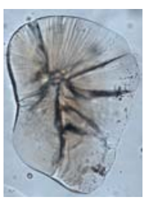
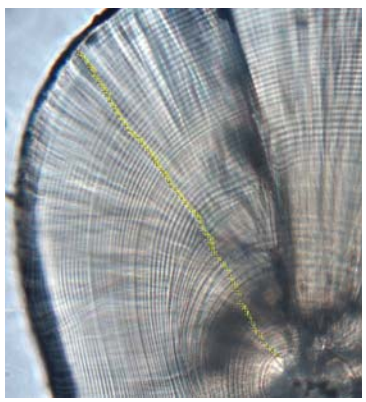
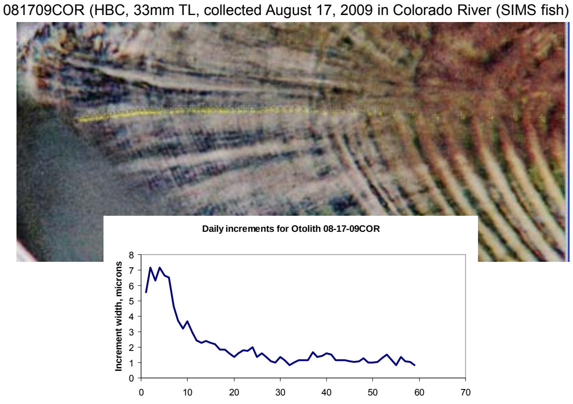
20100713FWS01 (HBC, 55mm TL, LCR-Rkm 2.0, collected 7-13-2010, 63 days old)



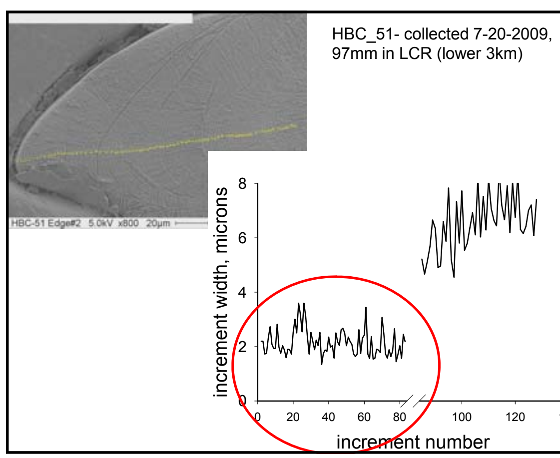


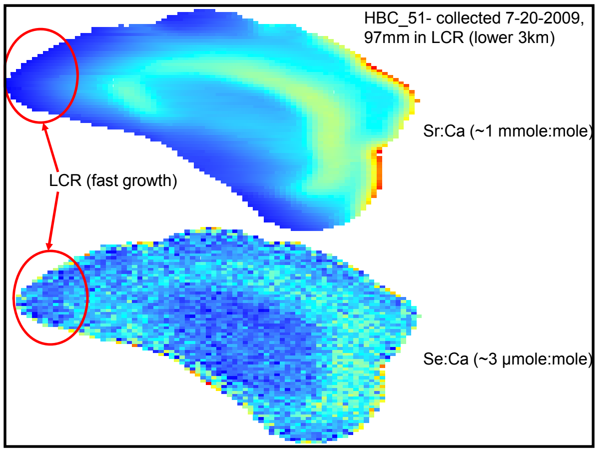
081709COR (HBC, 33mm TL, collected August 17, 2009 in Colorado River (SIMS fish)

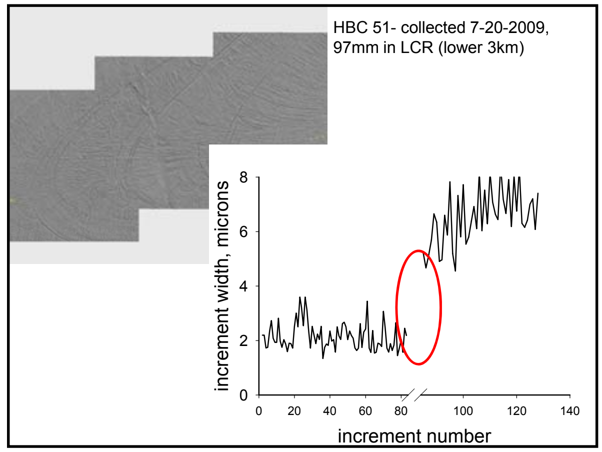


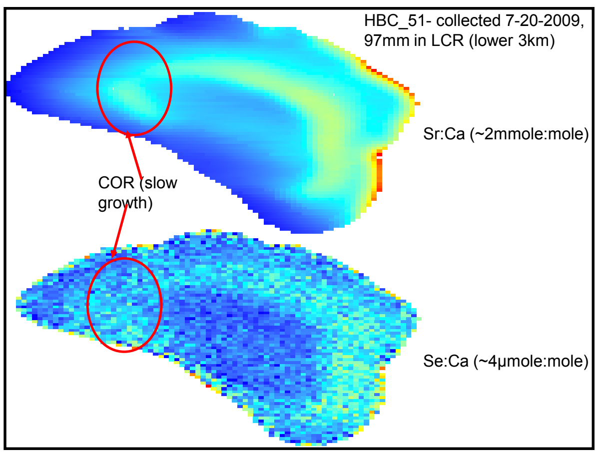
HBC 51- collected 7-20-2009, 97mm in LCR (lower 3km)

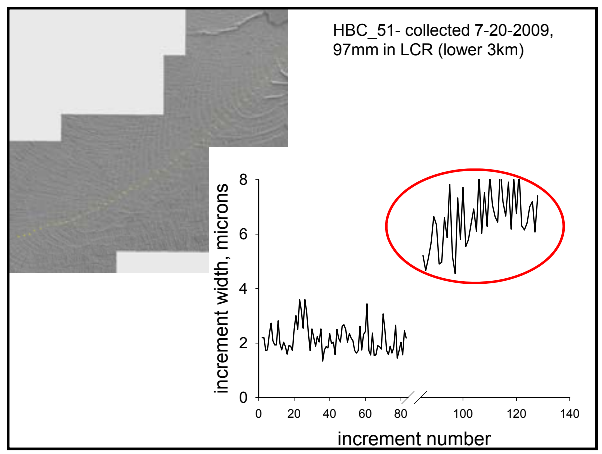
HBC_51- collected 7-20-2009, 97mm in LCR (lower 3km)

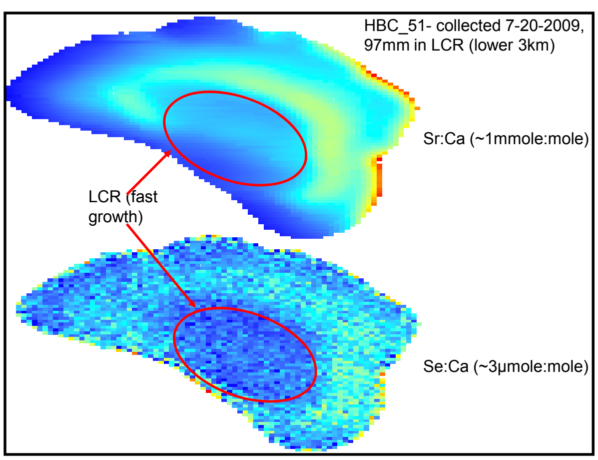


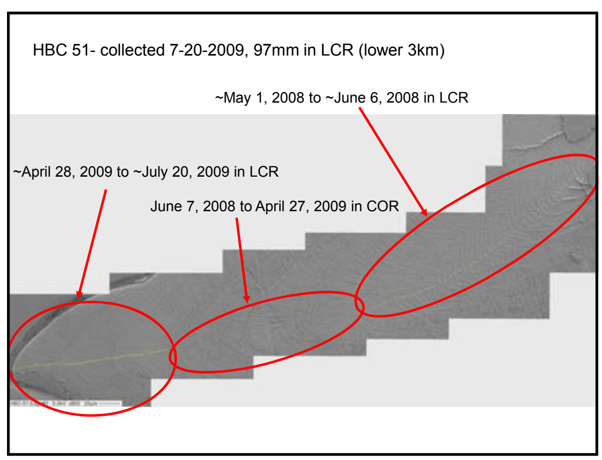

HBC_51- collected 7-20-2009, 97mm in LCR (lower 3km)
Sr:Ca (~1 mmole:mole)
LCR (fast growth)
Se:Ca (~3 µmole:mole)


HBC 51- collected 7-20-2009, 97mm in LCR (lower 3km)
increment width, microns
increment number
0
2
4
6
8
0
20
40
60
80
100
120
140


HBC_51- collected 7-20-2009, 97mm in LCR (lower 3km)
Sr:Ca (~2mmole:mole)
COR (slow growth)
Se:Ca (~4µmole:mole)


HBC_51- collected 7-20-2009, 97mm in LCR (lower 3km)
increment width, microns
increment number
0
2
4
6
8
0
20
40
60
80
100
120
140


HBC_51- collected 7-20-2009, 97mm in LCR (lower 3km)
Sr:Ca (~1mmole:mole)
LCR (fast growth)
Se:Ca (~3µmole:mole)


HBC 51- collected 7-20-2009, 97mm in LCR (lower 3km)
~May 1, 2008 to ~June 6, 2008 in LCR
~April 28, 2009 to ~July 20, 2009 in LCR
June 7, 2008 to April 27, 2009 in COR

Project objectives

- Identify natural markers- HBC migration, movements (LCR, COR)- Sr:Ca, Se:Ca high in MS, δ13C low in MS
- Otolith based- age/growth of HBC- difficult to find daily "COR" growth increments, LCR clear increments (at least to ~100mmTL)
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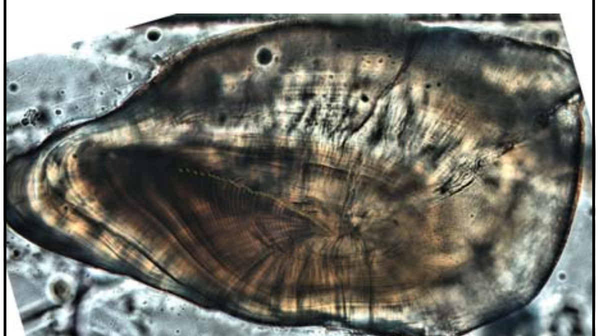
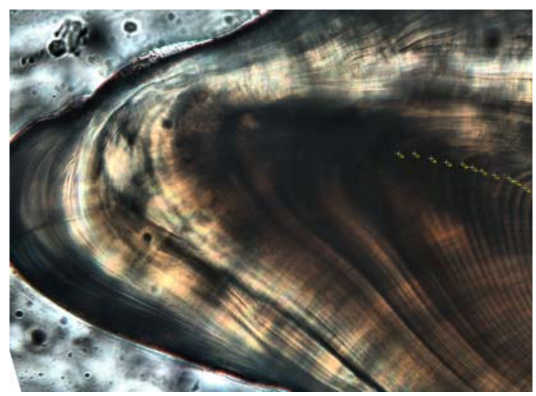
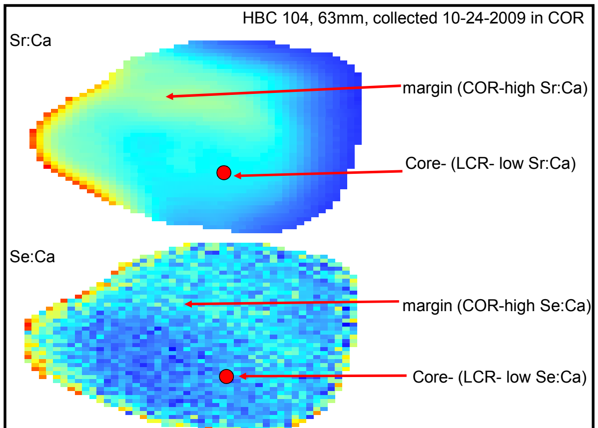
HBC 104, 63mm, collected 10-24-2009 in COR (steady flow)

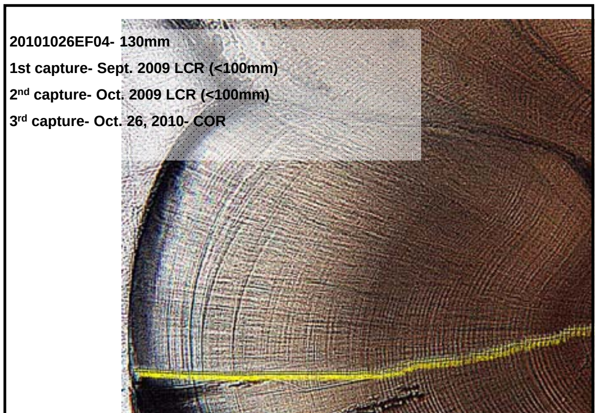


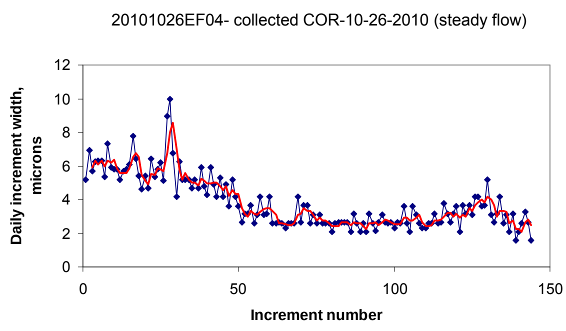
HBC 104, 63mm, collected 10-24-2009 in COR



HBC 104, 63mm, collected 10-24-2009 in COR







Project objectives

- Identify natural markers- HBC migration, movements (LCR, COR)- Sr:Ca, Se:Ca high in MS, δ13C low in MS
- Otolith based- age/growth of HBC- difficult to find daily "COR" growth increments, LCR clear increments (at least to ~100mmTL)
- Link natural markers and growth- impacts of Glen Canyon steady flow on HBC.- No drastic change in growth during steady flow. (NEED TO LOOK AT MORE FISH TO CONFIRM!)

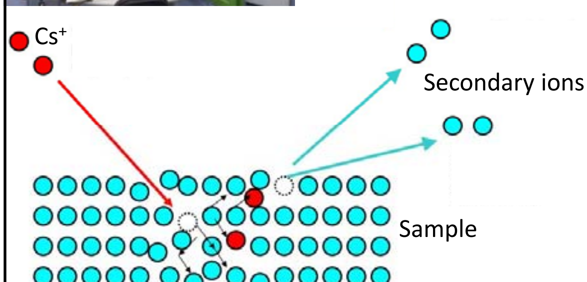
Acknowledgements:

Individuals:
Colton Finch
Brandon Gerig
Michael Dodrill
Mike Yard
Darren Dale

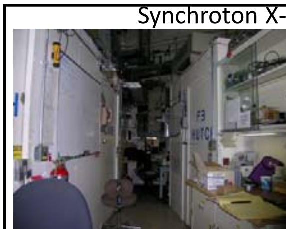
Agencies:
USGS- GCMRC
USFWS
NPS
BOR
AZGF

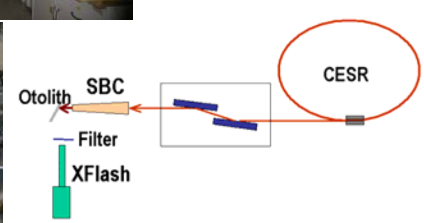
Analytical:
CHESS
WHOI-NENIMF

SIMS (secondary ion mass spectroscopy)



Synchroton X-ray fluorescence





An Overview of Humpback Chub Translocations and Chute Falls Monitoring During 2010

By
Arizona Fish and Wildlife Conservation Office
Flagstaff, AZ

Objectives

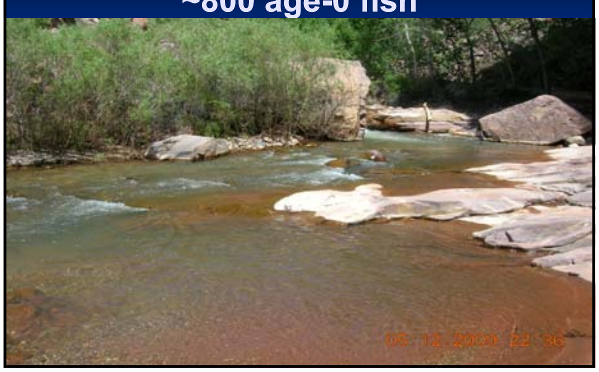
- Collect humpback chub for translocation to Chute Falls, Dexter, Shinumo, and Havasu creeks.
- BIO 2.M3.11-12 Monitor and obtain closed mark-recapture population estimates of humpback chub in the upper Little Colorado River (13.6 to ~18 km).
- Estimate what percentage of wild humpback chub are being cropped for translocation purposes.

Humpback Chub Collections and Dispersal

	Chute Falls	DNFHTC	Shinumo	Havasu	Total
2003	283				283
2004	300				300
2005	567				567
2008	299	300	200		799
2009	194	200	300		694
2010	109	185	300	300	894
Totals	1,752	685	800	300	3,537

Dexter since 2008 ~685 age-0 fish

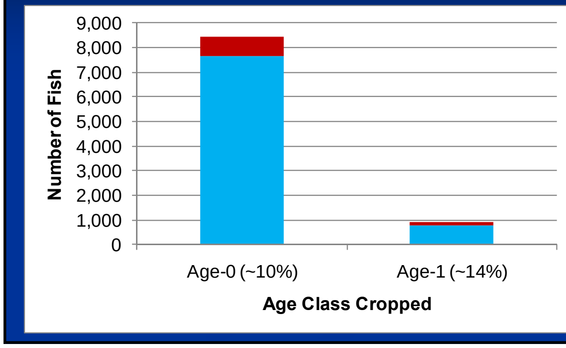
Shinumo Creek since 2008 ~800 age-0 fish



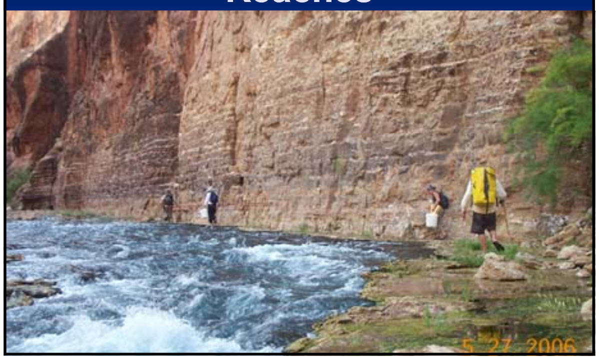
Havasu Creek – 2011 (300 fish)

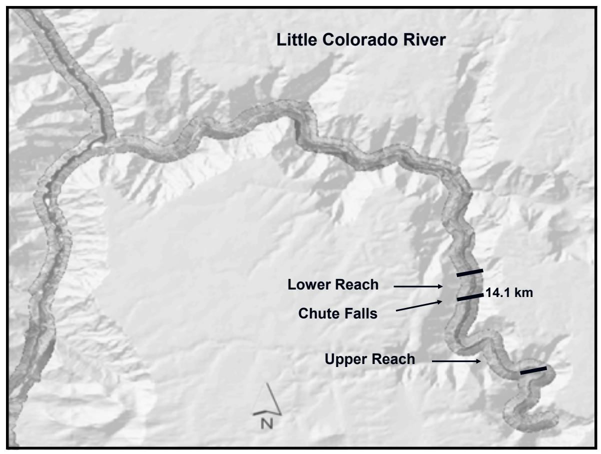
Chute Falls since 2003 ~1,752 mixed age-0 / age-1 fish

Humpback Chub Cropped in 2010 for Translocations

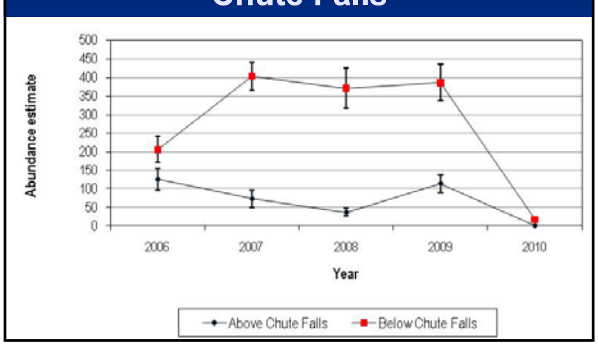


Monitoring the Chute Falls Reaches

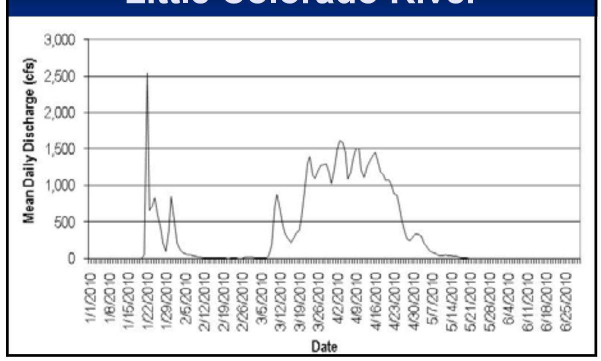




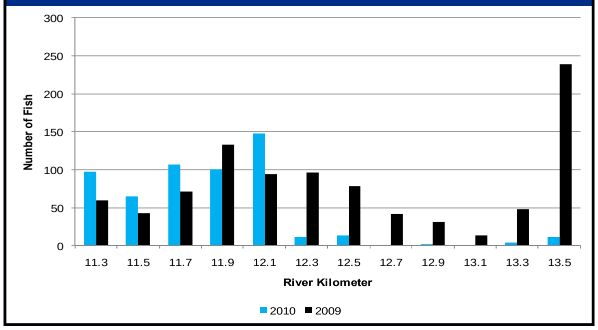
Abundances of Humpback Chub ≥ 200 mm above and below Chute Falls



Spring 2010 Hydrograph for Little Colorado River



Displacement of Humpback Chub Downriver between Monitoring in 2009 and 2010



Chute Falls Findings

- Growth of HBC translocated to above Chute has been very high.
- 1- year survivorship of HBC from the 2008 Chute Falls translocation was very high (~89%).
- 1- year survivorship of the 2009 cohort was likely considerably lower (possibly ~29% based on 11 recaps of 194 fish and *p* of 0.195).
- Chute Falls has much potential as a wild grow out facility.

Big Habitat

Successful Humpback Chub Survival, Growth and Recruitment

National Park Service
U.S. Department of the Interior

Grand Canyon National Park

Humpback Chub Translocation Efforts in GRCA: 2010 Update

Brian D. Healy, Emily C. Omana, Melissa Trammell
National Park Service

Jonathan Spurgeon, Craig Paukert, Joanna Whittier
University of Missouri, USGS Cooperative

David Speas
Bureau of Reclamation

Pamela J. Sponholtz
U.S. Fish and Wildlife Service

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Cooperators

- Funded by Reclamation and NPS

UtahState University

- Volunteers

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George Andjreko, AZ Game & Fish

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Translocation Goals

Ultimate Goals:
Restore Native Fish Populations, including humpback chub, to the Extent Feasible

Tributary Translocation may contribute towards:

- Establish 2nd Spawning Population in Grand Canyon
  - Provide "Population Redundancy"
- Rearing/Grow-out habitat Juvenile Humpback Chub
  - Increased Growth (escape predation)
- Augment Colorado River Aggregations

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Success of Tributary Translocations?

- **Evaluation In progress:**
  - **Factors influencing survival**

Today:

Will Humpback Chub remain in Shinumo Creek?
- Assess/Investigate Factors influencing emigration
- Population Estimates

Growth of translocated HBC compared to the Little Colorado River

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Little Colorado River

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Hatchery Treatments

- Parasite/disease Treatment
- Flow Training
- Pit Tagging
- Weight/length


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Non-native fish control

- Improve Survival of Translocated Humpback Chub
  - Electrofishing and Angling

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PIT Tag Antenna System


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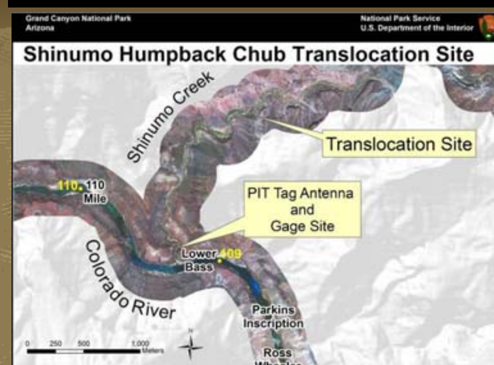

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Shinumo Translocation

- 302 in June 2009
- 300 in June 2010

Melissa Trammell/NPS

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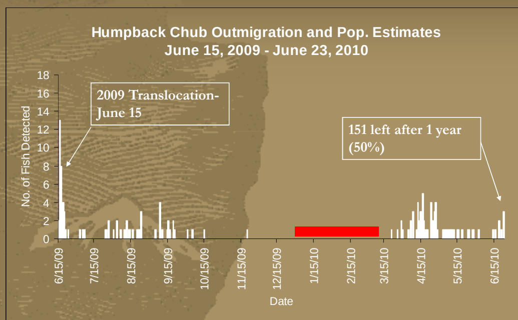
Results – Will HBC Remain in Shinumo?



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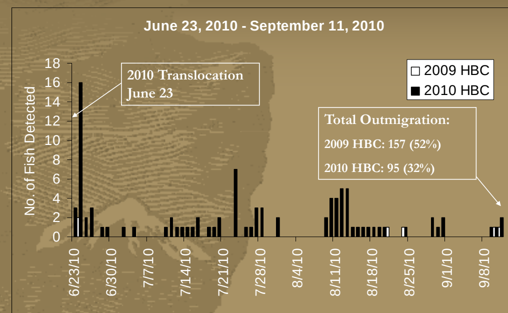
Results – Will HBC Remain in Shinumo?



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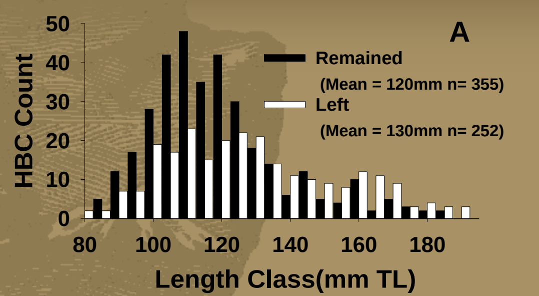
PIT Tag Antenna Results - Emigration



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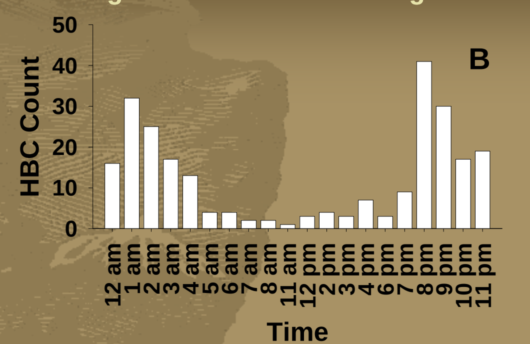
PIT Tag Antenna Results - Emigration



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PIT Tag Antenna Results - Summary

- About 250 of 602 (42%) have left (Nov. 2010)
- Largest pulses of outmigration occurred:
  - 1st 10 days after release
  - Prior to spring runoff (prior to 2010 translocation)
- Movements occurred primarily at night
- Emigration was not correlated with:
  - Temperature (*p=0.56*)
  - Stream flow (stage) (*p=0.57*)
- Larger Fish = more likely

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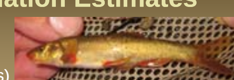
Mark-recapture Population Estimates

- June and September, 2010
- 2-pass Mark-recapture (all natives)



	Stream Reach			
Sampling Day	1	2	3	4
Day 1 (PASS 1)	Set Nets	Set Nets		
Day 2 (PASS 1)	Mark	Mark	Set Nets	Set Nets
Day 3 (PASS 1)			Mark	Mark
Day 4 (PASS 2)	Set Nets	Set Nets		
Day 5 (PASS 2)	Mark/ recap	Mark/ recap	Set Nets	Set Nets
Day 6 (PASS 2)			Mark/ recap	Mark/ recap

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Results: 2010 Post-Translocation Monitoring
June and September
Unique Re-captures
49 of 2009 class
68 of 2010 class
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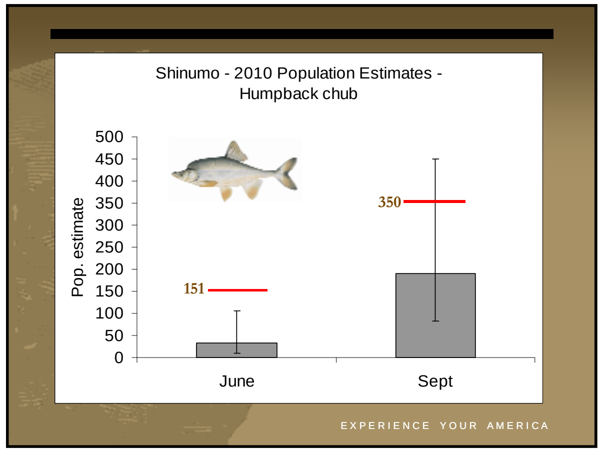
Shinumo - 2010 Population Estimates - Humpback chub
Pop. estimate
500
450
400
350
300
250
200
150
100
50
0
151
350
June
Sept
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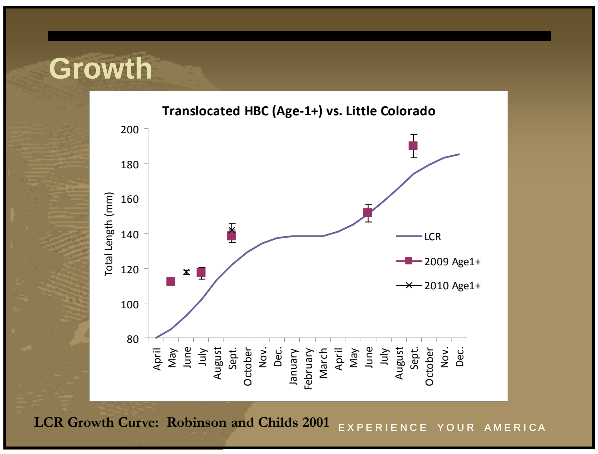
Growth
Translocated HBC (Age-1+) vs. Little Colorado
Total Length (mm)
LCR
2009 Age1+
2010 Age1+
April May June July August Sept. October Nov. Dec. January February March April May June July August Sept. October Nov. Dec.
LCR Growth Curve: Robinson and Childs 2001
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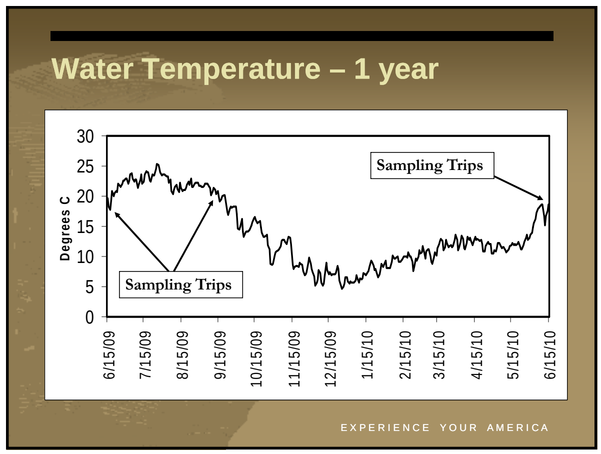
Water Temperature – 1 year
Degrees C
Sampling Trips
Sampling Trips
6/15/09 7/15/09 8/15/09 9/15/09 10/15/09 11/15/09 12/15/09 1/15/10 2/15/10 3/15/10 4/15/10 5/15/10 6/15/10
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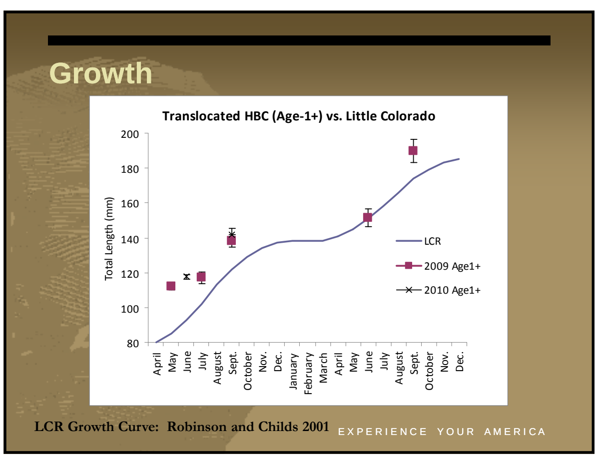
Growth
Translocated HBC (Age-1+) vs. Little Colorado
Total Length (mm)
LCR
2009 Age1+
2010 Age1+
April May June July August Sept. October Nov. Dec. January February March April May June July August Sept. October Nov. Dec.
LCR Growth Curve: Robinson and Childs 2001
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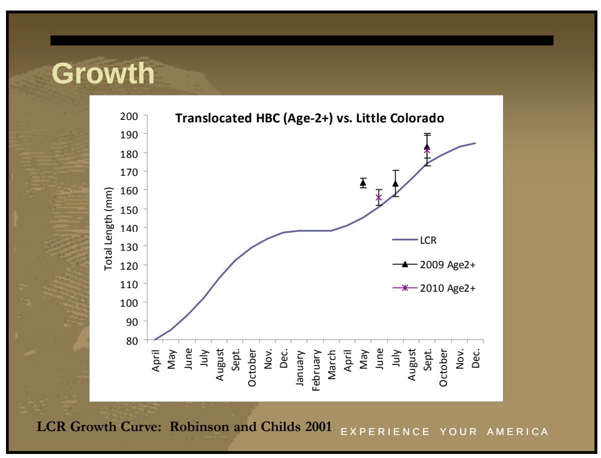
Growth
Translocated HBC (Age-2+) vs. Little Colorado
Total Length (mm)
LCR
2009 Age2+
2010 Age2+
April May June July August Sept. October Nov. Dec. January February March April May June July August Sept. October Nov. Dec.
LCR Growth Curve: Robinson and Childs 2001
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Next Steps – Shinumo Creek

- Collected 600 HBC-LCR Nov. 2010
- Bubbling Ponds Native Fish Facility – Rearing HBC
- Shinumo Creek Translocation III
  - June 2011 (300 fish)
- Continue NNF Fish Control

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Next Steps – Shinumo Creek

- Population Monitoring:
  - June and September, 2011
  - Survival Estimate:
    - Cormack Jolly-Seber Model
    - Encounter History
- Food Web and Native/NNF
  - Overlap in resource use
  - Piscivory
    - (Stomachs and Stable Isotope analysis)

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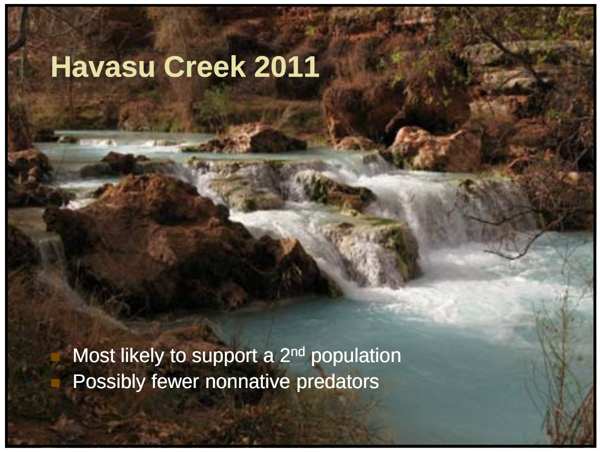
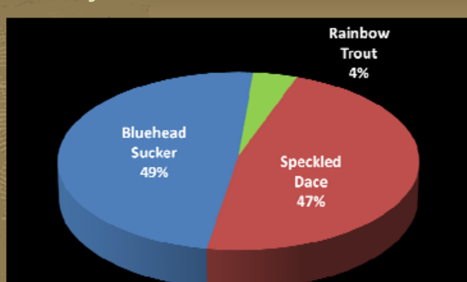


Havasu Creek Baseline Survey – February 2010



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Next Steps – Havasu Creek

- Havasu Creek
  - Develop Translocation Plan - Late winter/Spring
  - Baseline Sampling II –May 2011
    - Below Beaver Falls
    - Baseline Fish Survey
    - Water quality
    - Non-native fish
    - Food base
  - Translocation 2011 at end of Baseline Trip

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National Park Service
U.S. Department of the Interior
Grand Canyon National Park

Bright Angel Creek Trout Reduction Project Grand Canyon National Park

Brian D. Healy, Emily C. Omana, Melissa Trammell
National Park Service

David Speas
Bureau of Reclamation

Pamela J. Sponholtz
U.S. Fish and Wildlife Service

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Cooperators

- Funded by Reclamation and NPS
- Volunteers

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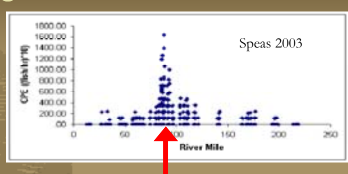
Project Background

- Bright Angel Creek: Major source of Brown Trout to Grand Canyon



- Rainbow trout introduced 1920's and 1930's
- NPS Exotic Species Management : *"..remove, when possible, or otherwise contain individuals or populations of these species that have already become established in parks." NPS Management Policies 2006*

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Bright Angel Creek Trout Reduction Project

- Purposes:
1. Benefit endangered humpback chub/other native fishes in the Colorado River.
2. Restore and enhance, to the extent feasible, native fishes that once flourished in Bright Angel Creek.

- Actions: Remove Brown and Rainbow Trout
1. Install and operate a weir (fish trap)
2. Electro-fishing for monitoring and removal

Project Background

- 2003 – Feasibility Study
- 2006 – EA Completed
- 2006-2007:
  - Weir Installed
  - Fall and Spring electro-fishing
  - Only Brown Trout Removed
- 2010 – Continued Tribal Consultation – Nonnative Control

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Winter 2010-2011 Activities

- Electro-fishing/Mechanical Removal – October (3 days)
- Weir installation – October 26 (Planned removal February 4)
- Electro-fishing planned January 24 – February 4
- Outreach:
  - Recording all visitor interactions
  - Outreach materials

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Weir Design

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Methods

- Checked Morning and Evening
- Water temperatures
- Fish:
  - Length
  - Weight
  - Spawning Condition
  - # eggs
  - Tags
  - Stomach Contents

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Beneficial Use

- Weir: 194 Trout Consumed
- Electro-fishing: 103 Trout consumed

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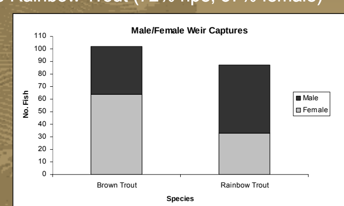
Weir Results – through January 10

- Captured/removed:
  - 104 Brown Trout (70% ripe, 62% female)
  - 90 Rainbow Trout (72% ripe, 37% female)



  - Eggs: Brown trout= 66,300, Rainbow trout = 38,800

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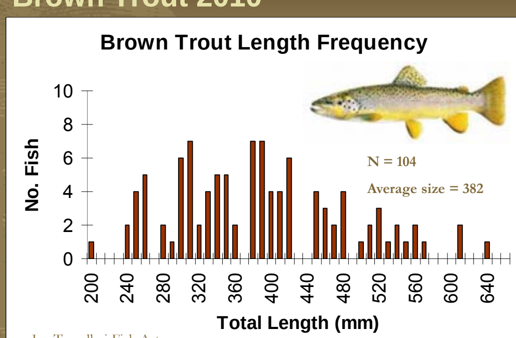
Brown Trout 2010



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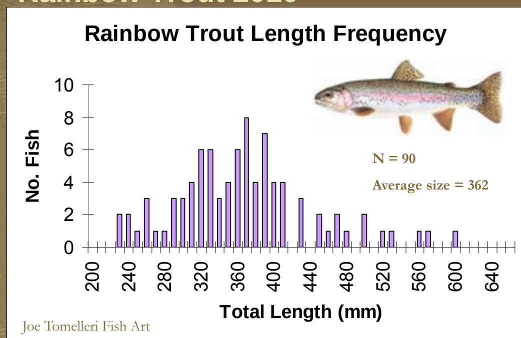
Rainbow Trout 2010



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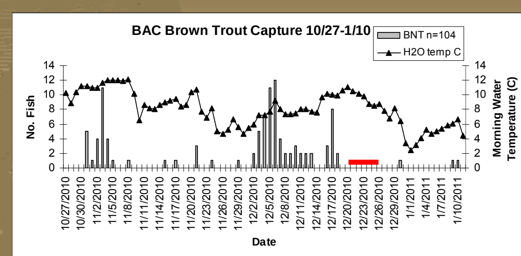
Results – Weir Captures (BNT)



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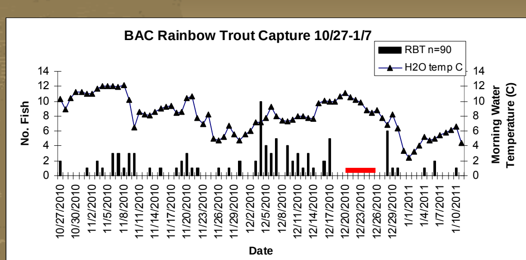
Results – Weir Captures (RBT)



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Trout Re-captures

Species	Length (mm)	Tag Number	Date Tagged	Days at Large	Location Tagged (RM)	Initial Length
Brown Trout	390	3D9.1C2D17D301	4/1/2009	582	86.4	367
Brown Trout	330	3D9.1C2D2132F3	4/2/2009	582	88.5	263
Rainbow Trout*		USGS20916	?	?	?	?
Rainbow Trout	**450**	**USGS13283**	**3/30/2009**	**590**	**60.2**	**402**
Rainbow Trout	479	USGS20911	?	?	?	?
Brown Trout	551	3D9.1BF1CD4EDE	5/21/2005	2018	87.4	230
Tag found in 332mm BNT digestive tract		3D9.1C2D8F0483	?	?	?	?
Brown Trout	297	3D9.1BF255F9ED	9/20/2007	1178	82.5	229
Brown Trout	296	3D9.1BF1D12101	?	?	?	?
Brown Trout	480	3D9.1C2D3D9D7D	?	?	?	?
Rainbow Trout	295	USGS12706	?	?	?	?

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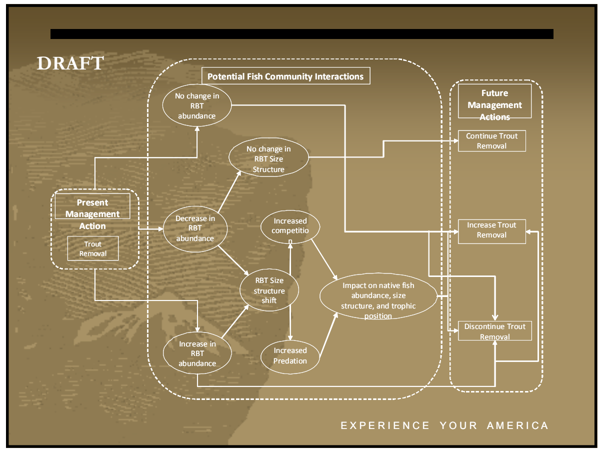
Electro-fishing - October

- Sampled ≈ 600 meters over 3 days
- Removed (nonnative fish):
  - 104 Rainbow trout (93% removal efficiency)
  - 125 Brown trout (96% removal efficiency)
- Sampled (native fish):
  - 4 bluehead suckers (<1% of catch)
  - 1046 speckled dace



- Electro-fishing sampling/removal January 24 – February 4th
- Remove weir February 4th

Phantom Ranch Boat Beach, circa 1911

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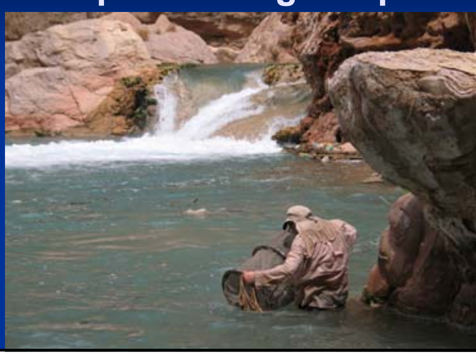
An Overview of Humpback Mark-Recapture Trips in the Little Colorado River During 2010

By
Arizona Fish and Wildlife Conservation Office
Flagstaff, AZ

Objectives

- BIO 2.R1.10 and BIO 2.M1.11,12 Obtain spring and fall closed mark-recapture population estimates of humpback chub ≥100 mm in the LCR (0 to 13.6 km).
- Obtain fall population estimate of HBC <100 mm through use of VIE tagging.
- SSQ 1-1 and 1-2

Methods: Closed Mark-Recapture Using Hoopnets



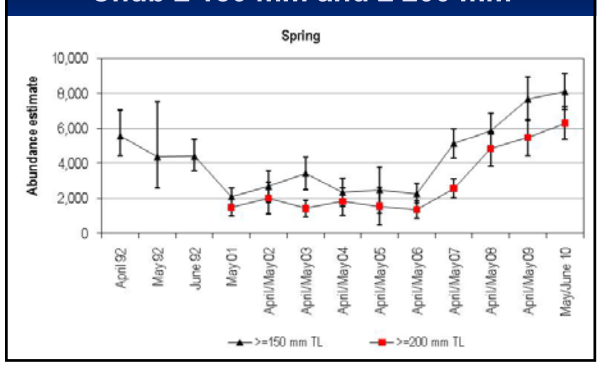
Spring HBC ≥ 100 mm

	N	SE	95% CIs	
2009	12,007	947	10,151	13,864
2010	8,908	534	7,862	9,953

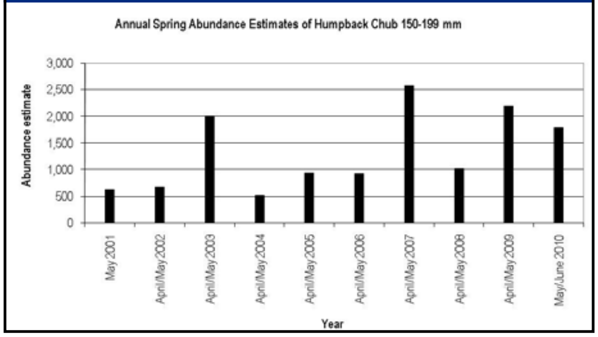
Spring HBC 100 – 149 mm

	N	SE	95% CIs	
2009	4,328	729	2,899	5,757
2010	762	127	514	1,011

Spring Abundance of Humpback Chub ≥ 150 mm and ≥ 200 mm



Spring Abundance of Humpback Chub from 150 to 199 mm from 2001 to 2010



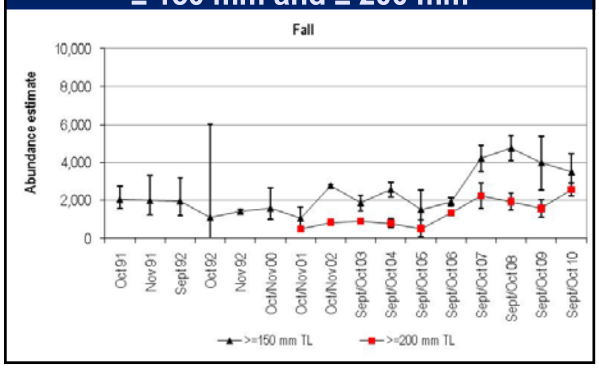
Fall HBC ≥ 100 mm

	N	SE	95% CIs	
2009	5,470	581	4,332	6,608
2010	3,887	258	3,371	4,383

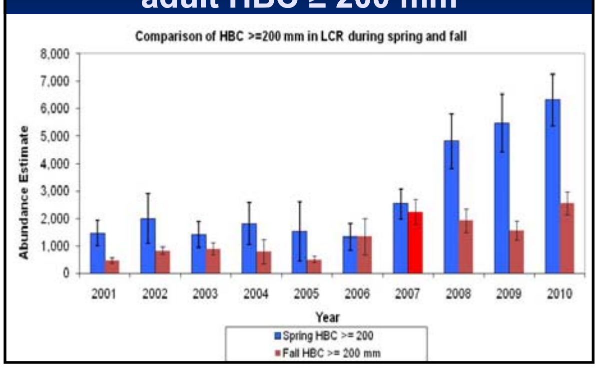
Fall HBC 100 – 149 mm

	N	SE	95% CIs	
2009	1,511	167	1,185	1,838
2010	384	76	230	528

Fall Abundance of Humpback Chub ≥ 150 mm and ≥ 200 mm



Comparison of spring and fall adult HBC ≥ 200 mm



Fall Visible Implant Mark-Recapture Efforts

Fall HBC 42-99 mm (VIE Studies)

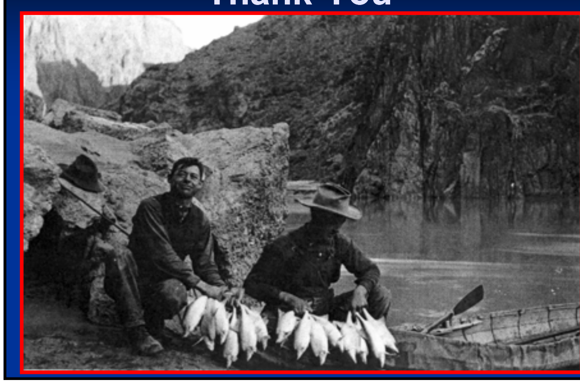
	N	SE	95% CIs	
2010	6,882	926	5,067	8,698

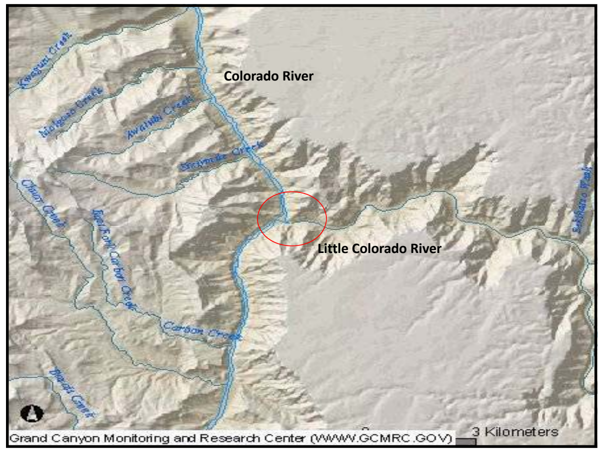
- Marked 380
- Examined 812
- Recaps 44

HBC Conclusions Spring and Fall Mark-Recapture

- Spring LCR abundances of HBC ≥150 mm and ≥200 have continued to steadily increase since 2006.
- Fall LCR abundances of HBC ≥150 mm beginning to decline since 2008, but HBC ≥200 mm appear to be holding steady.
- A relatively small cohort of age-0 HBC in fall 2009 resulted in low abundances of age-1 HBC (100-149 mm) in spring and fall 2010.
- By comparing spring to fall adult abundances, there appears to be a significant increase in the migratory portion of the adult population since 2008.
- First successful river-wide abundance estimate of age-0 humpback chub was obtained. Useful for translocations and HFE.

Thank-You





Introduction/Background

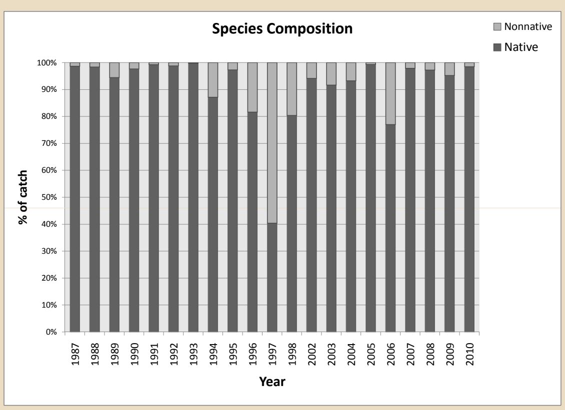
- **Annual standardized AGFD Little Colorado River (LCR) Lower 1200m spring (April/May) hoop net monitoring began in 1987.**
- **The LCR is the primary spawning site for the endangered humpback chub (HBC). Other native species spawn in the LCR such as flannelmouth sucker (FMS), bluehead sucker (BHS) and speckled dace. Nonnative species such as black bullhead (BBH), channel catfish (CCF), common carp and fathead minnow also spawn in the LCR.**
- **Catch Per Unit Effort (CPUE) indices are useful as independent validation for Age Structured Mark-Recapture (ASMR) population models of HBC.**
- **This project is one of the most consistent, standardized long-term monitoring projects in Grand Canyon, with the exception of 2000-2001.**

BIO 2.R2. Little Colorado River Humpback Chub Monitoring in the Lower 1,200m:

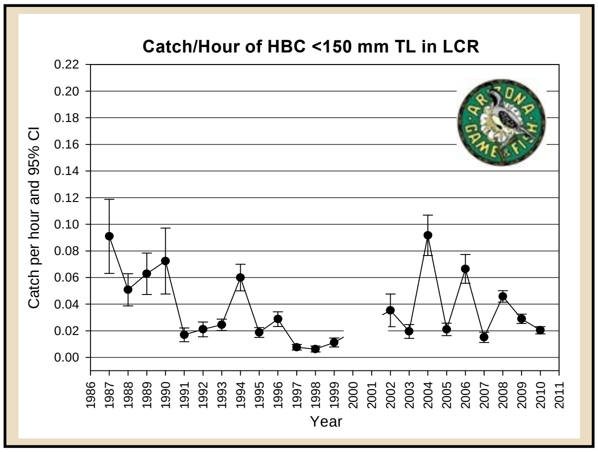
SA 1. What are the most limiting factors to successful HBC adult recruitment in the mainstem: spawning success, predation on YoY and juveniles, habitat (water, temperature), pathogens, adult maturation, food availability, competition?

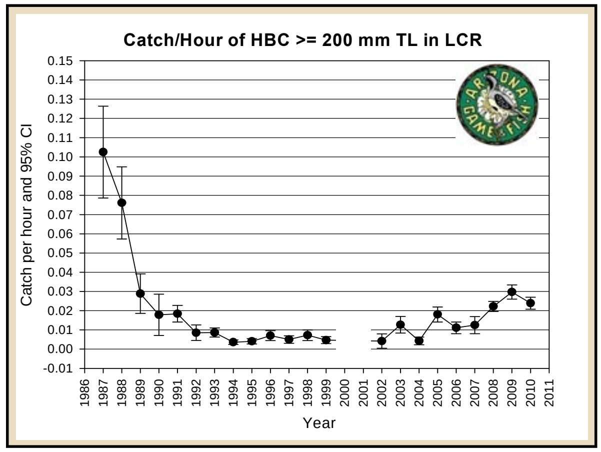
OBJECTIVES

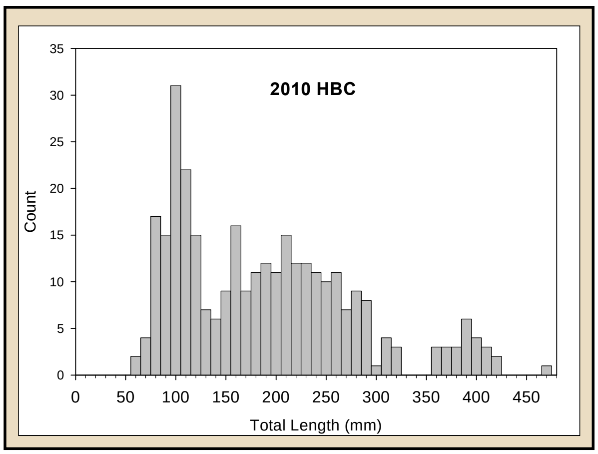
- **Asses population status and trends (CMIN 2.1.2.)**
- **Determine catch-per-unit-effort [fish/hour] (CMIN 2.1.2.)**
- **Determine species composition of catch**
- **Determine size and length frequency distributions (CMIN 2.1.2.)**

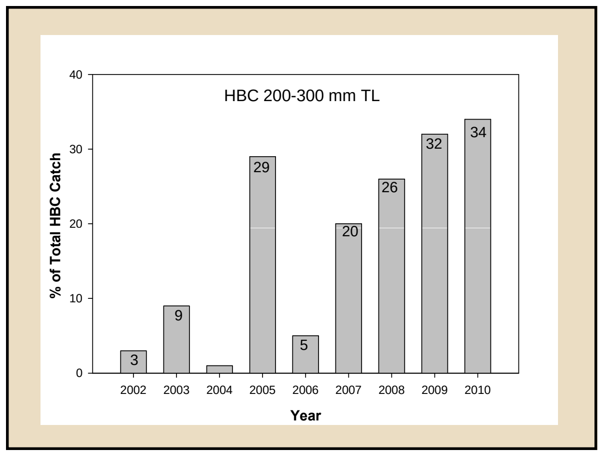


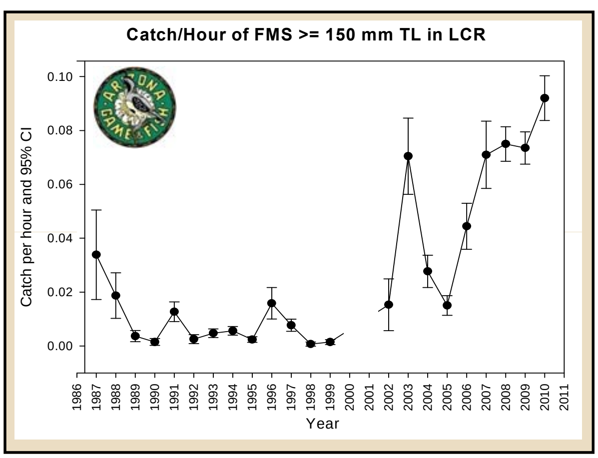
2010 Species	Count	% of Total Catch
Bluehead sucker (BHS)	83	3.96
Flannelmouth sucker (FMS)	671	31.98
Humpback chub (HBC)	315	15.01
Speckled dace (SPD)	997	47.52
Total Native	2066	98.5
Black bullhead (BBH)	0	0.00
Channel catfish (CCF)	12	0.57
Common carp (CRP)	1	0.05
Fathead minnow (FHM)	13	0.62
Plains killifish (PKF)	5	0.24
Rainbow trout (RBT)	1	0.05
Red shiner (RSH)	0	0.00
Total Non-native	32	1.5
Total	2098	100.0

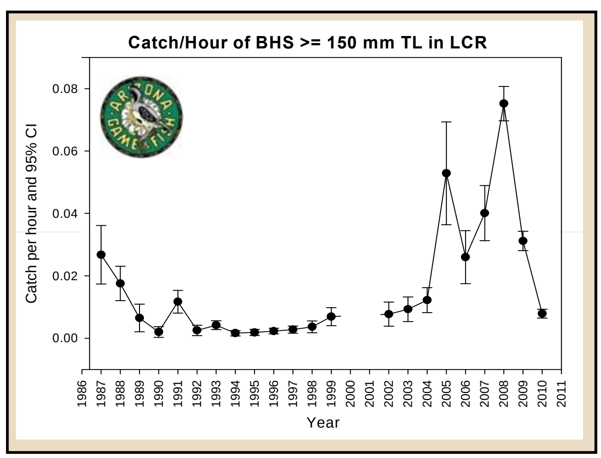

Catch/Hour of HBC <150 mm TL in LCR
Catch per hour and 95% CI
Year

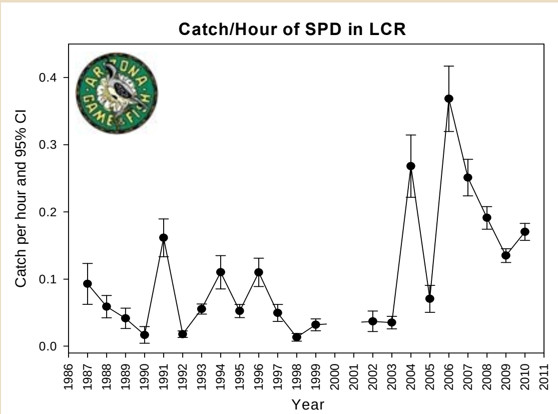

Catch/Hour of HBC >= 200 mm TL in LCR
Catch per hour and 95% CI
Year

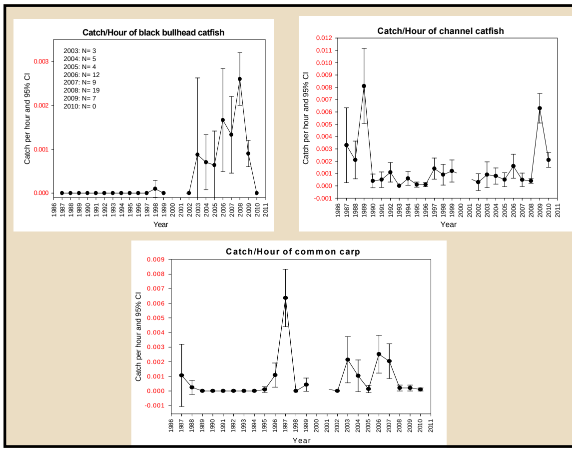

2010 HBC
Count
Total Length (mm)

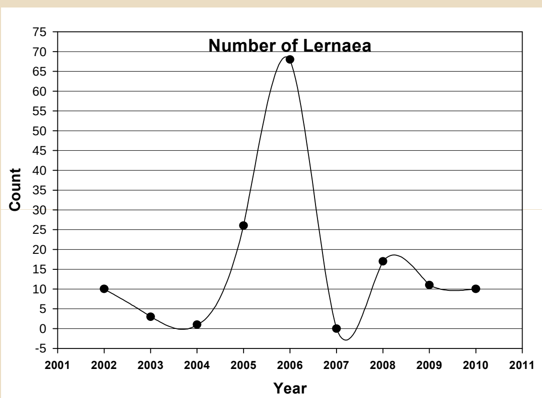

HBC 200-300 mm TL
% of Total HBC Catch
Year


Catch/Hour of FMS >= 150 mm TL in LCR
Catch per hour and 95% CI
Year


Catch/Hour of BHS >= 150 mm TL in LCR
Catch per hour and 95% CI
Year







Conclusions

- Catch/Hour of HBC ≥ 200 mm was similar to early 1990's catch rates [CMIN2.1.2.].
- Relative abundance of Flannelmouth sucker continues to remain above historic observations.
- Total catch of nonnative species remains low (< 5%).
- Relative abundance of commonly captured nonnative species tends to vary annually.
- Trends in LCR lower 1200 m adult HBC (≥ 200 mm) are similar to trends in Age Structured Mark Recapture abundance estimates for adult HBC.

SSQ 3-6

- What GCD operations (ramping rates, daily flow range, etc.) maximize trout fishing opportunities and catchability?
- Lees Ferry angler based model
- Since 1991
  - High mean low fluctuating flows (MLFF)
- Recent flow events
  - March 2008 high flow event (HFE)
  - Fall steady flows
    - Sept.-Oct. 2008-2012

CMINs

- **4.1.1**
  - Determine annual population estimates for rainbow trout in the Lees Ferry reach.
- **4.1.2**
  - Determine annual proportional stock density of rainbow trout in the Lees Ferry reach.
- **4.1.4**
  - Determine annual growth rate, relative condition (Kn), and relative weight of rainbow trout in the Lees Ferry reach.

Sampling

- Since June 2002, 27 random and 9 fixed sites sampled 3 times/year (spring, summer, fall)
  - PIT tagging in fixed sites
  - Floy tagging in random sites (2007)
- 2010, Fully random design, 36 sites, only 2 trips
  - PIT tagging in 9 sites that were near old fixed sites
  - Floy tagging elsewhere
  - Summer trip replaced by warm-water non-native trip

CMINs

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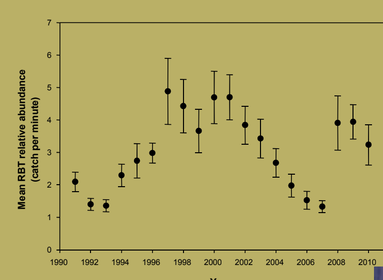
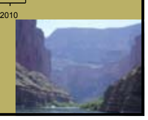
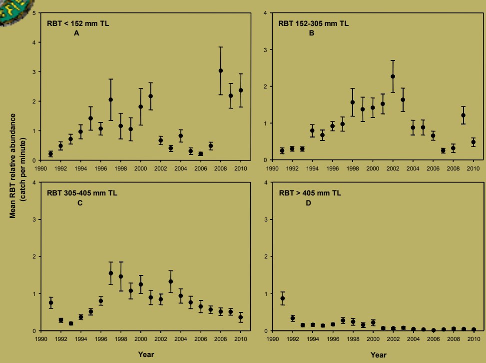
Relative abundance

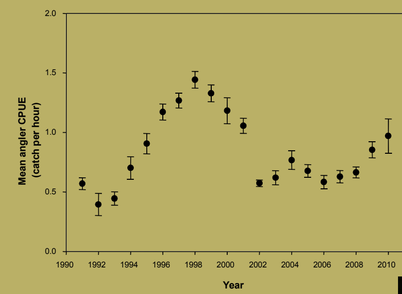


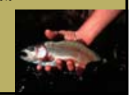


Relative abundance/Size structure

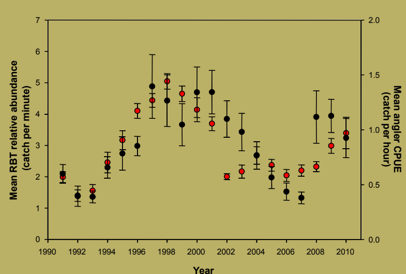


Angler creel survey





Angler creel survey



CMINs

- 4.1.1
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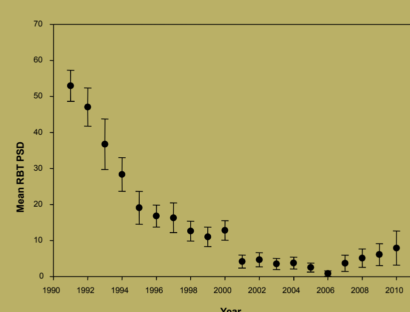
Proportional Stock Density (PSD)

$$PSD = \left(\frac{RBT \geq 406}{RBT \geq 305}\right) * 100$$

305 mm (12 inches) = Mean stocking size
406 mm (16 inches) = Preferred catch size

Size structure



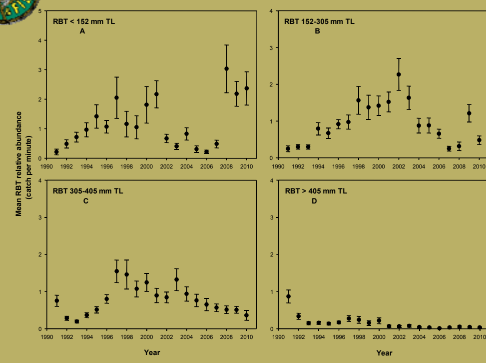
Size structure

- Is PSD still relevant?

$$PSD = \left(\frac{RBT \geq 406}{RBT \geq 305}\right) * 100$$

  - If RBT ≥ 406 increase in abundance, PSD goes up
  - OR, if RBT 305 - 405 decrease in abundance, PSD goes up, but it doesn't mean the fish are getting any larger
    - Currently an irrelevant metric?

Relative abundance/Size structure



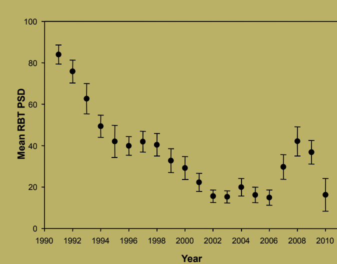
PSD Alternatives

- Change standard length cutoffs

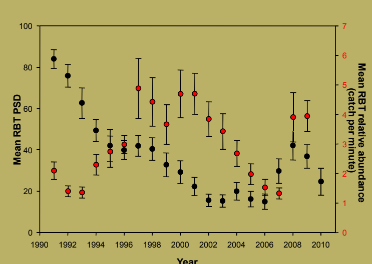
$$PSD = \left(\frac{RBT \geq 356}{RBT \geq 254}\right) * 100$$

- New regulation: ≥ 356 mm (14 inches) must be released (quality)
- 254 mm (10 inches) catchable (stock)

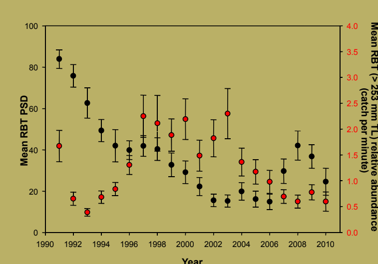
PSD Alternatives



PSD Alternatives



PSD Alternatives



CMINs

- 4.1.1
  - Determine annual population estimates for rainbow trout in the Lees Ferry reach.
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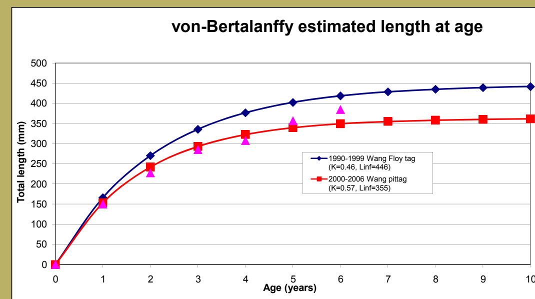
Growth rate



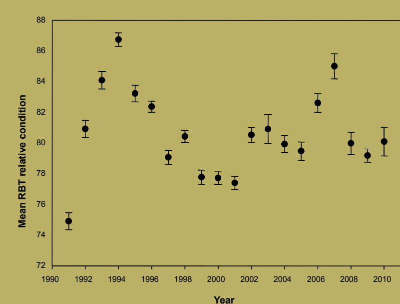
Relative condition

$$K_n = \left(\frac{W}{W'}\right) * 100$$

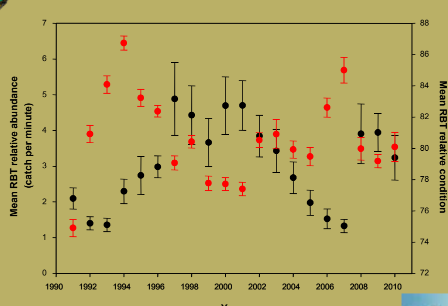
W = weight

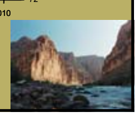
$W' = e^{[(-4.6 + 2.856) * \ln TL]}$

Relative condition

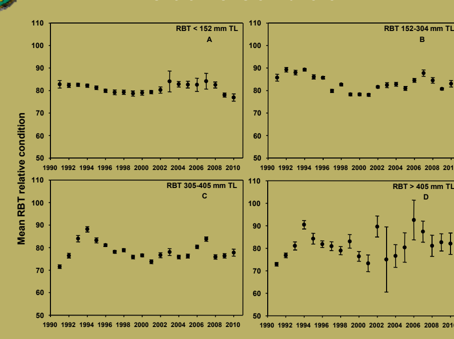


Relative condition

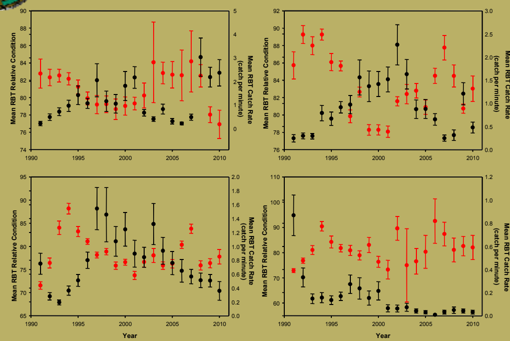




Relative condition

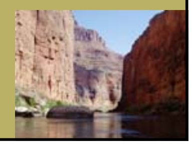


Relative condition



Conclusions

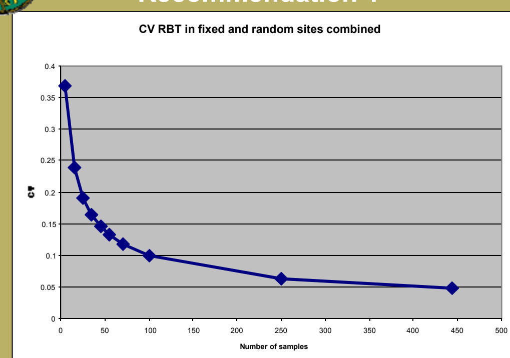
- **Lees Ferry fishery monitoring**
  - Last year it was concluded that fall steady flows aided in YOY and juvenile survival. It now looks as though the spring HFE and it's impact on the foodbase had more to do with that and the effects are deminishing.
  - Recruitment of 2008 cohort into young adult population. Not so much with the 2009 cohort.
  - Numbers of small fish remain high while numbers of large fish continue to decline.
- **Whirling disease**
  - First detected in June 2007
  - No detections since



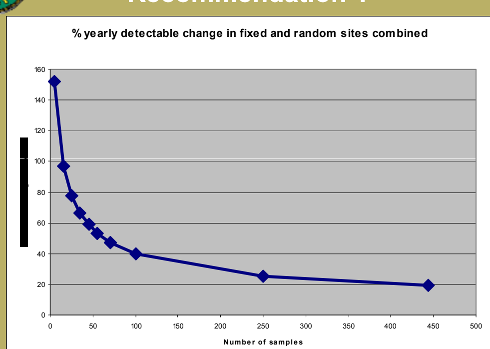
2009 PEP recommendations

1. **Reduce effort to sample adult RBT population in Lees Ferry to 1-2 trips/year and get rid of fixed sites**
2. **Redirect efforts for more non-native sampling**
3. **Incorporate Rainbow Trout Early Larval Life-history Study (RTELLS) work**

Recommendation 1

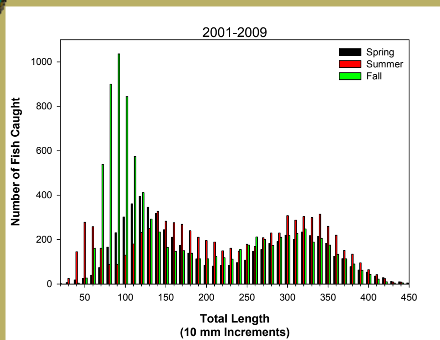


Recommendation 1

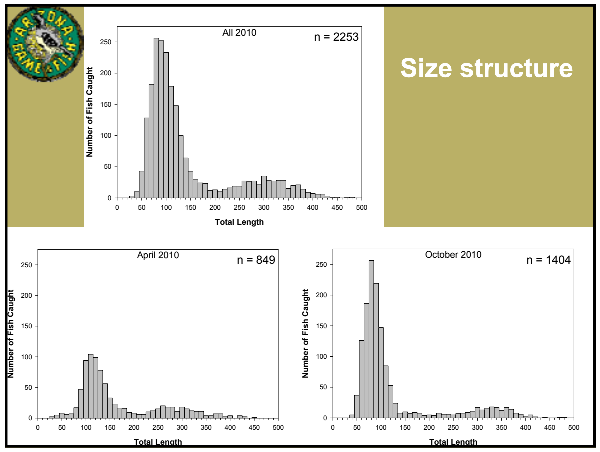


Recommendation 1

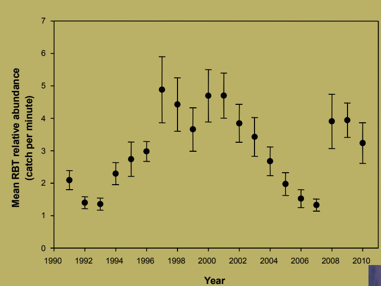
- **Sampling trips to occur in spring and fall**
  - Spring serves as decent indicator of adult population
  - Fall is best opportunity to detect WD and cohort strength



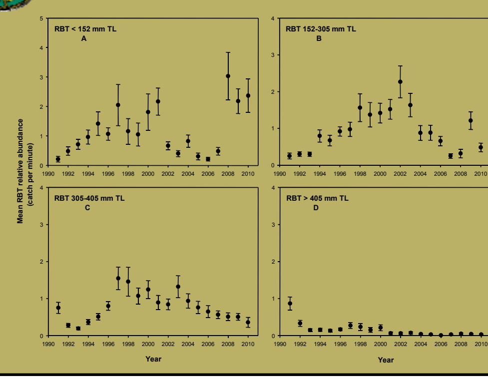
Size structure



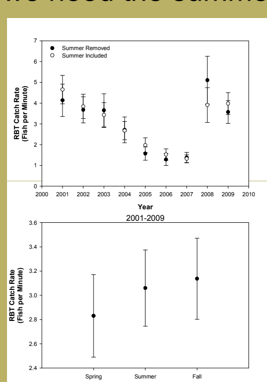
Relative abundance



Relative abundance/Size structure



Do we need the summer trip?



Recommendation 2

- **Summer sampling trip geared towards non-native fish**
- **Areas of interest**
  - Carp pond/Slough
  - Springs
  - Base of the GCD

July 21-23, 2010

Colorado River mile

-12.10 → -12.33

Objectives

- Detect non-native species in slough area
- Determine best technique to capture non-native species
- PIT tag common carp (CRP) to track future growth and movement
- Obtain population estimate of CRP in slough area

Methods

- Back-pack electrofishing
- Boat electrofishing
- Trammel nets
- 20 hoop nets
  - Stink cheese (10 catfish nets)
  - Aquamax (10 standard hoops)
- 20 minnow traps
  - Canned cat food bait
- Block net set at mouth of slough

Results

Table 1. Number of each species captured per sampling method near RM -12.0 during July 2010 sampling. Species are coded as followed: common carp (*Cyprinus carpio*; CRP); flannelmouth sucker (*Catostomus latipinnis*; FMS); rainbow trout (*Oncorhynchus mykiss*; RBT), and green sunfish (*Lepomis cyanellus*; GSF).

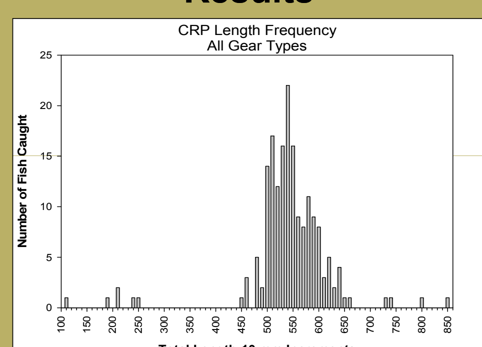
Date	Method	CRP	FMS	RBT	GSF
7/21/2010	Back-pack electrofishing	7	-	-	-
7/21/2010	Boat electrofishing	13	-	3	-
7/22/2010	Boat electrofishing	114	3	19	2
7/22/2010	Trammel netting	3	7	-	-
7/23/2010	Boat electrofishing	70	2	6	-
7/23/2010	Trammel netting	2	4	-	1
	Total	**209**	**16**	**28**	**3**
	% Composition	**81.6**	**6.3**	**10.9**	**1.2**

Results

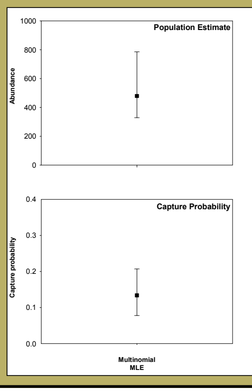
Table 2. Growth and movement information resulting from recaptures of PIT-tagged common carp (*Cyprinus carpio*; CRP) and flannelmouth sucker (*Catostomus latipinnis*; FMS) captured during July 2010 sampling near RM -12.0. Mark location LCR indicates species was tagged in the Little Colorado River and is calculated into distance moved by adding the value to Mark location, where 61.70 represents the RM at the confluence. Negative values for distance moved indicates movement upstream.

Method	Species	Tag number	Date marked	Mark location (RM)	Mark location LCR (RM)	Date recaptured	Recap location (RM)	Days out	Mark length (mm)	Recap length (mm)	Distance moved (miles)	Instant growth (mm/day)
Boat electro-fishing	CRP	3D9.1BF198D35C	11/3/2003	-12.00	-	7/22/2010	-12.28	2,453	399	504	-0.28	0.0428
	CRP	3D9.1BF198D3F4	11/3/2003	-12.00	-	7/23/2010	-12.28	2,454	451	519	-0.28	0.0277
	CRP	3D9.1BF198DAFA	11/3/2003	-11.80	-	7/22/2010	-12.33	2,453	403	513	-0.53	0.0448
	CRP	3D9.1BF1CD38D4	7/12/2004	-0.20	-	7/22/2010	-12.28	2,201	286	502	-12.08	0.0981
	FMS	3D9.1BF22A9837	1/12/2006	45.10	-	7/22/2010	-12.33	1,652	449	527	-57.43	0.0472
Trammel netting	FMS	5116164E1E	5/17/1999	61.70	0.04	7/22/2010	-12.31	4,084	396	507	-74.05	0.0272
	FMS	3D9.1BF256209C	4/7/2006	61.70	0.07	7/22/2010	-12.19	1,567	265	504	-73.96	0.1525
	FMS	3D9.1BF1CD2BF6	4/8/2006	132.50	-	7/22/2010	-12.31	1,566	186	406	-144.81	0.1405
	FMS	3D9.1BF1CD322B	4/8/2006	73.70	-	7/23/2010	-12.31	1,567	195	438	-86.01	0.1551
	FMS	3D9.1C2D8AF6F6	6/30/2010	-12.25	-	7/22/2010	-12.31	22	504	521	-0.06	0.7727

Results



Results



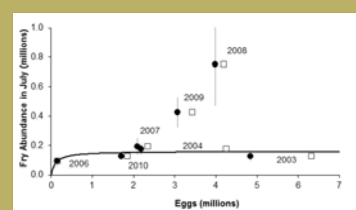
Conclusions

- Slough is dominated by common carp
- Large population of carp in 0.23 mile span may suggest sampling occurred during spawning aggregation; 71 ripe males out of 180 that did not include recaps= 39.4% of population
- 26 total CRP recaptures from boat electrofishing; 165 new PIT tags (boat electrofishing) reflects a low recapture rate/ lots of carp
- No CRP or FMS ≤ 100 mm TL were captured during this sampling; adult population
- No fish species captured in hoop nets or minnow traps throughout sampling
- Slough most likely serves as a thermal refuge for CRP and FMS
- Future monitoring of the slough may be incorporated into Lees Ferry monitoring trips

Recommendation 3

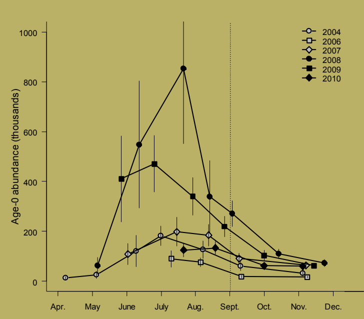
- **Coordination with Korman and Foster**
- **Continue sampling larval fish to determine effects of experimental actions**
- **Continue fall-winter redd counts**

RTELLS



Josh Korman, 2010 preliminary data

RTELLS



Josh Korman, 2010 preliminary data

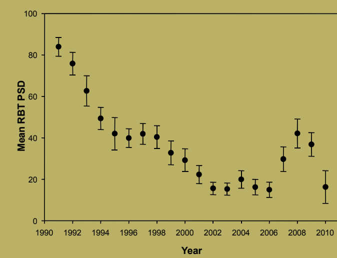
Foodbase

- Results available through Ted Kennedy
  - Started in 2003
- Very informative and, along with RTELLS, helps explain recent trends
- Provides better picture of Lees Ferry ecology and rainbow trout population responses to various flow regimes
- We would like to see this work continue and possibly expand

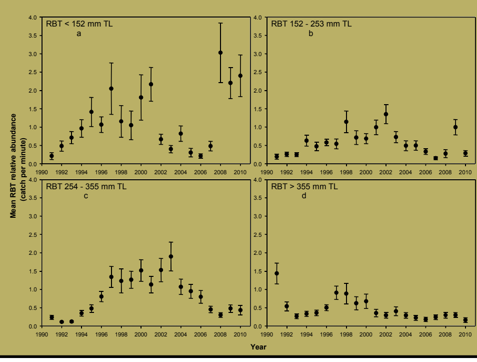
Relative abundance/Size structure

- New regulation as of October
  - Release fish ≥14” (356 mm TL)
    - Old regulation; release ≥12” (305 mm TL)
  - <152 mm, 152 - 254 mm, 255 – 355 (10” – 14”; stock size), ≥356 mm (quality size)

PSD Alternatives



PSD Alternatives



SSQ

- SSQ 1-1. To what extent are adult populations of native fish controlled by production of young fish from tributaries, spawning and incubation in the mainstem, survival of young-of-year and juvenile stages in the mainstem, or by changes in growth and maturation in the adult population as influenced by mainstem conditions?

Background

Non-native salmonids (i.e., rainbow and brown trout) have increased in abundance since early 1990's

↓

Salmonids may limit recruitment of native fishes
(Minckley 1991; Marsh and Douglas 1997; U.S. Department of Interior 2002)

↓

GCMRC Protocol Evaluation Program advocated long-term monitoring of non-native fish species

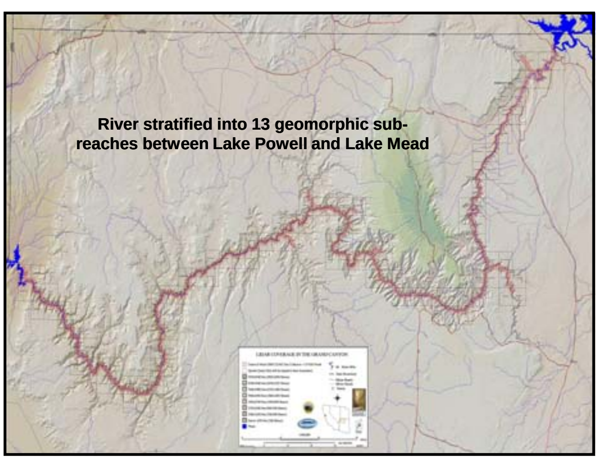
↓


Photo: Rogers 2005

→ Mainstem fish community monitoring

2010 Objectives

- Describe trends in nonnative salmonid and carp, and native catastomid catch-per-unit-effort (CPUE; fish/hr) and distribution from 2000 – 2010.
- Measure changes in fish CPUE near the confluence of the Little Colorado River.
- Evaluate the ability to monitor movement and growth of rainbow trout by Floy tagging.



Methods: Electrofishing

- Two trips conducted in Spring (April– May)
- Randomized site selection within study reaches
- Single-pass shoreline electrofishing at night (2 boats)
- ~900 transects (1 transect = ~300 sec. shock time)
- Data attained: Species ID, TL (all species) & FL (natives only; mm), Wt (g), and tag returns (i.e., Floy, PIT, and/or fin-clips)

Goal: Gather information on any fish we can get our hands on!

Non-native monitoring targets:

Also, rare and elusive species (e.g., centrarchids)

Native monitoring targets:

Methods: Tagging

PIT Tags:
- **Brown trout > 149 mm TL**
- **Most native species > 149 mm TL**
- **Humpback chub > 99 mm TL**

Floy Tags:
- **Rainbow trout > 199 mm TL**
- **Common carp > 199 mm TL**

Fin-clip:
- **Brown trout (adipose fin)**
- **Rainbow (left pelvic)**
- **Common carp (dorsal spine)**

2010 Objectives

- Describe trends in nonnative salmonid and carp, and native catastomid catch-per-unit-effort (CPUE; fish/hr) and distribution from 2000 – 2010.
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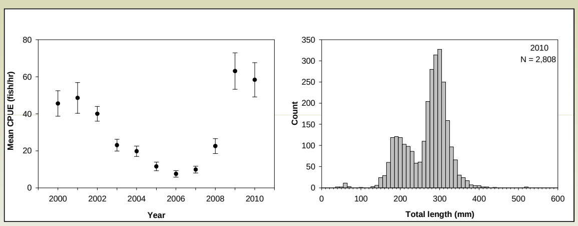
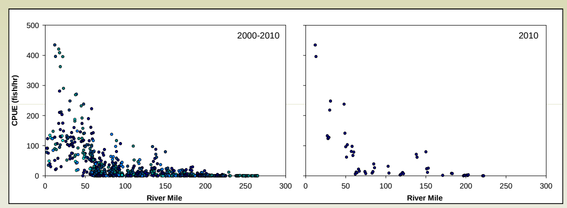
- Evaluate the ability to monitor movement and growth of rainbow trout by Floy tagging.

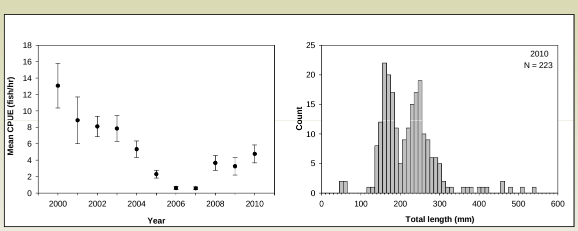
Rainbow trout



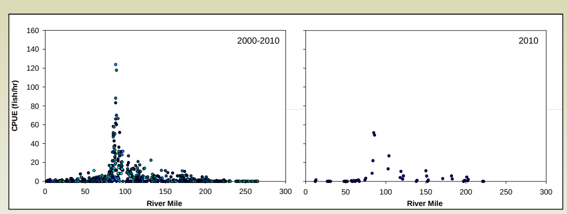
Rainbow trout



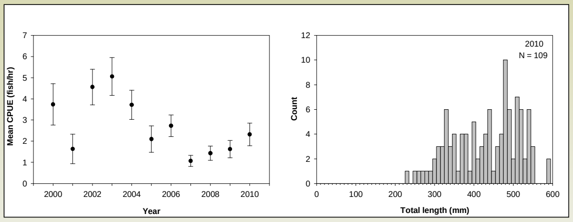
Brown trout



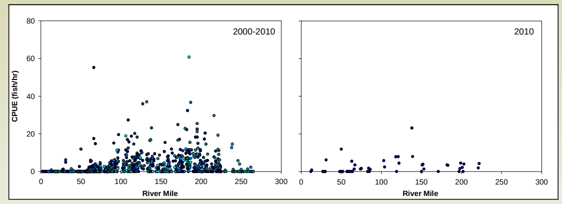
Brown trout



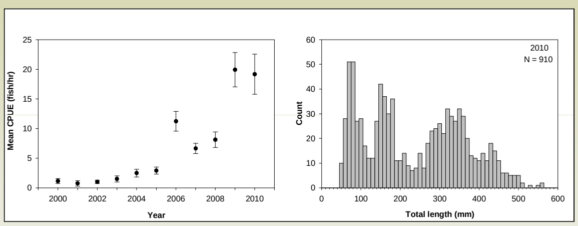
Common carp



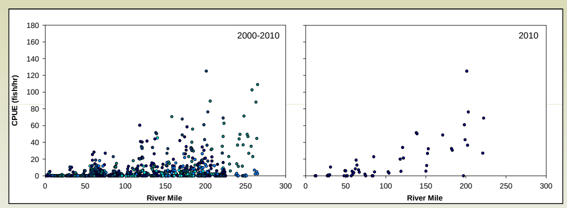
Common carp

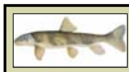


Flannelmouth sucker

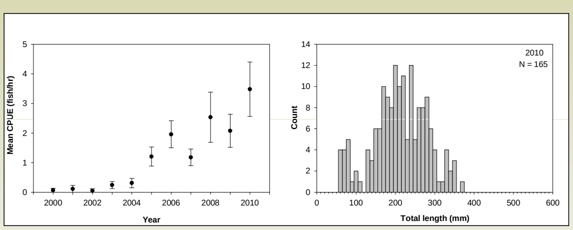


Flannelmouth sucker

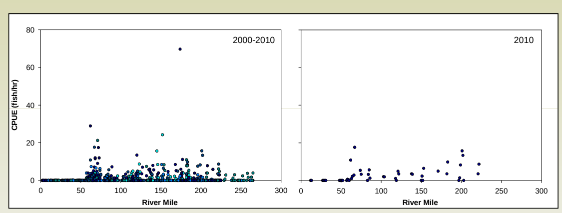




Bluehead sucker



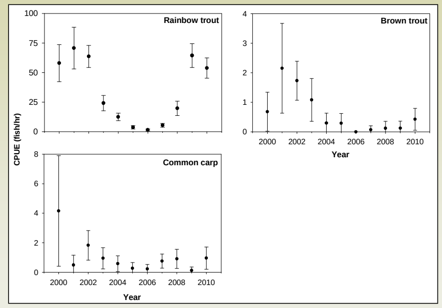
Bluehead sucker



2010 Objectives

- Describe trends in nonnative salmonid and carp, and native catastomid catch-per-unit-effort (CPUE; fish/hr) and distribution from 2000 – 2010.
- Measure changes in fish CPUE near the confluence of the Little Colorado River.
- Evaluate the ability to monitor movement and growth of rainbow trout by Floy tagging.

Results: Removal Reach

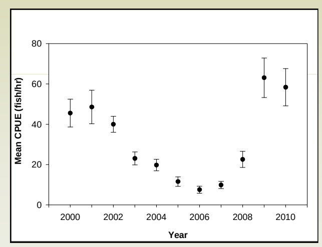


Conclusions

- Since mid-2000's - increasing trends in CPUE for all species both native and nonnative
- Fish distribution consistent with previous years
- Few humpback chub collected (N=15)
- Currently, best tool to assess when the 1,200 rainbow trout trigger is met for mechanical removal to occur
- Potential issues with1 trip vs. 2 trips
  - Reduce the ability to collect rare nonnative fishes
  - Turbidity drastically influences capture probability

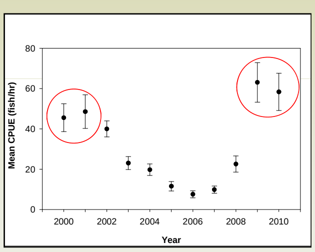
Conclusions

- Higher CV's and larger confidence intervals – adding more uncertainty (e.g., rainbow trout)



Conclusions

- Higher CV's and larger confidence intervals – adding more uncertainty (e.g., rainbow trout)



Questions?

USGS
science for a changing world

Progress on Processing 2009 High-Resolution Airborne Imagery

Philip A. Davis and Laura E. Cagney

U.S. Department of the Interior
U.S. Geological Survey

Primary Objectives

Provide consistent, calibrated, and undistorted multispectral image database for the Colorado River corridor from Lake Powell to Pierce Ferry for late May, 2009 with 20-cm spatial resolution and 30-cm positional accuracy.

Such a database, not previously obtained, should provide more capability, accuracy, and efficiency in image analyses that produce specific monitoring databases.

Conclusion: Our analyses thus far have proven this to be true.

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Environmental Issues During the 2009 Overflights

Normally, data collection would occur under clear sky conditions, within a narrow daily time window, which would constrain environmental parameters that affect airborne image data.

The weather during the 2009 collection was the worst ever, producing variations in solar flux, atmospheric transmission and scattering, and solar phase angle throughout the mission, all of which had to be normalized for each flight line of image data.

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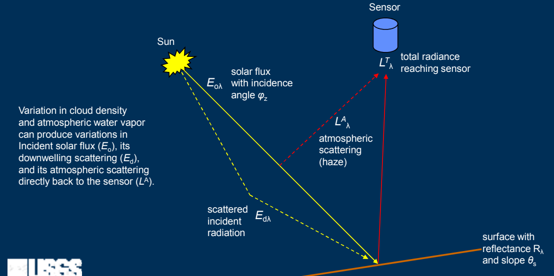
Environmental Effects on Image Data

general radiometric equation

$$L^T_\lambda = \frac{[(E_{o\lambda} \cdot T_{o\lambda} \cdot \cos\varphi_z + E_{d\lambda}) \cdot T_{s\lambda} \cdot R_\lambda \cdot \cos\theta_s]}{\pi} + L^A_\lambda$$



Variation in cloud density and atmospheric water vapor can produce variations in Incident solar flux (E_o), its downwelling scattering (E_d), and its atmospheric scattering directly back to the sensor (L^A).

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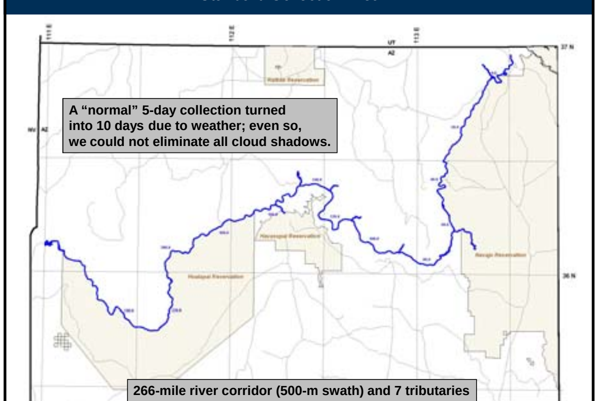
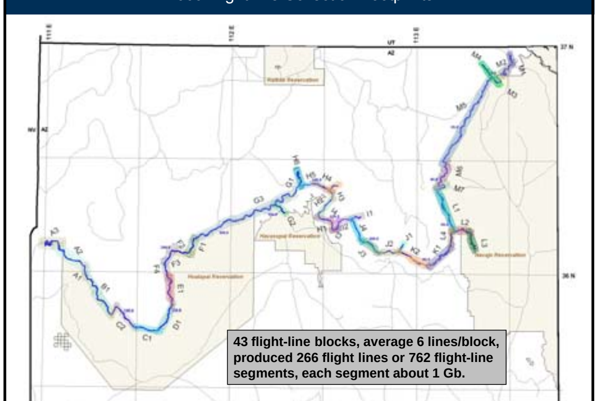
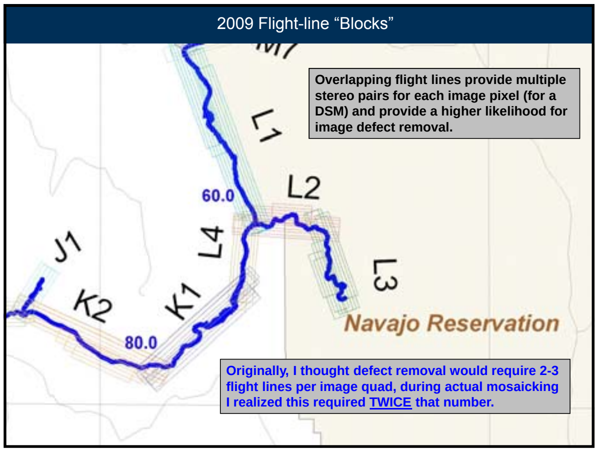
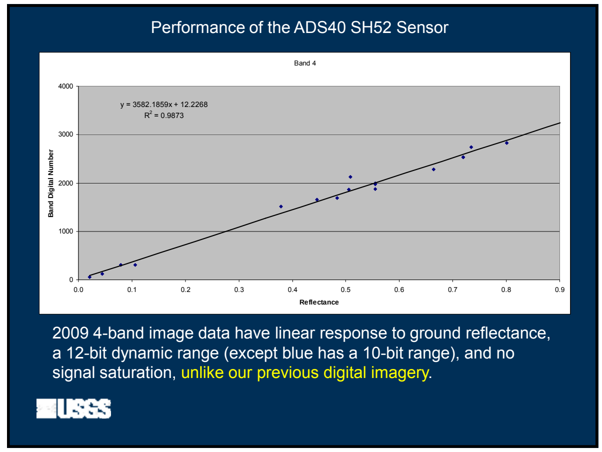
Standard Collection Area

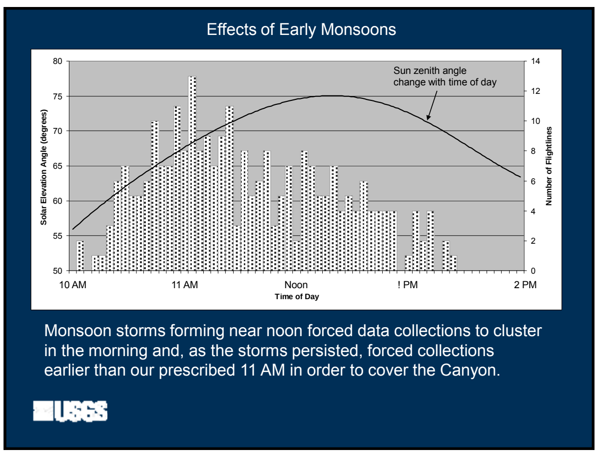


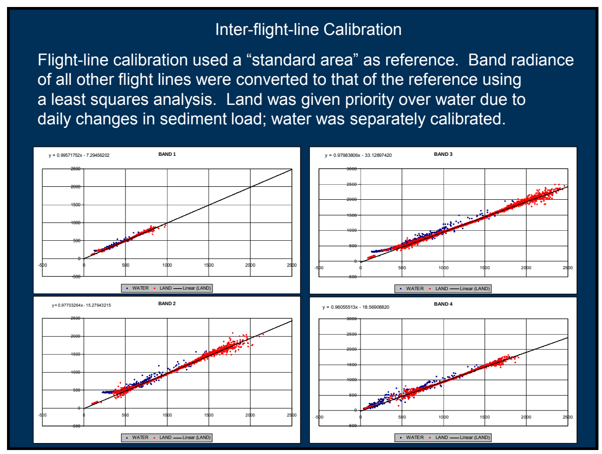
2009 Flight-line Collection Footprints

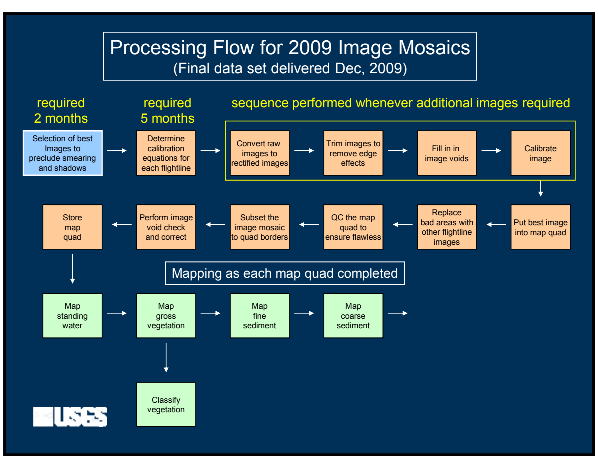


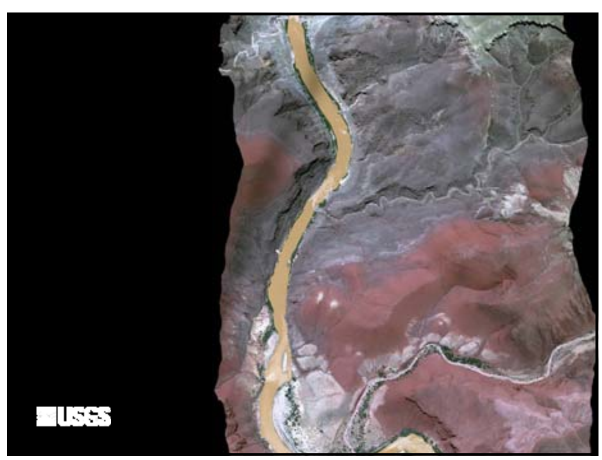

2009 Flight-line "Blocks"
Overlapping flight lines provide multiple stereo pairs for each image pixel (for a DSM) and provide a higher likelihood for image defect removal.
L1
L2
60.0
J1
L4
L3
K2
K1
80.0
Navajo Reservation
Originally, I thought defect removal would require 2-3 flight lines per image quad, during actual mosaicking I realized this required TWICE that number.

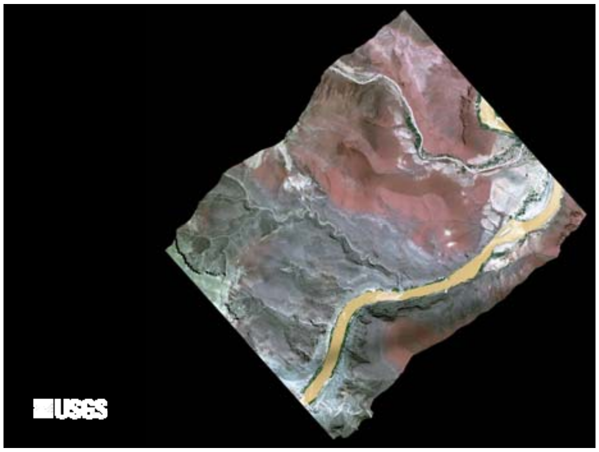

Performance of the ADS40 SH52 Sensor
Band 4
y = 3582.1859x + 12.2268
R2 = 0.9873
Band Digital Number
Reflectance
2009 4-band image data have linear response to ground reflectance, a 12-bit dynamic range (except blue has a 10-bit range), and no signal saturation, unlike our previous digital imagery.
USGS


Effects of Early Monsoons
Sun zenith angle change with time of day
Solar Elevation Angle (degrees)
Number of Flightlines
10 AM
11 AM
Noon
! PM
2 PM
Time of Day
Monsoon storms forming near noon forced data collections to cluster in the morning and, as the storms persisted, forced collections earlier than our prescribed 11 AM in order to cover the Canyon.
USGS


Inter-flight-line Calibration
Flight-line calibration used a "standard area" as reference. Band radiance of all other flight lines were converted to that of the reference using a least squares analysis. Land was given priority over water due to daily changes in sediment load; water was separately calibrated.
BAND 1
BAND 3
BAND 2
BAND 4


Processing Flow for 2009 Image Mosaics
(Final data set delivered Dec, 2009)
required 2 months
required 5 months
sequence performed whenever additional images required
Selection of best images to preclude smearing and shadows
Determine calibration equations for each flightline
Convert raw images to rectified images
Trim images to remove edge effects
Fill in in image voids
Calibrate image
Put best image into map quad
Replace bad areas with other flightline images
QC the map quad to ensure flawless
Subset the image mosaic to quad borders
Perform image void check and correct
Store map quad
Mapping as each map quad completed
Map standing water
Map gross vegetation
Map fine sediment
Map coarse sediment
Classify vegetation
USGS


USGS



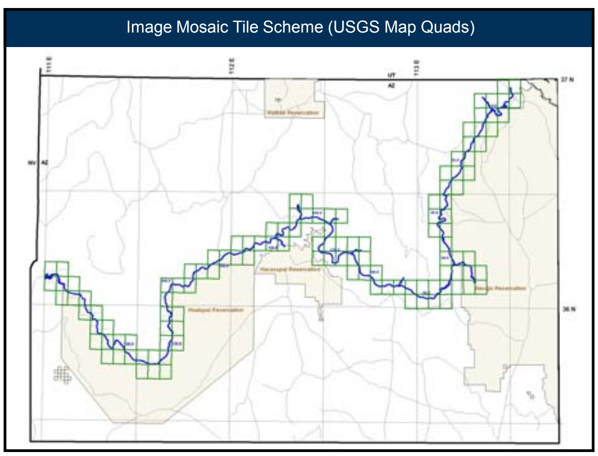
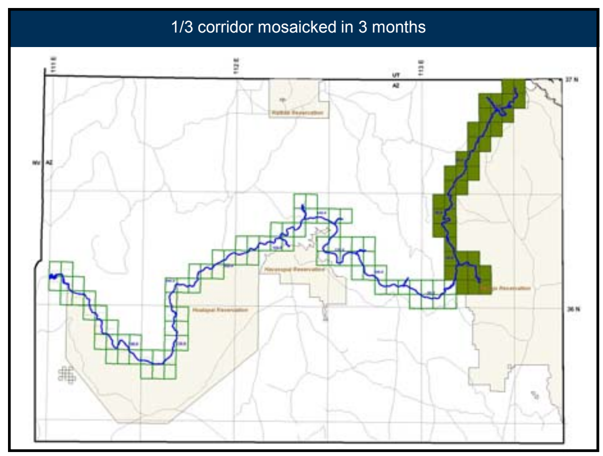
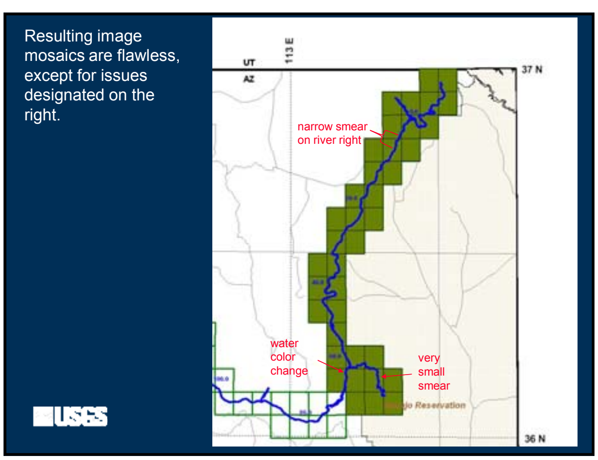
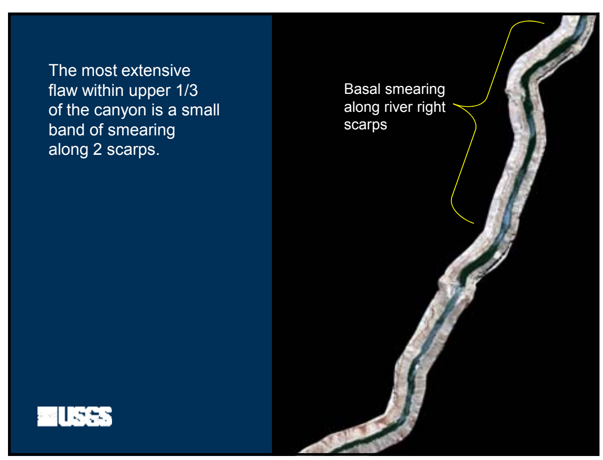
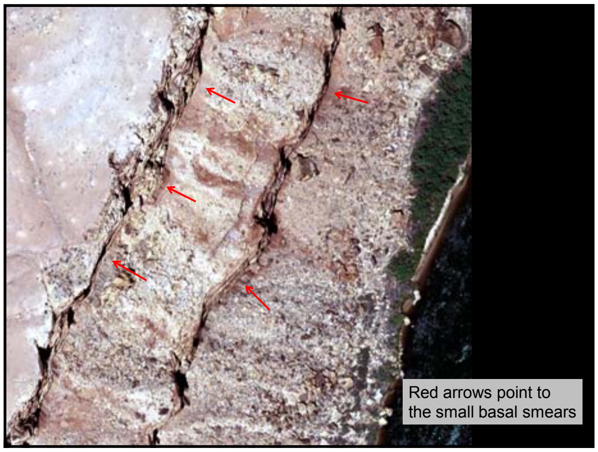


Image Mosaic Tile Scheme (USGS Map Quads)


1/3 corridor mosaicked in 3 months


Resulting image mosaics are flawless, except for issues designated on the right.
UT
AZ
113 E
37 N
narrow smear on river right
water color change
very small smear
36 N


The most extensive flaw within upper 1/3 of the canyon is a small band of smearing along 2 scarps.
Basal smearing along river right scarps



Adjacent Flight Lines South of LCR

River left – western flight line shows smearing along slopes, as well as distortion (smearing) of near-shore vegetation.

USGS

Adjacent Flight Lines South of LCR

River left – eastern flight line shows no smearing. Acquired a different day, hence change in water color.

USGS

Adjacent Flight Lines South of LCR

River right – eastern flight line shows smearing along slopes.

USGS

Adjacent Flight Lines South of LCR

River right – western flight line shows no smearing along slopes.

USGS

Objective was to provide consistent, accurate reflectance on land and in the water and to minimize image distortions.

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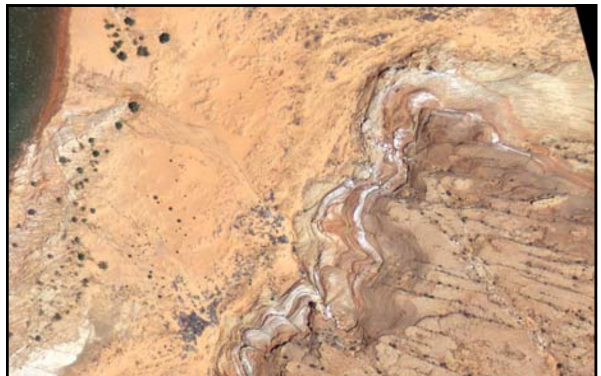
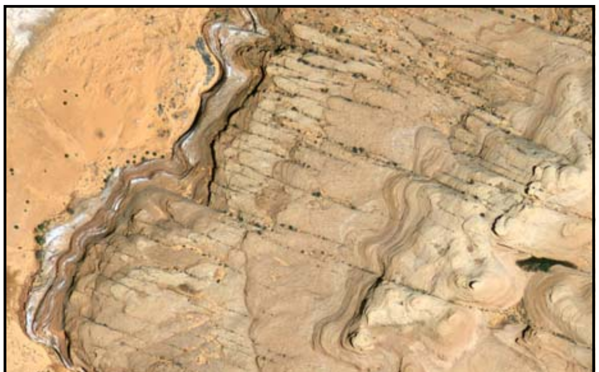
East side of Lake Powell

2009 natural-color images

USGS



USGS



USGS

USGS

Glenn Canyon

Comparing image data:

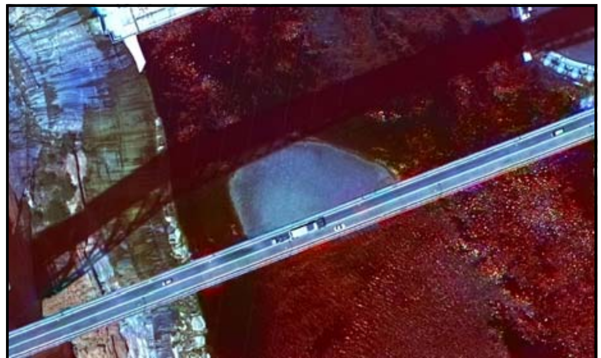
2009 natural color
2005 natural color
2002 natural color
2002 4-band natural color

USGS

2009 natural color

Arizona “bridge to nowhere”

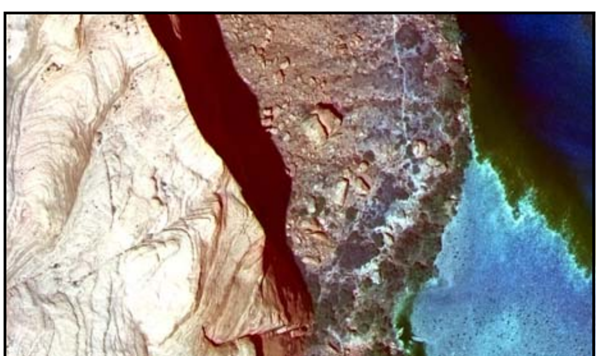
2005 natural color



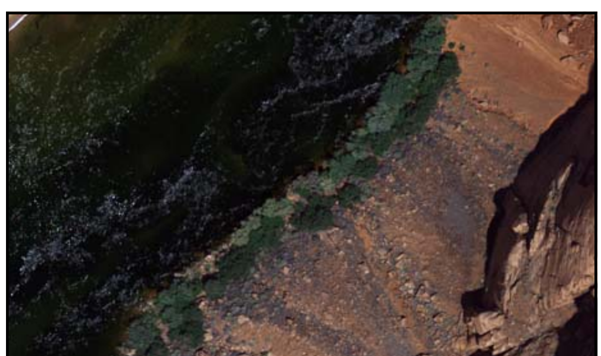
2002 natural color

2009 natural color

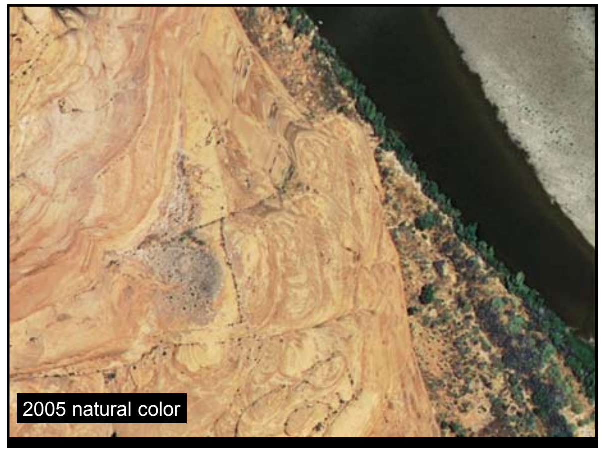
2005 natural color

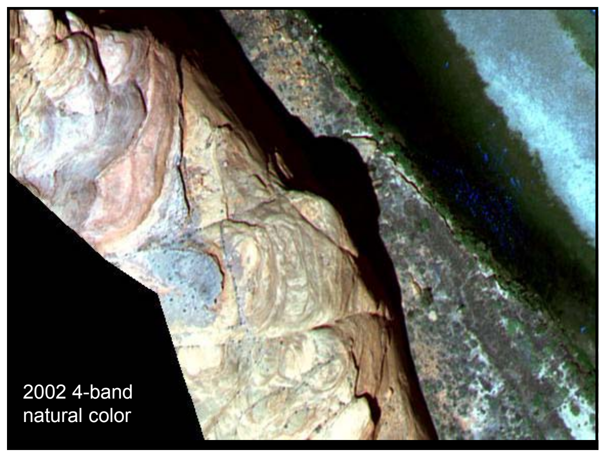


2002 natural color



2009 natural color

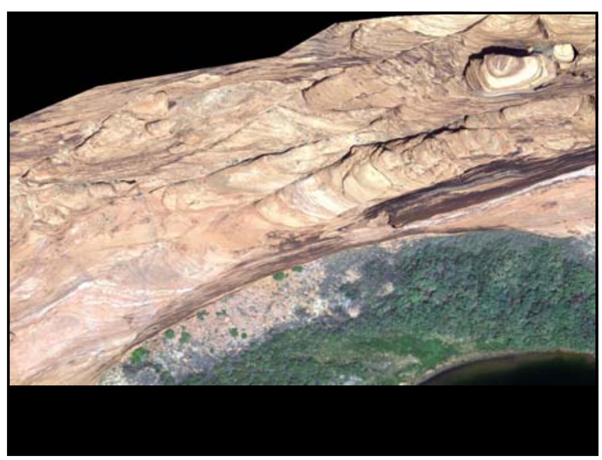




Lees Ferry
(up and downstream)

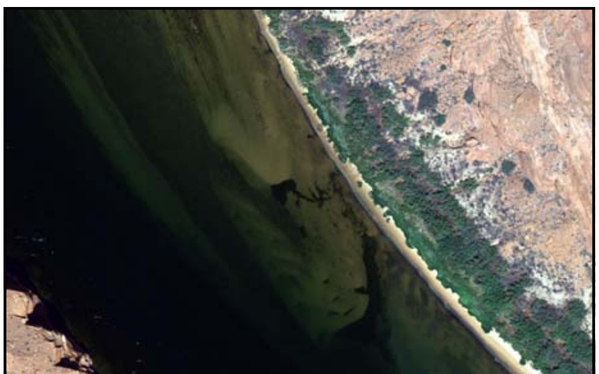
2009 natural-color images

USGS



[redacted]

[redacted]



[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

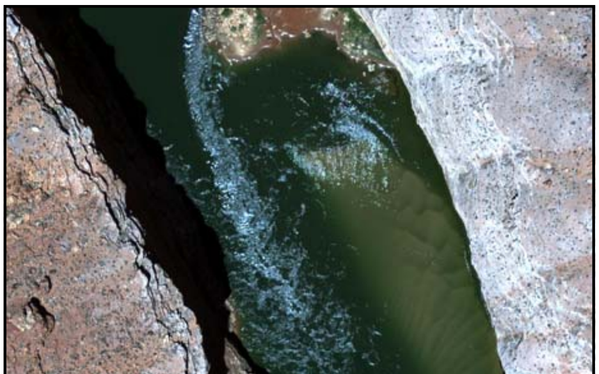
[redacted]

30-45 Mile

Comparing image data:

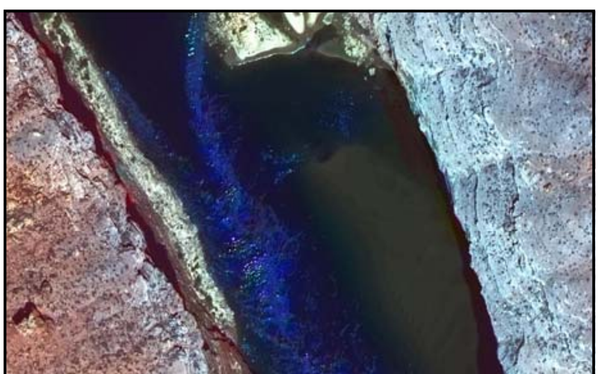
2009 natural color
2005 natural color
2002 natural color
2002 4-band natural color

USGS

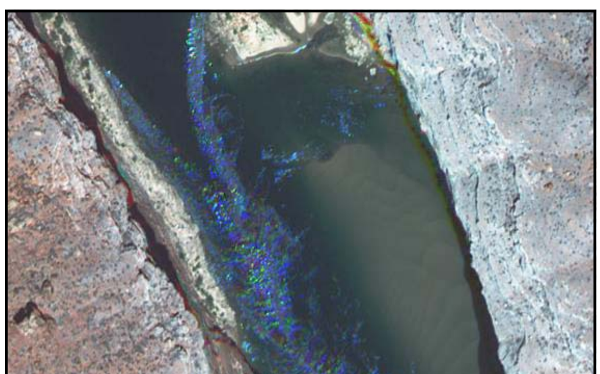


33.2R M - 2009 natural color

2005 natural color



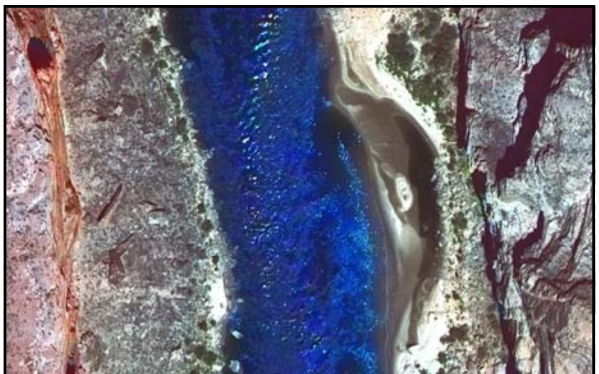
2002 natural color



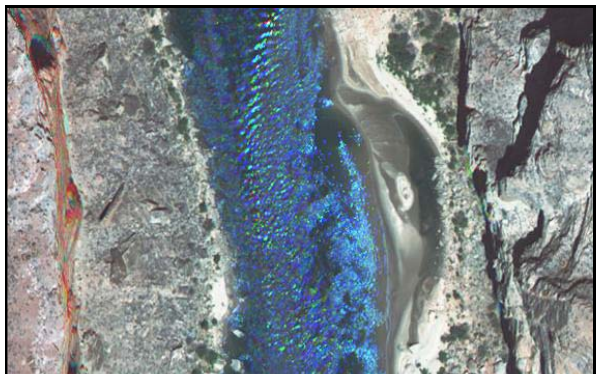
2002 4-band natural color

40.2R M - 2009 natural color

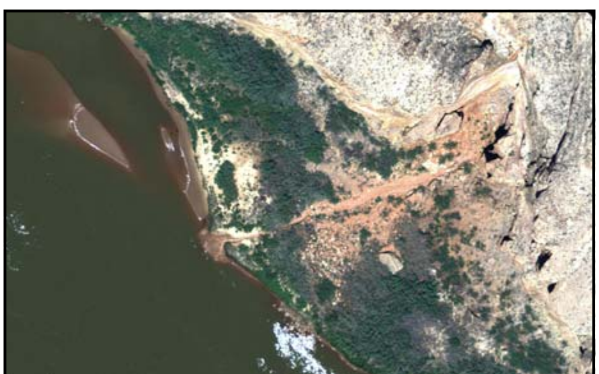
2005 natural color



2002 natural color

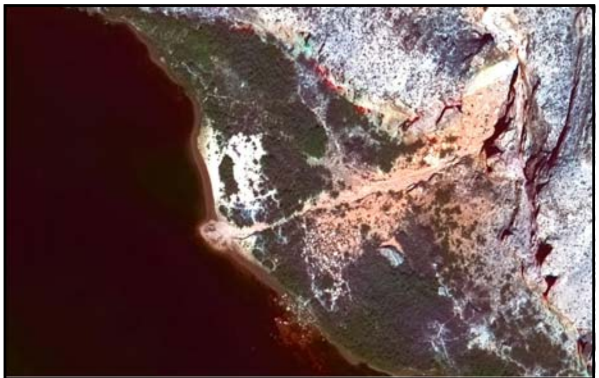


2002 4-band natural color



43 .7R M - 2009 natural color

2005 natural color



2002 natural color

2002 4-band natural color

FY11 Plans

Complete 2009 4-band image quads for entire corridor.

Complete most, if not all, derivative map products that depict geomorphic-landscape (GLC) elements, similar to derived from the 2002 and 2005 image data. These databases can be produced much faster in the 2009 data than its image mosaicking.

Start vegetation classification.

Publish the 2002 and 2005 GLC databases, as soon as we verify and, if necessary, correct the 2005 vegetation data.

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USGS science for a changing world

Data Acquisition and Management System (DAMS)

2010 GCMRC Annual Report Meeting
January 19, 2011

Glenn Bennett

DAMS Shoebox to Web

The Data Acquisition and Management System (DAMS) is a suite of software applications that automates the process of database and web design for individual datasets.

After initial dataset definition, DAMS facilitates project scientists and data stewards to upload, manage, and publish tabular data.

DAMS Design Features

- Rapid creation of tabular databases
- Associates reports and metadata files with data sets
- Accepts data from users and automated data retrieval systems
- 'Smart' data synchronization
- User controlled web publishing
- 'Fine-grained' publishing
- 'Snapshot' archiving system

DAMS Public Datasets

Dataset	Records	Period of Record	
Acoustic - Silt Clay & Sand	1,184,288	8/11/2002	5/10/2010
Instantaneous Stage Discharge	2,191,042	11/15/1925	8/25/2010
GCMRC - Temp, Conductance	7,700,362	8/10/1988	9/28/2010
Lake Powell - Major Ions	11,488	4/25/1964	11/3/2008
Lake Powell - Nutrients	3,150	7/12/1991	11/3/2008
Lake Powell - Profiles	68,380	4/25/1964	11/3/2008
Glen Canyon Dam (hourly)	15,936	10/10/2008	1/17/2011
USGS Stage Discharge (unit)	6,089,966	10/7/1980	1/18/2011
	17,264,612		

DAMS Internal Datasets

Dataset	Records	Period of Record	
Foodbase Drift Data	2,97	10/15/2007	5/25/2009
Ambersnail 20 cm plots	812	4/2/2004	9/22/2008
Ambersnail Presence Absence	77	9/23/2006	9/22/2008
Ambersnail Random Tiered	163	3/3/2004	9/24/2005
Weather Data (onset)	2,195,736	11/14/2003	1/29/2006
Weather Data (vaisala)	2,130,801	2/23/2007	1/20/2009
USGS Stage Discharge (daily)	197,935	10/1/1921	7/16/2010
	4,525,524		

DAMS Online Demo

www.gcmrc.gov/dasa/tabdata/

DAMS Future Plans

- Improve QA/QC and data validation
- Improve flexibility of web based queries
- Add Graphing Interface – Data Plotting
- Incorporate analysis tools and procedures

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DAMS Screenshots

Select Tabular Data

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DAMS Screenshots

Select Dataset

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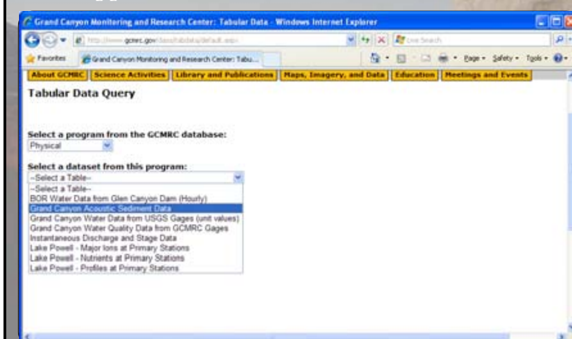
DAMS Screenshots



Select Table

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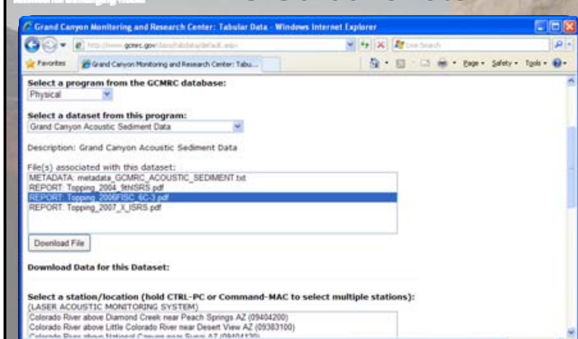
DAMS Screenshots



View Metadata & Reports

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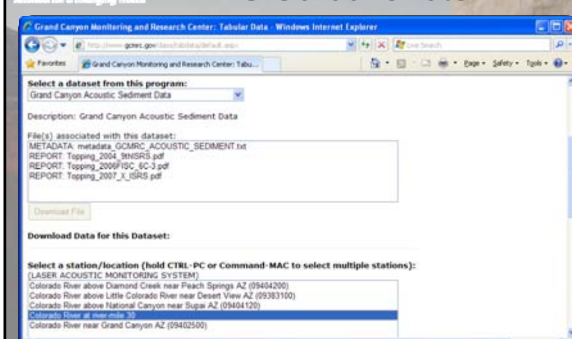
DAMS Screenshots



Select Station(s)

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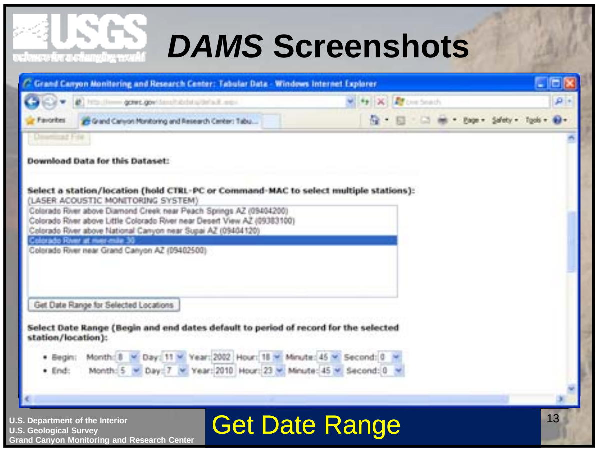
DAMS Screenshots
Get Date Range
13
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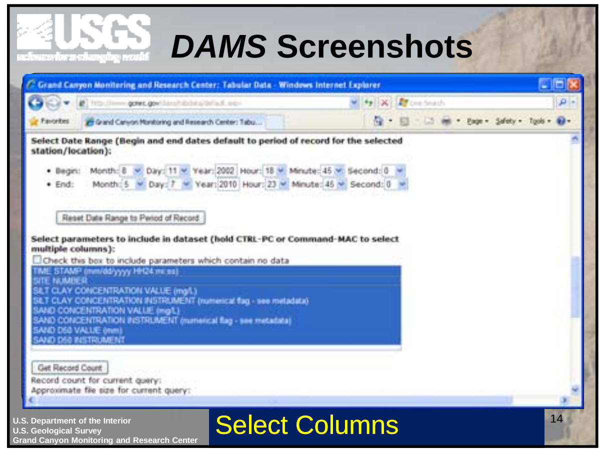
Grand Canyon Monitoring and Research Center


DAMS Screenshots
Select Columns
14
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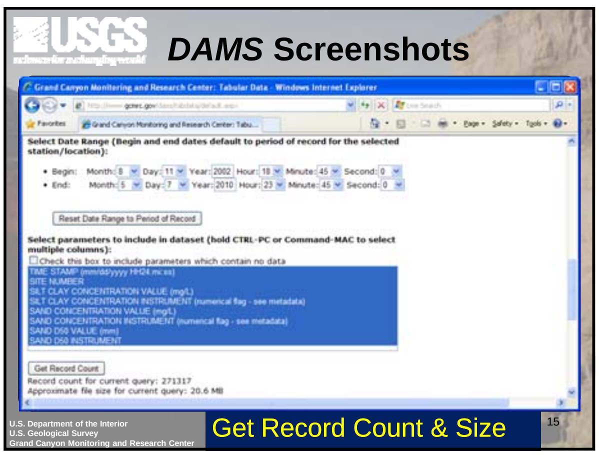
DAMS Screenshots
Get Record Count & Size
15
U.S. Department of the Interior
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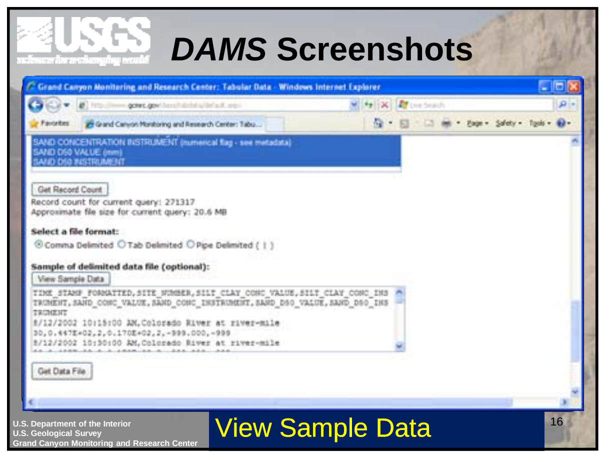
Grand Canyon Monitoring and Research Center


DAMS Screenshots
View Sample Data
16
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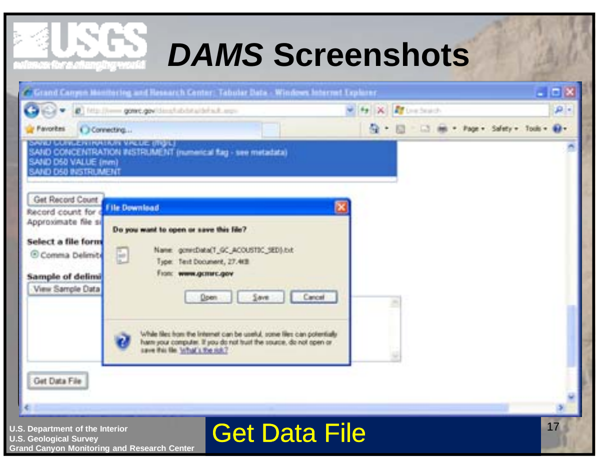
Grand Canyon Monitoring and Research Center


DAMS Screenshots
Get Data File
17
U.S. Department of the Interior
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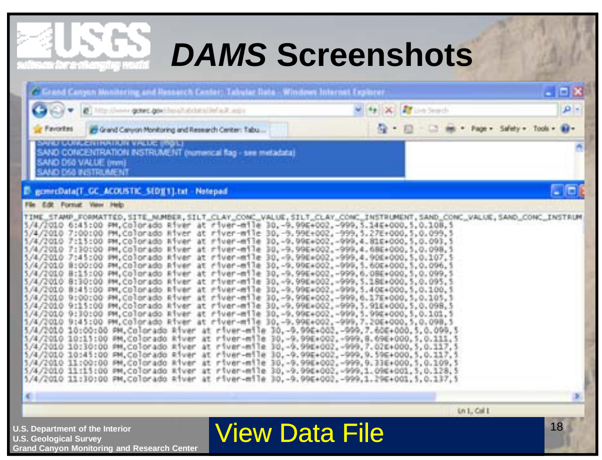
Grand Canyon Monitoring and Research Center


DAMS Screenshots
View Data File
18
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USGS

GIS Support for Integrated Analysis and Projects

GCDAMP Annual Reporting Meeting
January 19, 2011
Phoenix AZ

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USGS

Main components of GIS Support

- Maintain software and spatial data processing capabilities for Center
- Provide Spatial Analysis support to science projects
- Create Mapping / Cartographic products ranging from field support to publications
- Develop internal and external access to Center's spatial databases

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GIS / RS Software

- ESRI ArcGIS suite (v9.3.1)
  - Enterprise environment – available to most researchers
  - Desktop and Server options for data processing
  - Additional add-ons for improved functionality
  - Includes ArcGIS Server used for publishing maps on the Web.
- ENVI Image processing software
  - Added 3 seats to support 2009 data
  - Set up custom training for software
- ERDAS, XTools, etc.

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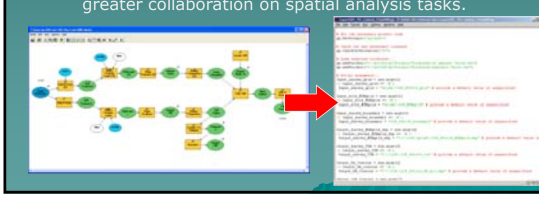
USGS

Spatial Analysis Support

- Model builder to Python
  - Python scripting environment is integrated within GIS processing framework
  - Allows for more advanced analysis & batch processing
  - Models/Scripts can be shared across network, allowing for greater collaboration on spatial analysis tasks.



4

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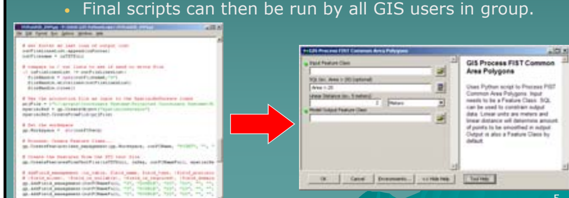
Spatial Analysis Support

- Model builder to Python
  - Workflow allows GIS users to build some processing components in Model builder,
  - Export to Python Script, then edited by GIS programmer,
  - Final scripts can then be run by all GIS users in group.



5

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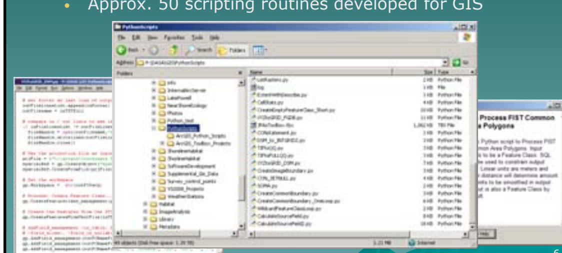
Spatial Analysis Support

- Python Script Library
  - Approx. 50 scripting routines developed for GIS

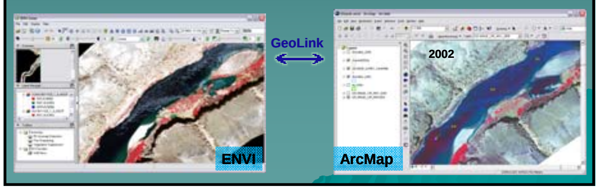


6

USGS

Image Analysis Support

- Improved workflow within Image Analysis project
  - Trained 3 new staff on using GIS/RS for project
  - Share data between ArcMap & ENVI software platforms.
    - Allows for overlay of 2009 image data during image processing steps.
    - Will increase ability to share new data faster.



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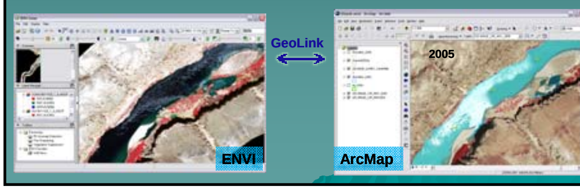

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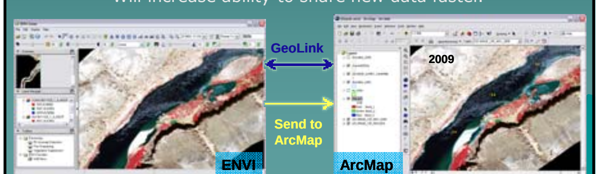

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Mapping and Cartographic Support

- Continued field support with customized river maps
  - Utilizes an add-on to ArcGIS (MapBook).
  - Thematic layers added for specific research purposes
- Numerous maps made for publications for GCMRC staff and cooperators

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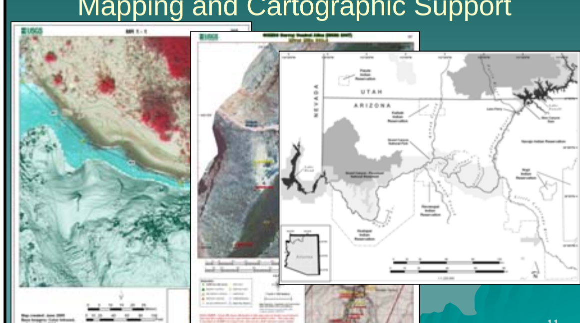
Mapping and Cartographic Support



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Access to Spatial Data

- Migration from IMS to Arc Server
  - Necessary to phase out Internet Map Server
    - not supported by ESRI very well
    - Built on older technology
    - Unstable web configuration
- Newer technology allows for much greater functionality
  - Greater flexibility in how Map Services are consumed.
  - Can incorporate data sets from other entities in-house.

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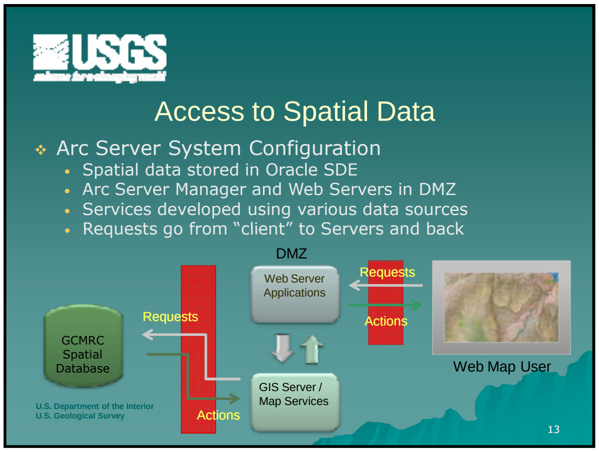
Access to Spatial Data
Arc Server System Configuration
Spatial data stored in Oracle SDE
Arc Server Manager and Web Servers in DMZ
Services developed using various data sources
Requests go from "client" to Servers and back
DMZ
Web Server Applications
Requests
Actions
GCMRC Spatial Database
Requests
Web Map User
GIS Server / Map Services
Actions
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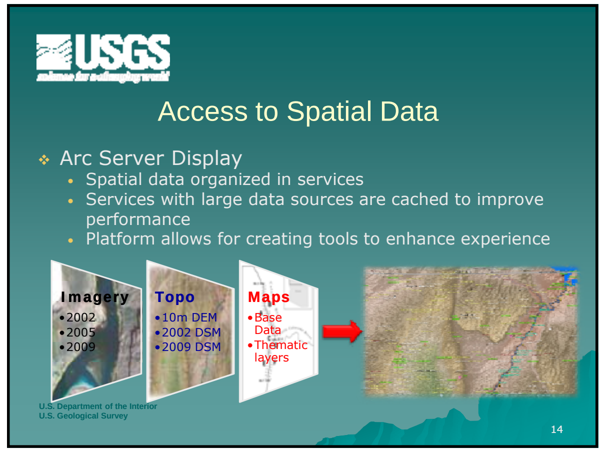
Access to Spatial Data
Arc Server Display
Spatial data organized in services
Services with large data sources are cached to improve performance
Platform allows for creating tools to enhance experience
Imagery
•2002
•2005
•2009
Topo
•10m DEM
•2002 DSM
•2009 DSM
Maps
•Base Data
•Thematic layers
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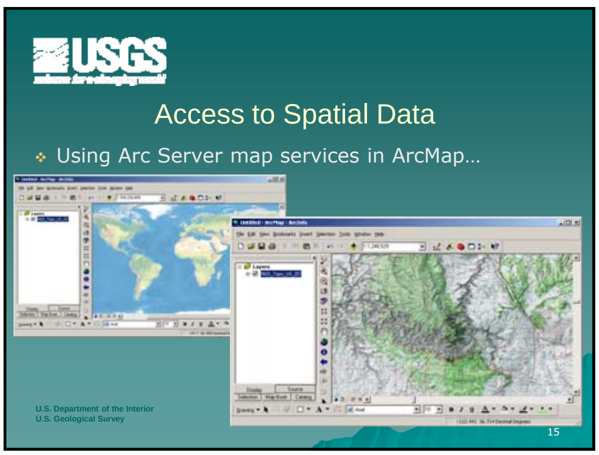
Access to Spatial Data
Using Arc Server map services in ArcMap…
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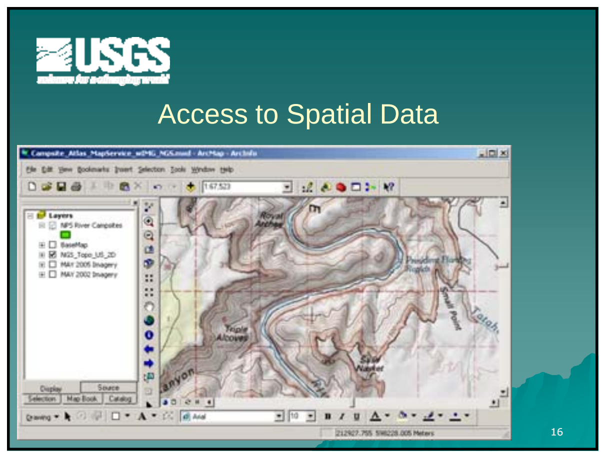
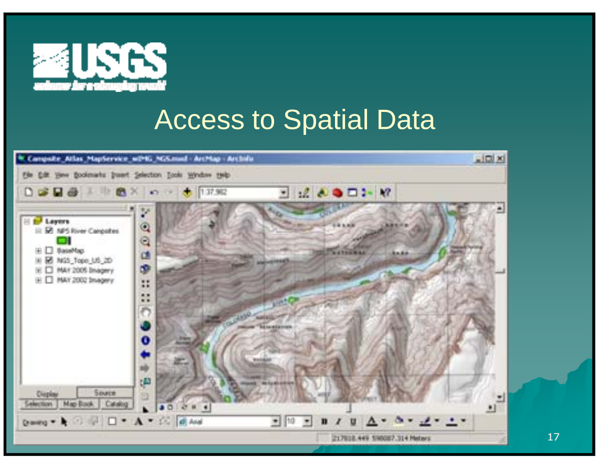

Access to Spatial Data
16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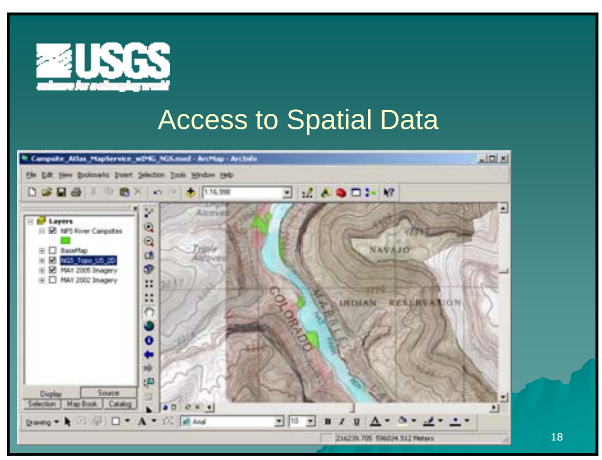
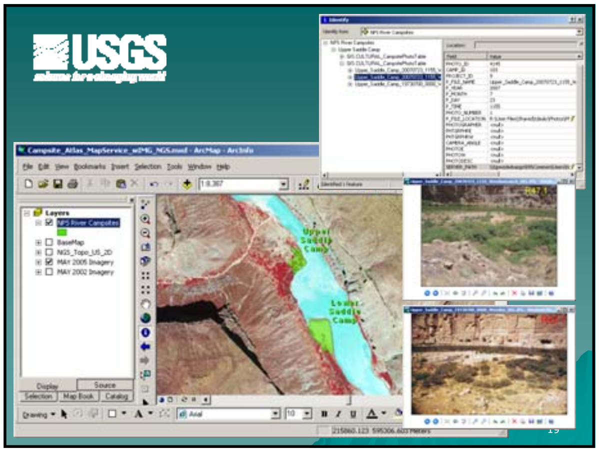

Access to Spatial Data
18



Access to Spatial Data

- Arc Server Benefits
  - Services created in Arc Server can be consumed in more customizable services (i.e. MS Silverlight, Adobe Flex, Google Maps,…)
  - Can change levels of detail to provide better user experience
  - Allows for cached map services that greatly improve performance

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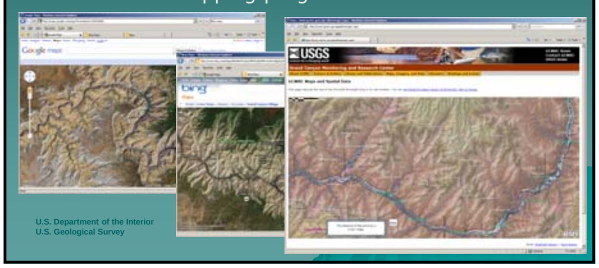
Access to Spatial Data

- Arc Server Web components can work with other web-based mapping programs…



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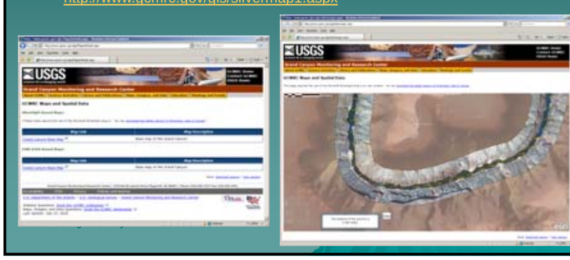
Access to Spatial Data

- Example of Arc Server using MS Silverlight

http://www.gcmrc.gov/gis/silvermap1.aspx



A PROSPECTUS TO EVALUATE TRADEOFF AND DECISION SUPPORT METHODS FOR GCDAMP

AMP SCIENCE ADVISORS

JANUARY, 2011 TWG MEETING

GENERAL CATAGORIES OF DSS

- QUALITATIVE APPROACHES
- QUANTITATIVE METHODS

QUALITATIVE APPROACHES

- SIMPLISTIC METHODS AND MODELS
- EASILY UNDERSTOOD AND APPLIED
- LOW USER COST AND TIME INVESTMENT
- LIMITED USE OF COMPLEX ASSESSMENTS
- CONSTRAINED TO MORE COARSE ANALYSIS

QUANTITATIVE APPROACHES

- COMPLEX METHODS AND MODELS
- MORE DIFFICULT TO UNDERSTAND SYSTEM DETAIL
- REQUIRES ANALYSTS TO OPERATE
- HIGH DEVELOPMENT COST
- SUMMARY OUTPUTS USEFUL IN MORE SIMPLISTIC MODELS
- USEFUL FOR COMPLEX ASSESSMENTS AND MICRO-ANALYSIS

DSS SHOULD INCORPORATE SEVERAL CAPABILITIES

- COST ASSESSMENTS
- BENEFIT ASSESSMENTS
- ASSESSMENT OF RISK
- EVALUATION OF UNCERTAINTY
- TRADEOFF ANALYSIS
- EASE OF USE AND UNDERSTANDING

SA ASSESSMENT APPROACH

- LITERATURE AND USER REVIEW
- CRITERIA FOR COARSE SCREENING, SELECT 4-8 METHODS IN CURRENT USE
- REFINE EVALUATION CRITERIA AND SELECT 2-4 METHODS FOR ANALYSIS
- EVALUATE APPLICATION TO AMP
- FINAL REPORT TO TWG : SUMMER 2011