

**BENTHIC ECOLOGY OF THE COLORADO RIVER,
GLEN CANYON NATIONAL RECREATION AREA, ARIZONA:
AQUATIC INVERTEBRATE BIOGEOGRAPHY AND THE ROLE OF
SHALLOW HYPORHEIC ANOXIA (SHA)**

Larry Stevens and Biology Department Staff
Museum of Northern Arizona, Flagstaff
and
Craig Ellsworth, WAPA



The Museum of Northern Arizona Easton Collections Center

**>400,000 invert specimens, 50 yr
databasing of MNA and other
Colo. Plateau collections is on-going**



PROJECT TASKS

(ONE-YEAR DURATION, FUNDING BY WAPA)

TASK 1: COMPILE AND EVALUATE EXISTING INFORMATION ON CRE REGIONAL AQUATIC MACROINVERTEBRATE DIVERSITY AND WATER QUALITY REQUIREMENTS

- **Emphasis on EPT**
- **Historical presence in the CRE drainage**
- **Diversity**
- **Water quality requirements**

TASK 2: MAP THE DISTRIBUTION OF SHALLOW HYPORHEIC ANOXIA (SHA) AND CONDUCT FIELD EXPERIMENTS ON ITS DEVELOPMENT AND IMPACTS

- ***Task 2a: Map the distribution of SHA***
- ***Task 2b: Determine SHA impacts on WQ and soil geochemistry***
- ***Task 2c: Determine the effects of SHA on aquatic invertebrates***
- ***Task 2d: Determine the effects of flood disturbance on SHA and the benthos***
- ***Task 2e: Effects of flow variation on SHA development***

Develop a conceptual model of SHA development

TASK 1:
**COMPILE DISTRIBUTION, HABITAT, AND WATER QUALITY REQUIREMENTS ON
EPT AND OTHER AQUATIC MACROINVERTEBRATES IN THE CRE DRAINAGE**



Adult *Apatania arizona* [Trichoptera: Apataniidae (Limnephilidae)]:
Smithsonian Institution ♂ paratype - AZ: Apache Co., ASNF; Little Colorado River Sheep Crossing; 33.58 N, -109.31W, 2800 m elevation; collected on 14 Aug 1995 by CM & OS Flint Jr., identified by OS Flint, Jr.; adult total length (excluding antennae) = 8 mm.



Adult *Polycentropus gertschi* (Trichoptera: Polycentropodidae) .
Specimen from Smithsonian Institution – AZ: Apache Co., Little Colorado River near Greer at 8,300 ft (2530 m) elevation, collected 13 August 1995 by C. and O. Flint Jr. Total body length = 9-10.5 mm.

Shallow Hyporheic Anoxia



SHALLOW HYPORHEIC ANOXIA PILOT STUDY

WHAT?: BLACK OOZE, REDUCED SEDIMENTS AT SHALLOW DEPTH BELOW THE CRE CHANNEL FLOOR

WHERE 1?: UBIQUITOUS? THROUGHOUT LOWER LAKE POWELL?

FROM GLEN CANYON DAM DOWNSTREAM TO LEES FERRY

APPARENTLY NOT (YET) DOWNSTREAM IN GRAND CANYON

WHERE 2?: DEPTH PROFILE ACROSS CHANNEL AND WITHIN BED TBD

**HOW?: ELEVATED ORGANIC CARBON CONCENTRATIONS FROM DECOMPOSING BENTHIC MACROPHYTES,
BUT WHY IN LAKE POWELL AND WHY NOT BELOW LEES FERRY?**

WHEN?: DIEL VARIATION

SEASONAL VARIATION

HISTORY OF DEVELOPMENT

OTHER ? : GRAIN SIZE EFFECTS OR RESPONSES?

HFE RESPONSES? FLOOD SCOUR EFFECTS?

FOODBASE IMPACTS – BUT NOT A SOURCE AND PATHWAY ANALYSIS

SO WHAT ? : DOES SHA MATTER?

WILL SHA PROGRESS DOWNSTREAM?

Shallow Hyporheic Anoxia

Anoxia

- Oxidation of organic matter by bacteria
- Depletion of dissolved oxygen
- Release of toxic chemicals/compounds (e.g., mercury)?

Production of hydrogen sulfide

- Rotten egg smell
- Dark black color in sediment
- Toxic to most biota
- Impacts on aquatic organisms?



Shallow Hyporheic Anoxia

Influenced by biochemical oxygen demand (BOD)

- Type of bacteria and organic material present
- pH
- Temperature

Common in:

- Ocean sediments
- Eutrophic systems
- But not reported in cold-stenothermic dam tailwaters



Schedule and Planning

Pilot Trip: Pending NPS permitting

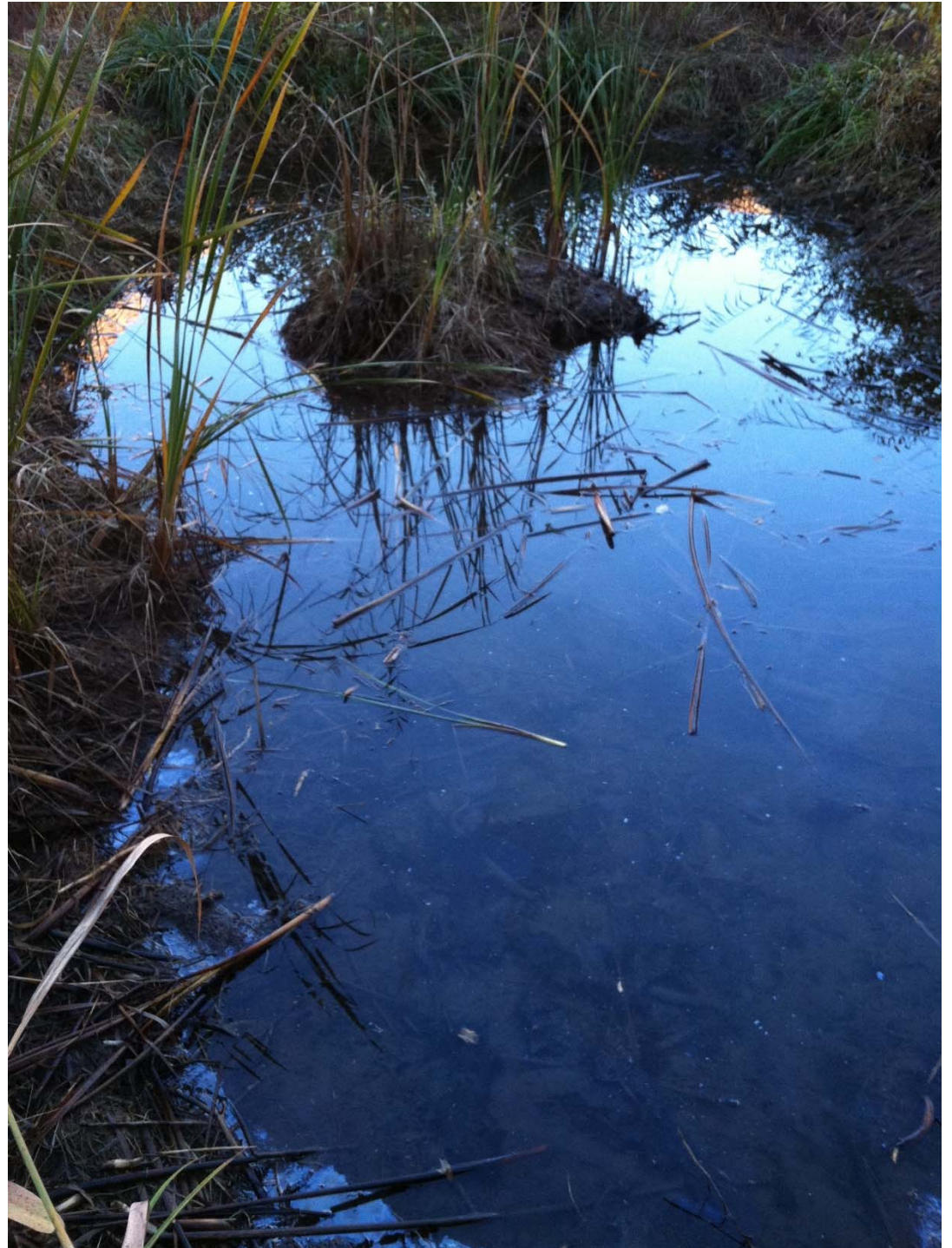
SHA distribution monitored seasonally

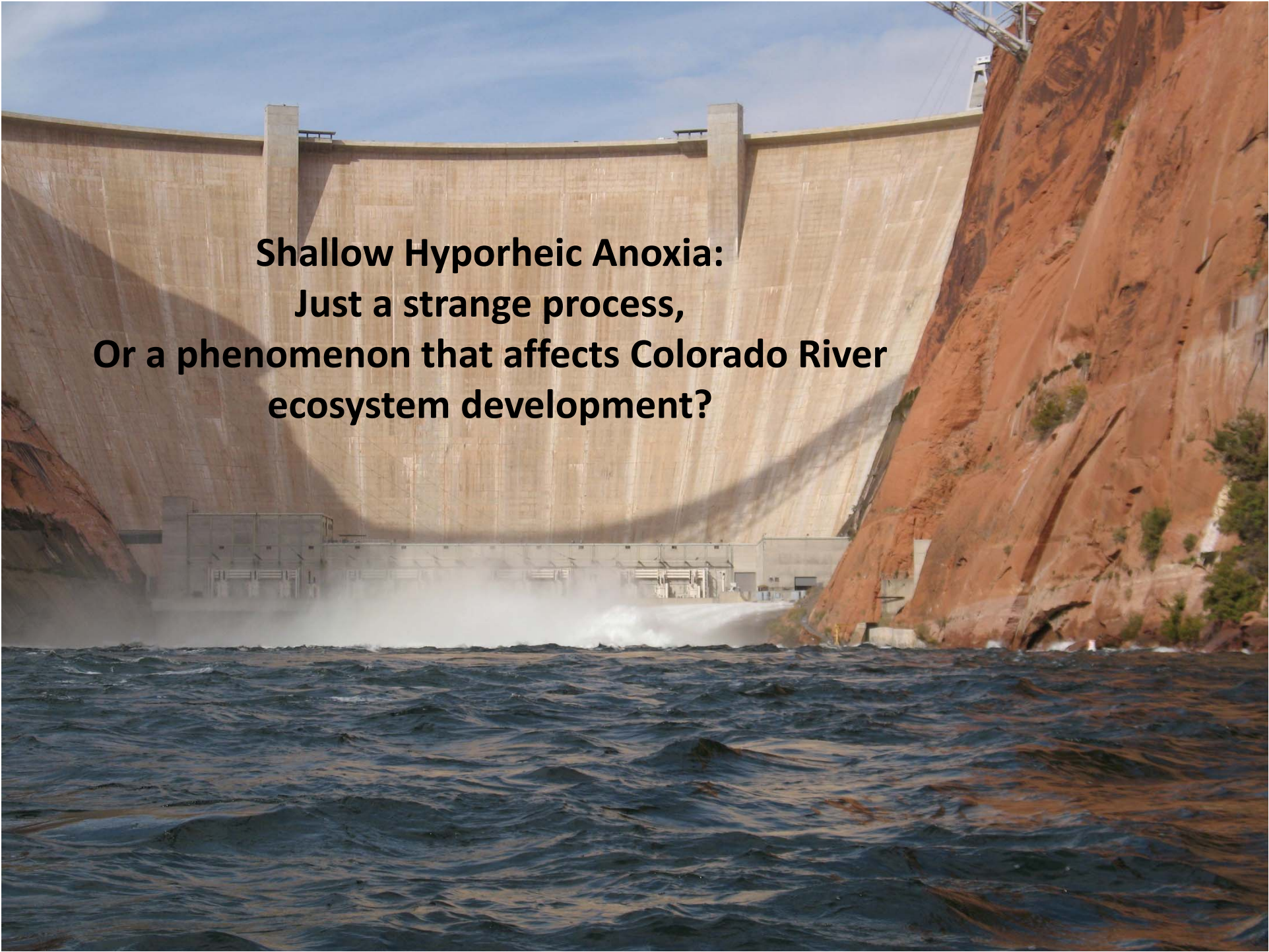
Transects: 3 on Lake Powell shores
6 from GC Dam to LF
3 ds from LF

Water and soil geochemistry sampling

Experimental manipulations of temp,
flow variation, DO at Hidden Slough
(-6.5R)

Bioassays on common aquatic taxa,
in situ and laboratory studies



A photograph of a large concrete dam, likely the Glen Canyon Dam, with water flowing over its spillways. The dam is situated between steep, reddish-brown rock cliffs. The foreground shows turbulent, dark blue water. The sky is clear and blue.

**Shallow Hyporheic Anoxia:
Just a strange process,
Or a phenomenon that affects Colorado River
ecosystem development?**