Kootenai River Ecosystem Operational Loss Assessment, Protection, Mitigation, and Rehabilitation Project

(BPA Project Number 2002-011-00)

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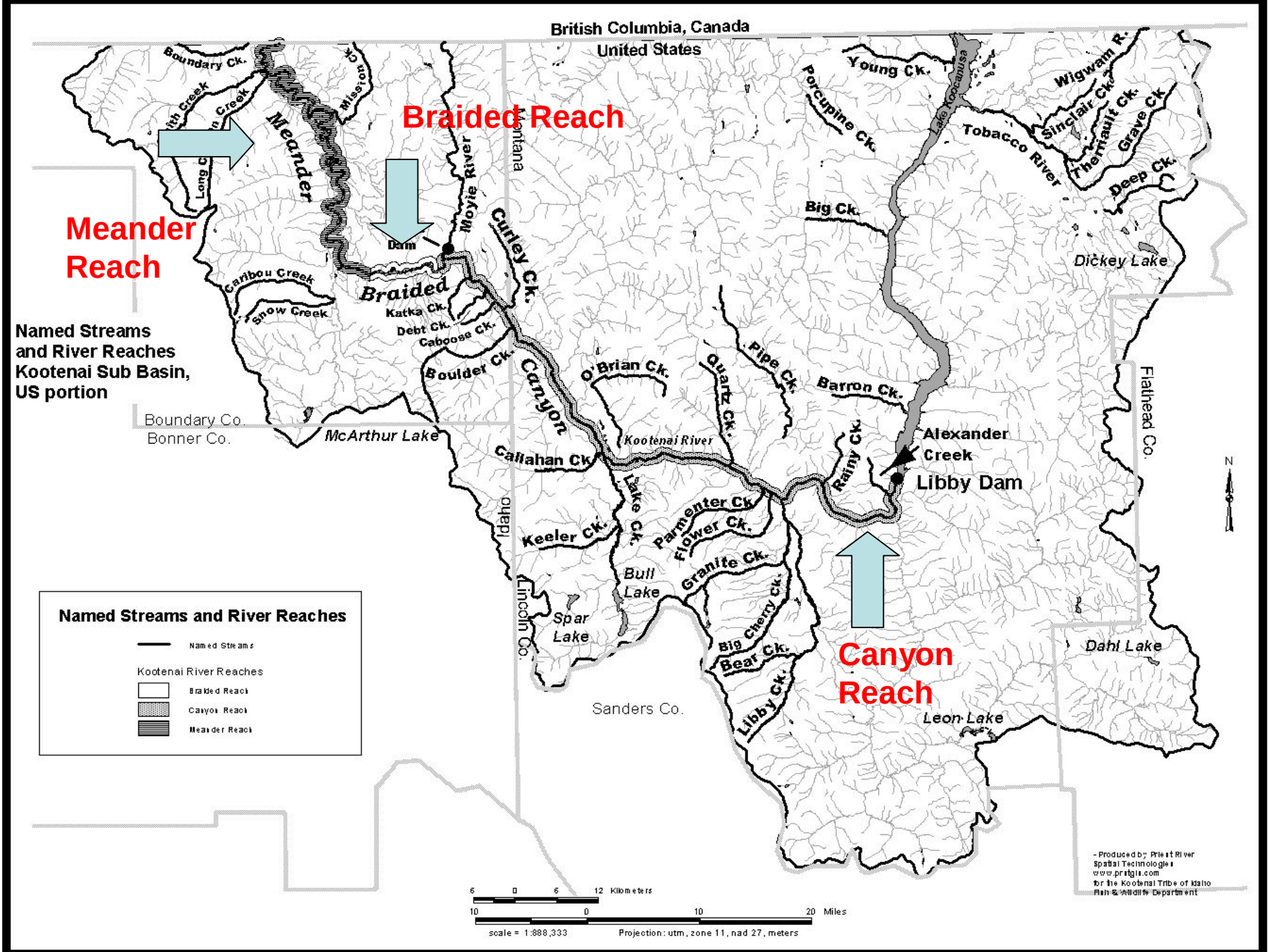
Fish and Wildlife Department
Kootenai Tribe of Idaho

Operational Loss Assessment

- **<u>Goal 1:</u> Develop a scientifically valid and regionally acceptable assessment tool to quantify habitat and ecological function loss due to the operation of Libby Dam.**

- **<u>Goal 2:</u> Ensure this tool is transferable to evaluate operational losses of the Federal Columbia River Hydropower System outside the Kootenai River Subbasin.**

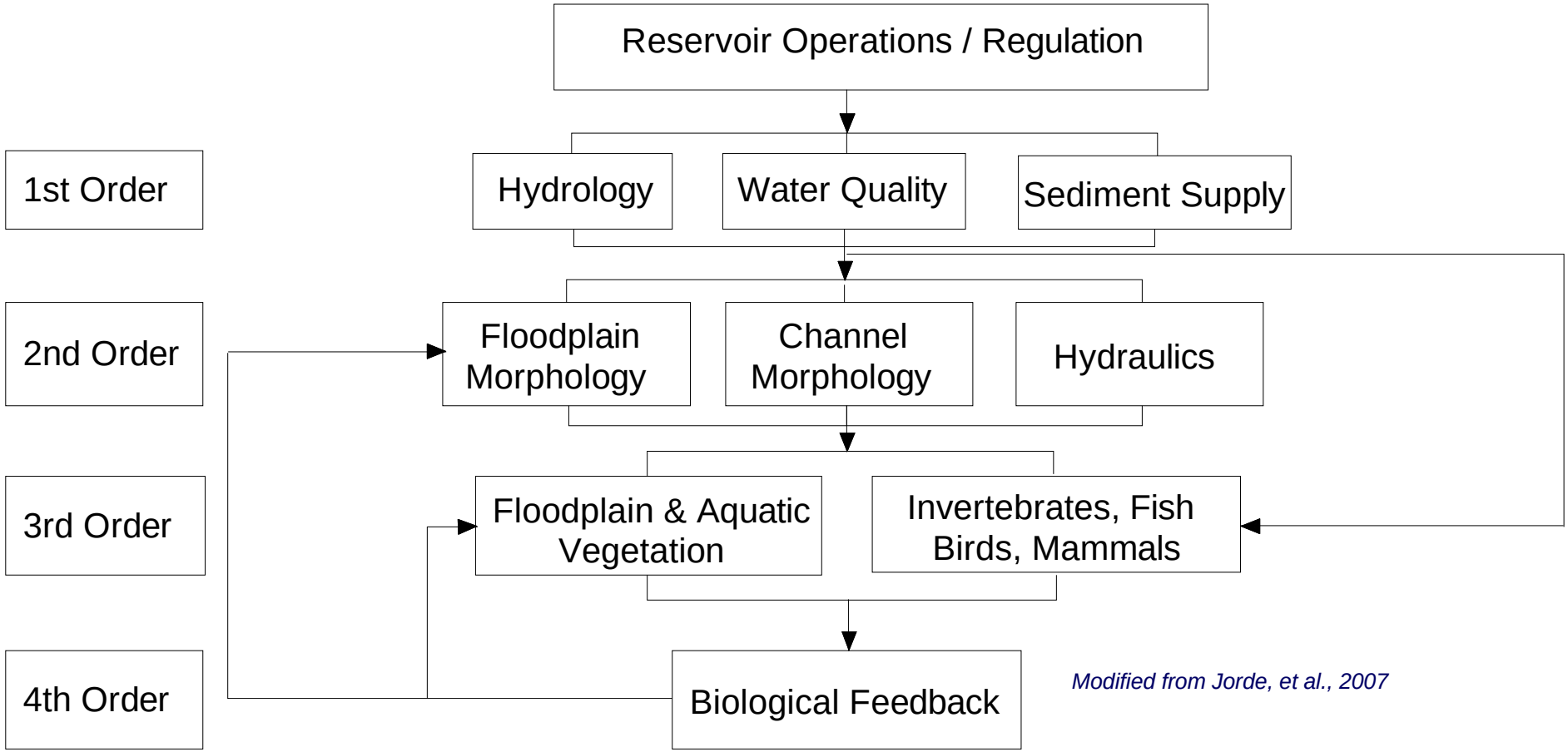

British Columbia, Canada
United States
Braided Reach
Meander Reach
Canyon Reach
Named Streams and River Reaches Kootenai Sub Basin, US portion
Boundary Co.
Bonner Co.
Sanders Co.
Lincoln Co.
Flathead Co.
Montana
Idaho
Boundary Ck.
Meander
Mission Ck.
Moyie River
Dam
Braided
Curley Ck.
Caribou Creek
Snow Creek
Katka Ck.
Debt Ck.
Caboose Ck.
Boulder Ck.
Canyon
McArthur Lake
O'Brian Ck.
Quartz Ck.
Pipe Ck.
Barron Ck.
Kootenai River
Callahan Ck
Lake Ck.
Keeler Ck.
Parmenter Ck
Flower Ck.
Granite Ck.
Bull Lake
Spar Lake
Big Cherry Ck.
Bear Ck.
Libby Ck.
Rainy Ck.
Alexander Creek
Libby Dam
Young Ck.
Porcupine Ck.
Lake Koocanusa
Wigwam R.
Sinclair Ck.
Tobacco River
Thernault Ck.
Grave Ck.
Deep Ck.
Big Ck.
Dickey Lake
Dahl Lake
Leon Lake
N
Named Streams and River Reaches
Named Streams
Kootenai River Reaches
Braided Reach
Canyon Reach
Meander Reach
6 0 6 12 Kilometers
10 0 10 20 Miles
scale = 1:888,333
Projection: utm, zone 11, nad 27, meters
Produced by Priest River Spatial Technologies
www.prstgis.com
for the Kootenai Tribe of Idaho
Fish & Wildlife Department

Requires a Multidisciplinary Approach

Research Design and Review Team

- Scott Soults, Roland Capilo - Kootenai Tribe of Idaho
- Dwight Bergeron, Dr. Alan Wood - Montana Fish, Wildlife and Parks
- Dr. Klaus Jorde, Dr. Elowyn Yager - Center for Ecohydraulics, University of Idaho
- Dr. Tim Hatten, Invertebrate Ecology, Inc.
- Dr. Bahman Shafii - Statistical Consulting Services
- Dr. Philip Tanimoto - Conservation Imaging, Inc.
- Dr. Stewart Rood, Karen Gill - University of Lethbridge, Alberta, Canada
- Dr. Paul Anders - Cramer Fish Sciences, Inc.
- Mike Burke - Inter-fluve
- Dr. Gregory Egger - Umweltbüro Klagenfurt

Conceptual Approach: *Hierarchy of Impacts in Response to River Regulation*



Modified from Jorde, et al., 2007

Conceptual Framework

Index of Ecological Integrity (IEI)
Hierarchical integration from community, Habitat levels to ecosystem level characterization

Community Index Changes:

Index of Ecological Integrity (IEI)

Index of Hydrologic Alteration

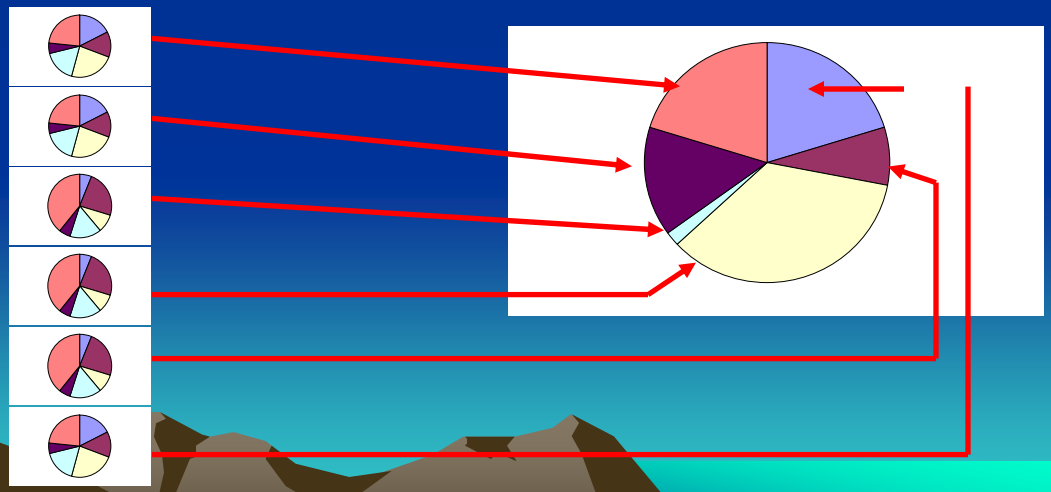
Index of Fluvial Alteration

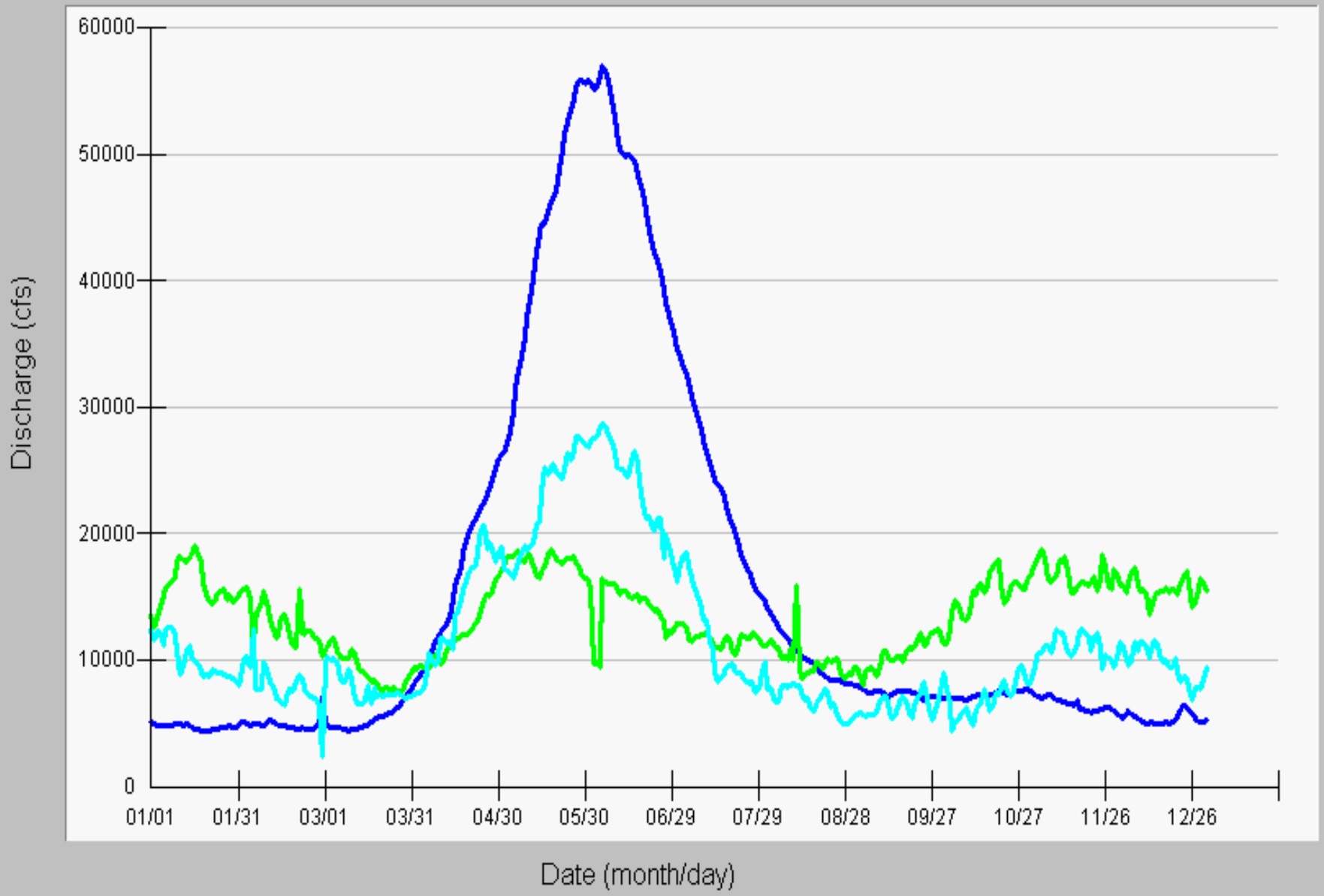
Index of Vegetation Alteration

Aquatic IBI

Invertebrate IBI

Avian IBI



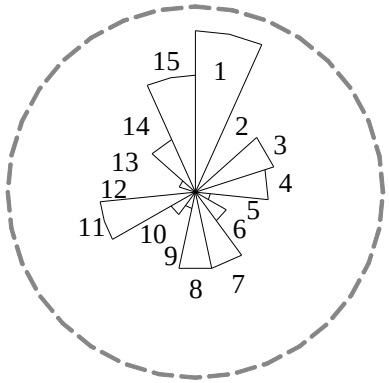

Mean Monthly Flow Patterns in the Kootenai River at Bonner's Ferry, ID 1928-1999
Discharge (cfs)
60000
50000
40000
30000
20000
10000
0
01/01
01/31
03/01
03/31
04/30
05/30
06/29
07/29
08/28
09/27
10/27
11/26
12/26
Date (month/day)
Pre-Libby dam (1928-1972)
Post-Libby dam (1973-1990)
Post-Libby dam Augmented (1991-1999)

INDEX OF HYDROLOGICAL ALTERATION

1 flow predictability
2 winter mean daily flow (November-March)
3 spring/summer mean daily flow (April-July)
4 autumn mean daily flow (August-October)
5 1-day minimum flow
6 7-day minimum flow
7 1-day maximum flow
8 7-day maximum flow
9 base flow
10 low pulse count
11 low pulse duration
12 high pulse count
13 high pulse duration
14 rise rate
15 fall rate

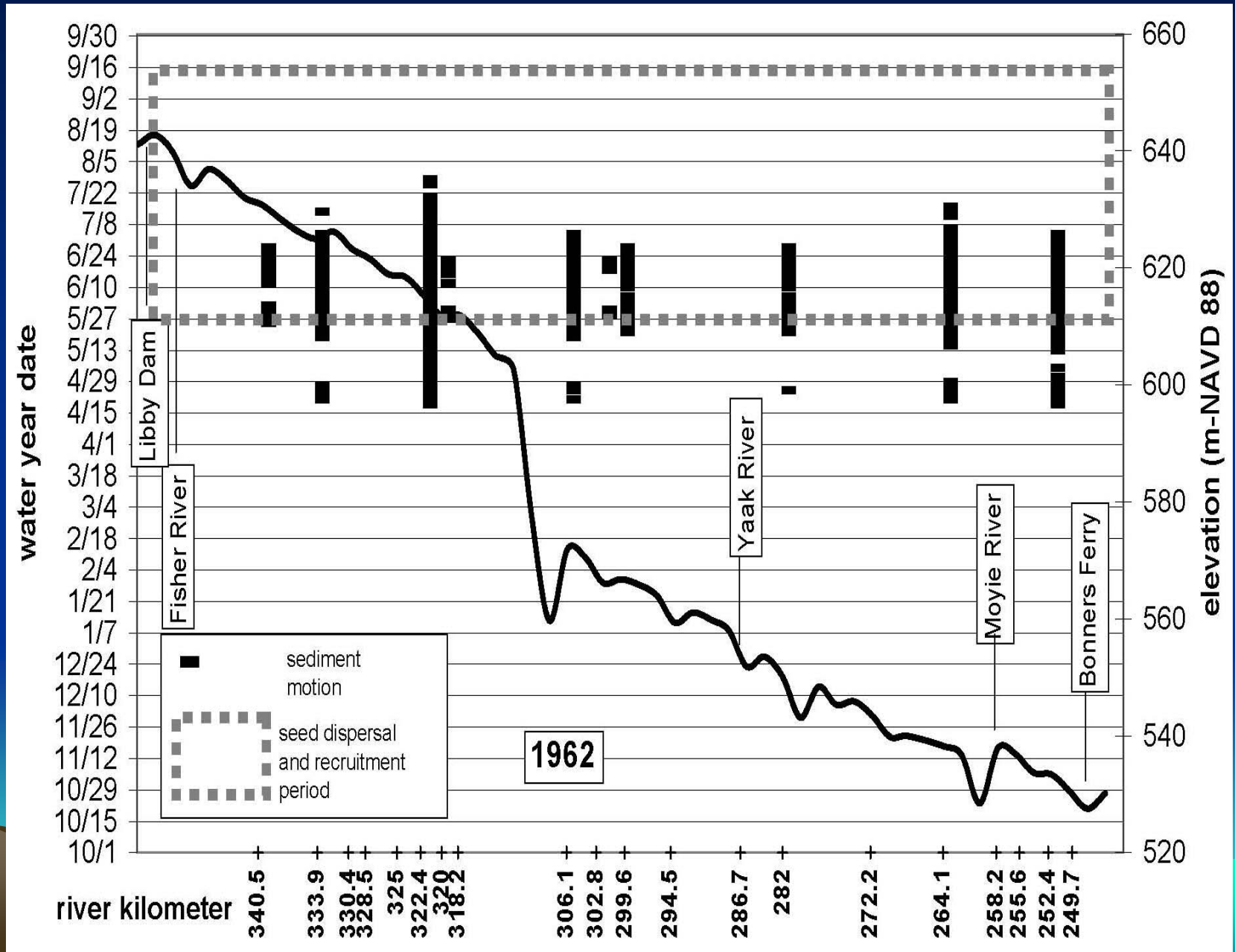
0% change

% Deviation - Median Basis

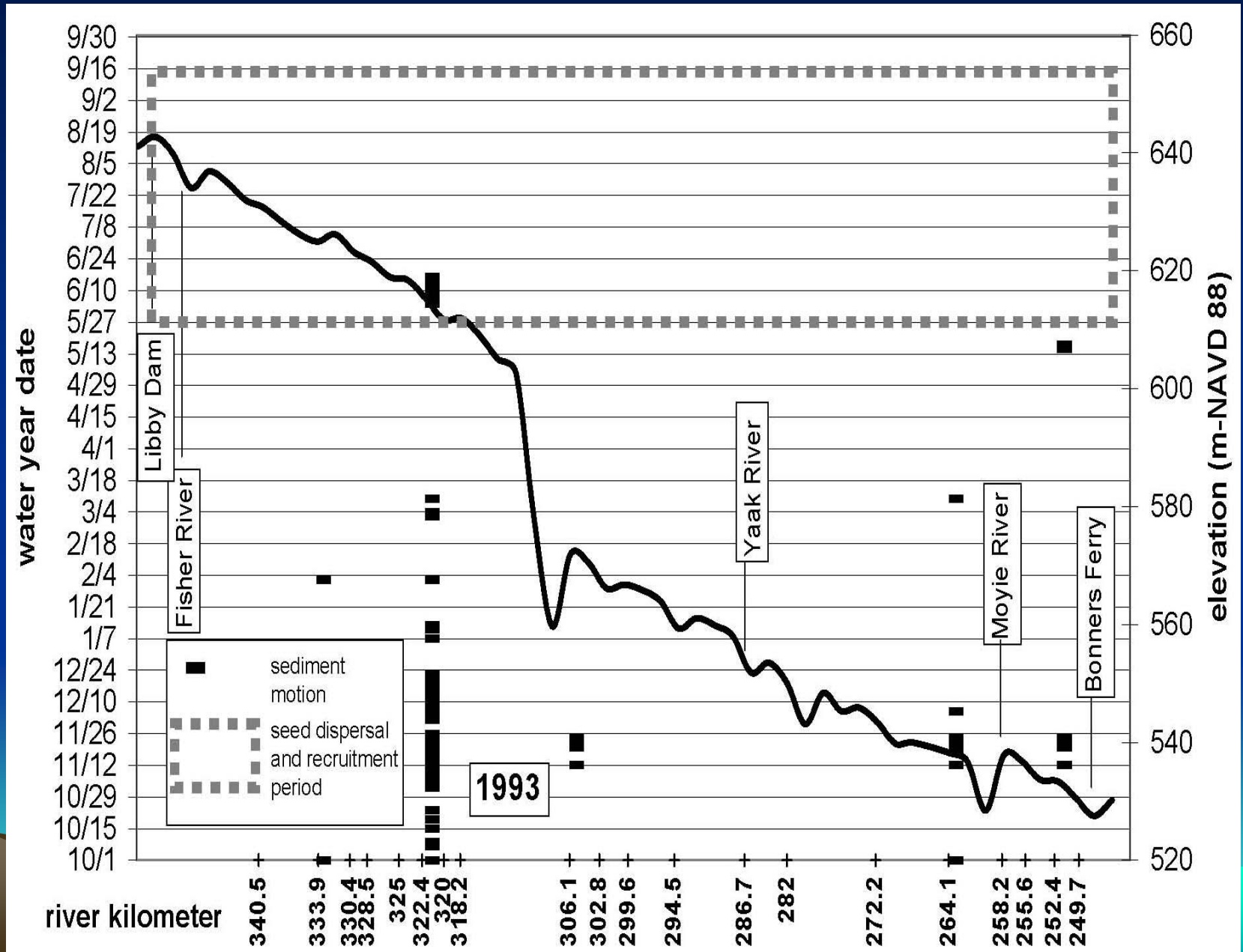


Mean % Deviation: 124%
Deviation from Circularity: >100
Note: Parameters with deviation > 100% are shown as 0.

IFA - Second Order Impacts

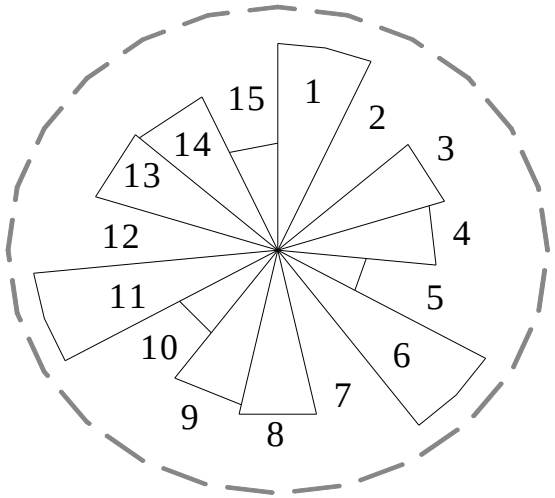


IFA - Second Order Impacts



INDEX OF FLUVIAL ALTERATION

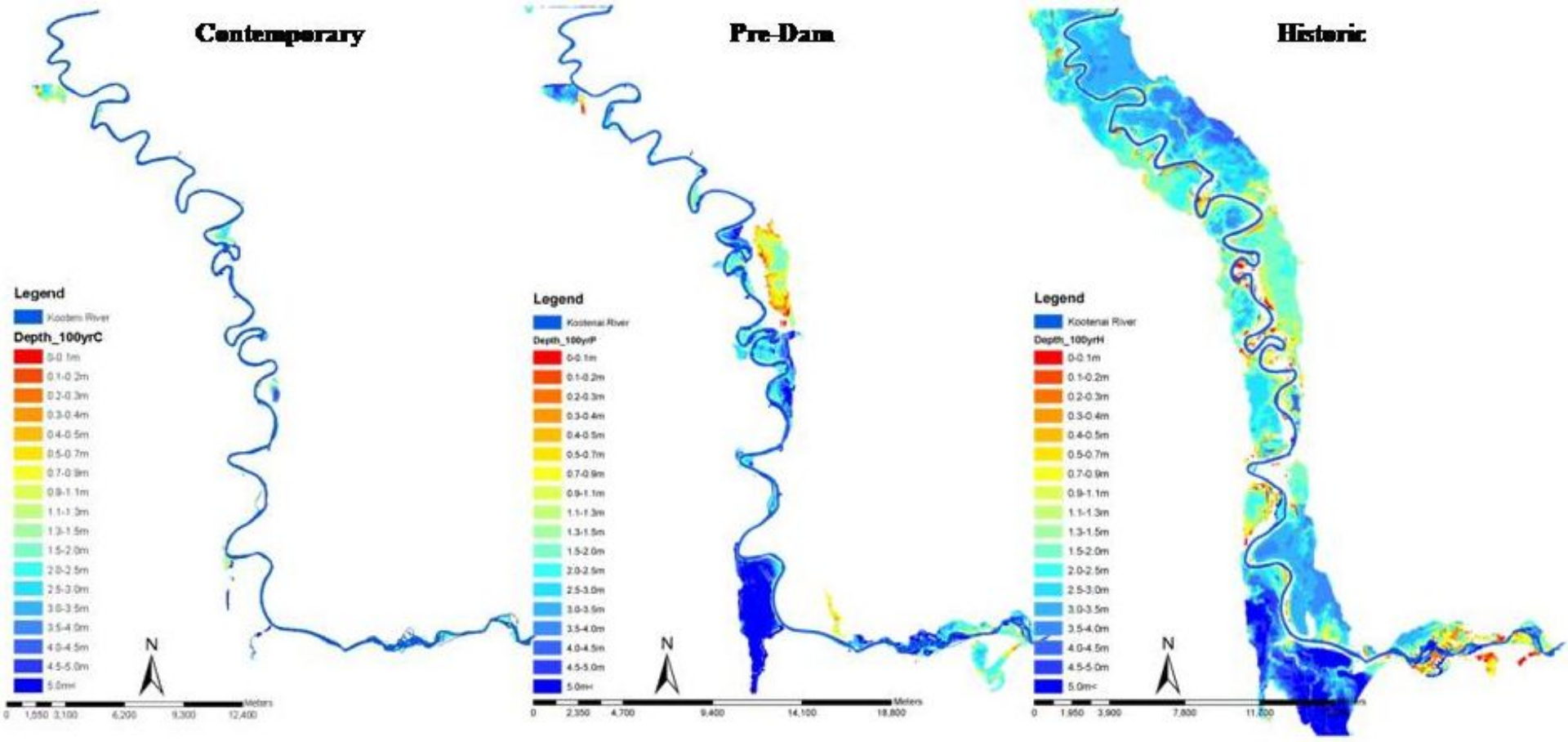
% Deviation -
Mean Basis



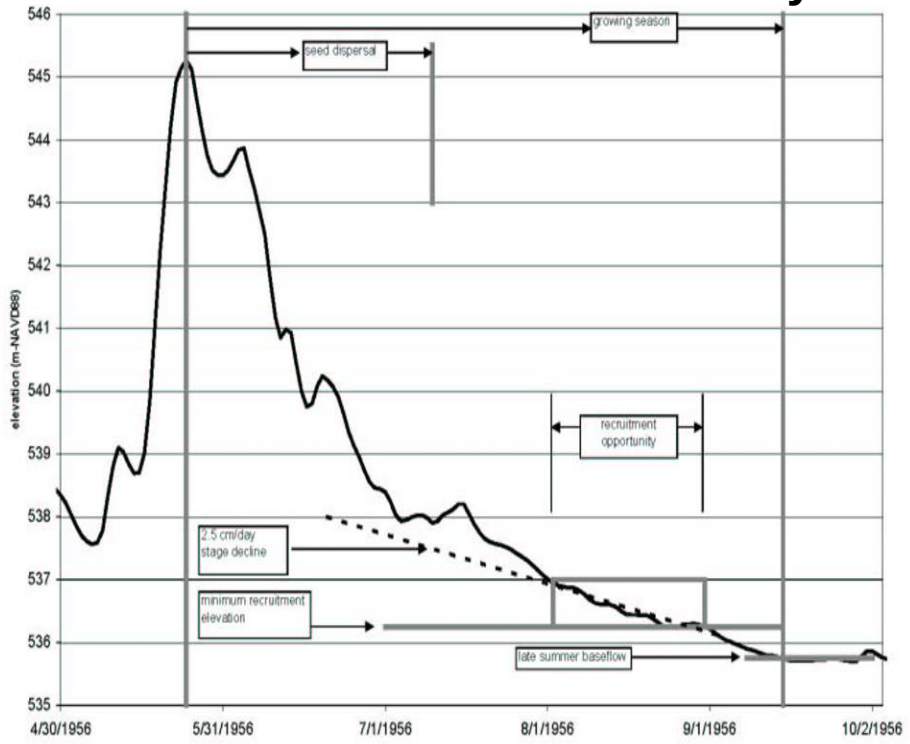
1 wet year pair - depth
2 wet year pair - stage fluctuation
3 wet year pair - velocity
4 wet year pair - bed shear stress
5 wet year pair - stream power
6 avg year pair - depth
7 avg year pair - stage fluctuation
8 avg year pair - velocity
9 avg year pair - bed shear stress
10 avg year pair - stream power
11 dry year pair - depth
12 dry year pair - stage fluctuation
13 dry year pair - velocity
14 dry year pair - bed shear stress
15 dry year pair - stream power
— — — — 0% deviation

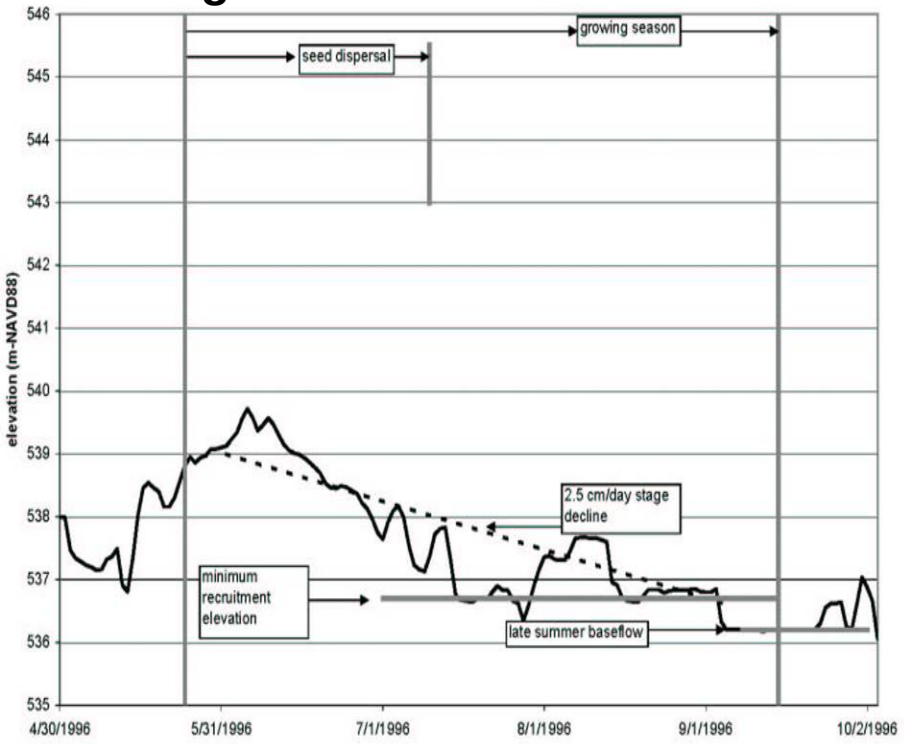
Mean % Deviation: 61%
Deviation from Circularity: >100
Note: Parameters with deviation > 100% are shown as 0.

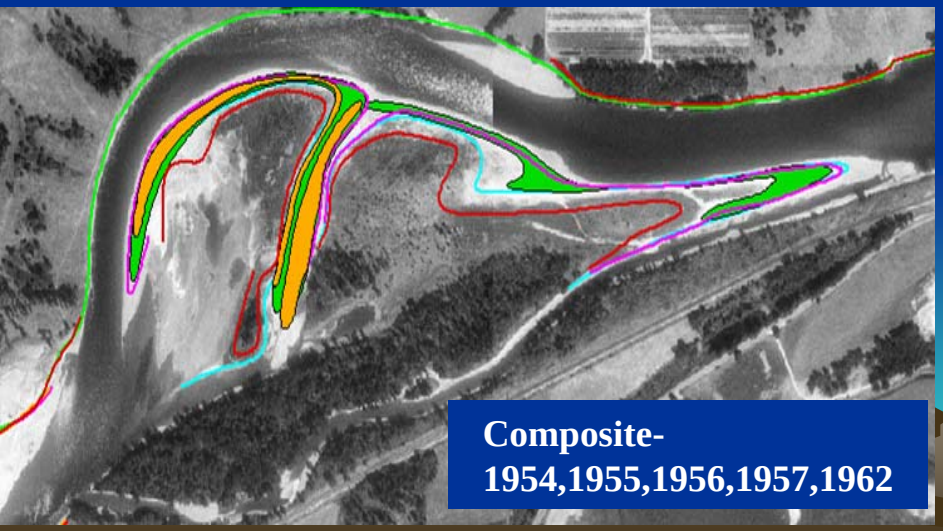
Extending IFA into Floodplains



1 & 2 D Hydraulic Modeling



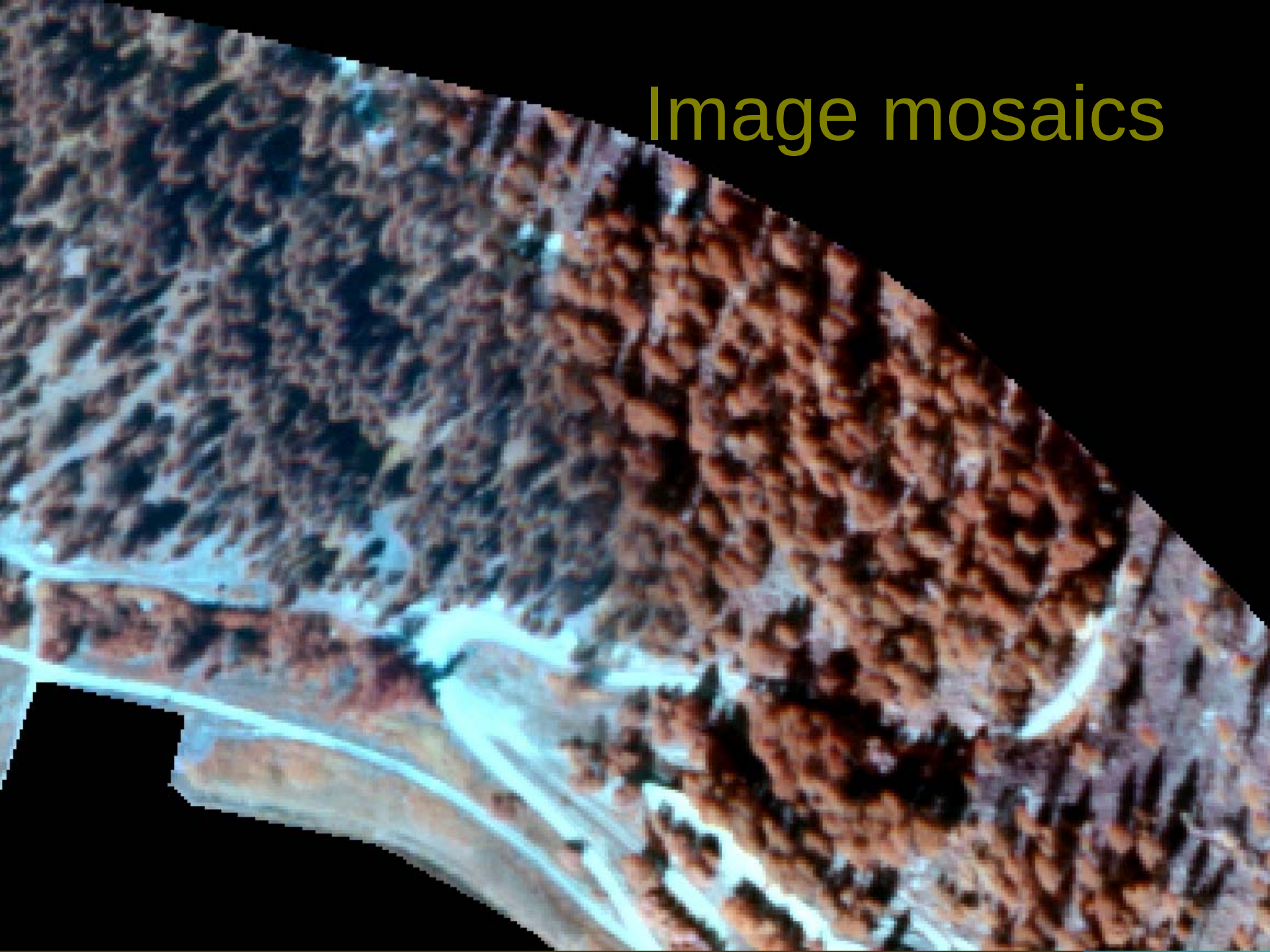




High Resolution Land Classification and NDVI (Primary Productivity)

- National Agricultural Imagery Program (NAIP) Imagery
  - Benefits
    - 1 meter resolution
    - Excellent positional accuracy
    - No cost for true color imagery, relatively inexpensive for color infrared
  - Draw Backs
    - Shadows
    - Imaging mosaics

Image mosaics



Vegetation model development

- Functional relationship between hydrology, physical process, riparian ecosystem and vegetation communities
- Boolean approach (absent or present) and based on hard threshold
- Retrogression (reverse succession) occurs when the effect of chronic stress (disturbances) reduces community structure or changes species
- Yearly time step
- Input and outputs are in raster format

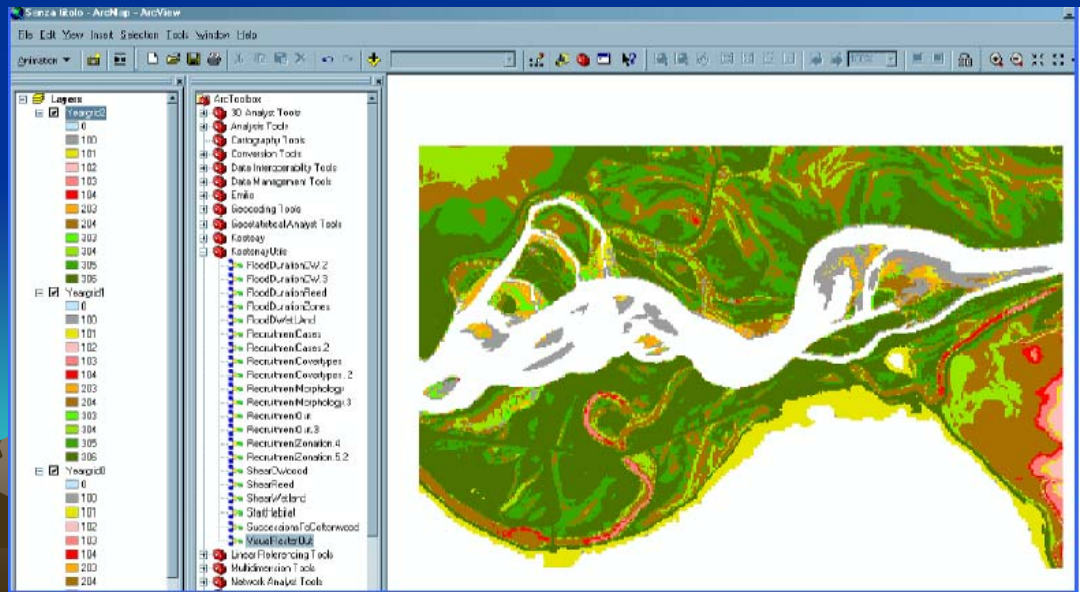
Input

- Different zone
- Morphology (topography)
- Height-over-mean water level
- Height-over-base flow level
- Shear stress
- Flood duration

Output

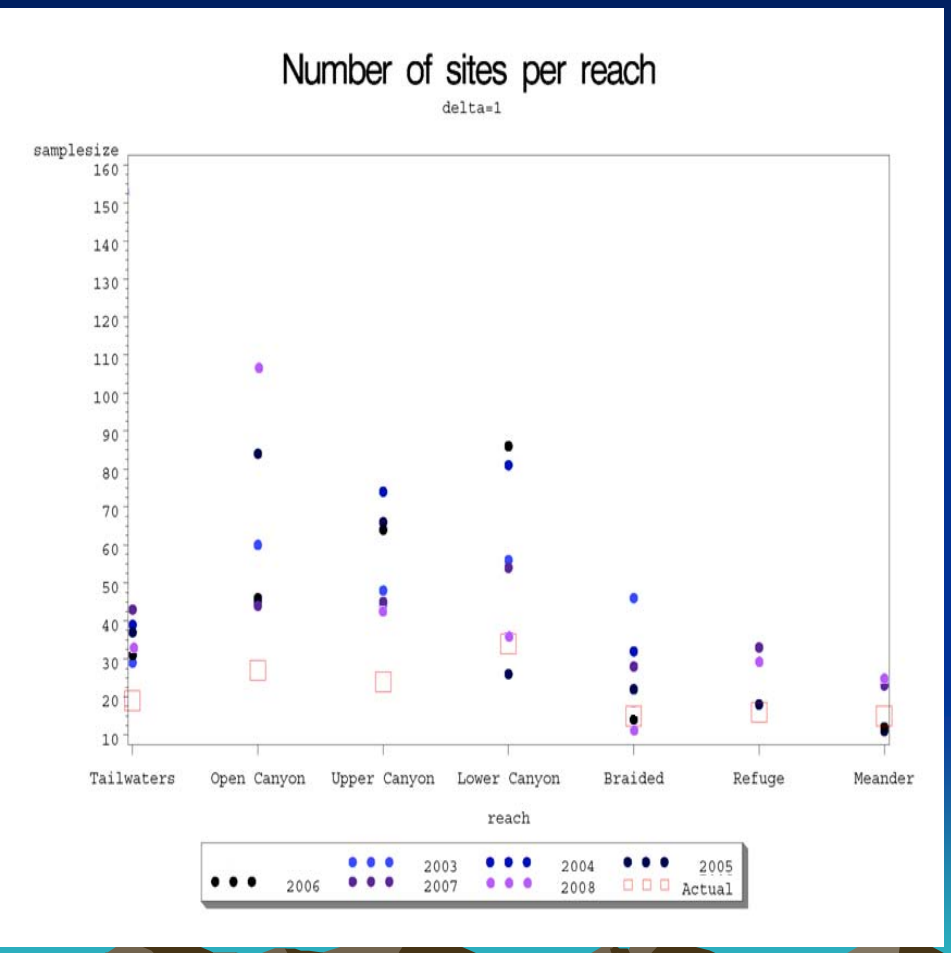
- Spatially distributed vegetation cover map for every year

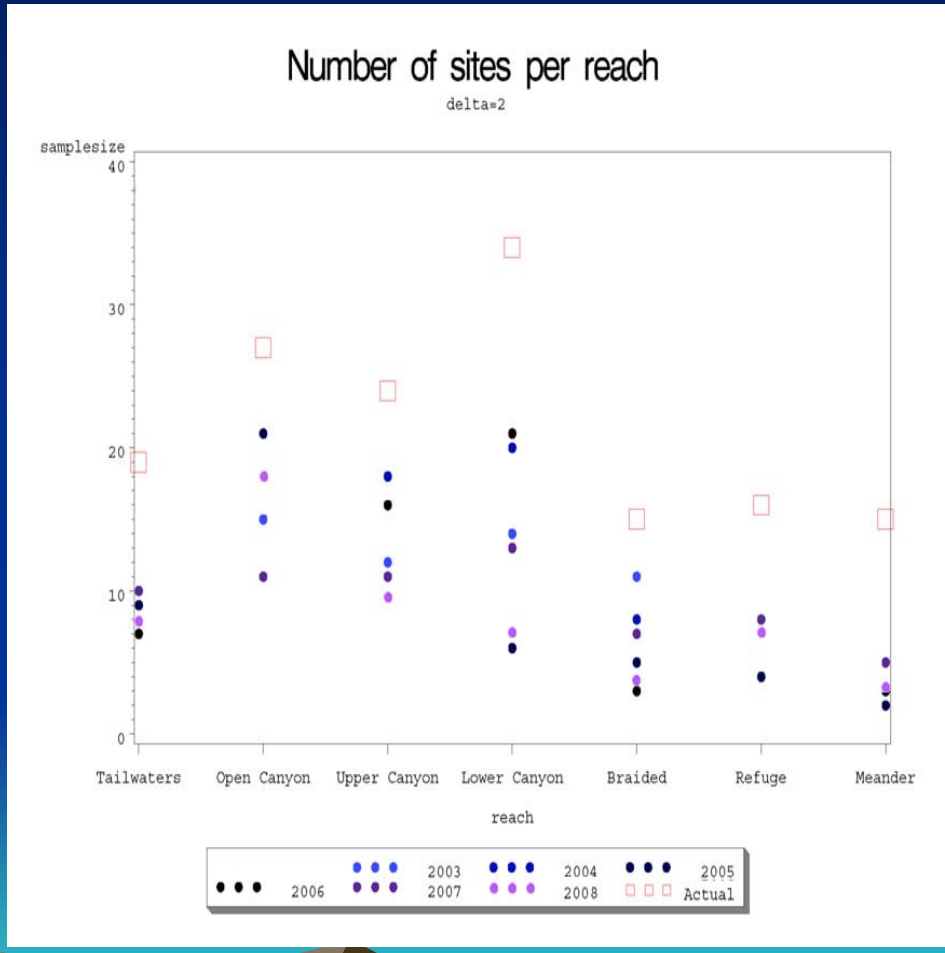
	Communities	Age ranges	
	Gravel & sand bar (LBV)	0	1
	Pioneer vegetation (MBRV)	2	3
Reed series	Reed and forbs (HBRV)	4	25
Cottonwood series	Cottonwood and willow shrub (HBCV)	4	15
Wetland series	Deep Marsh (LWV)	0	3
	Shallow marsh and wet meadow (MWV)	4	25
	Wet forbs and shrubs (HWV)	26	110
Reed series	Reed, forbs and shrubs (LFRV)	26	110
Cottonwood series	Young cottonwood forest (LFCV)	16	55
	Old cottonwood forest (MFCV)	56	110
	Mature mixed hardwood forest (VFCV)	110	300



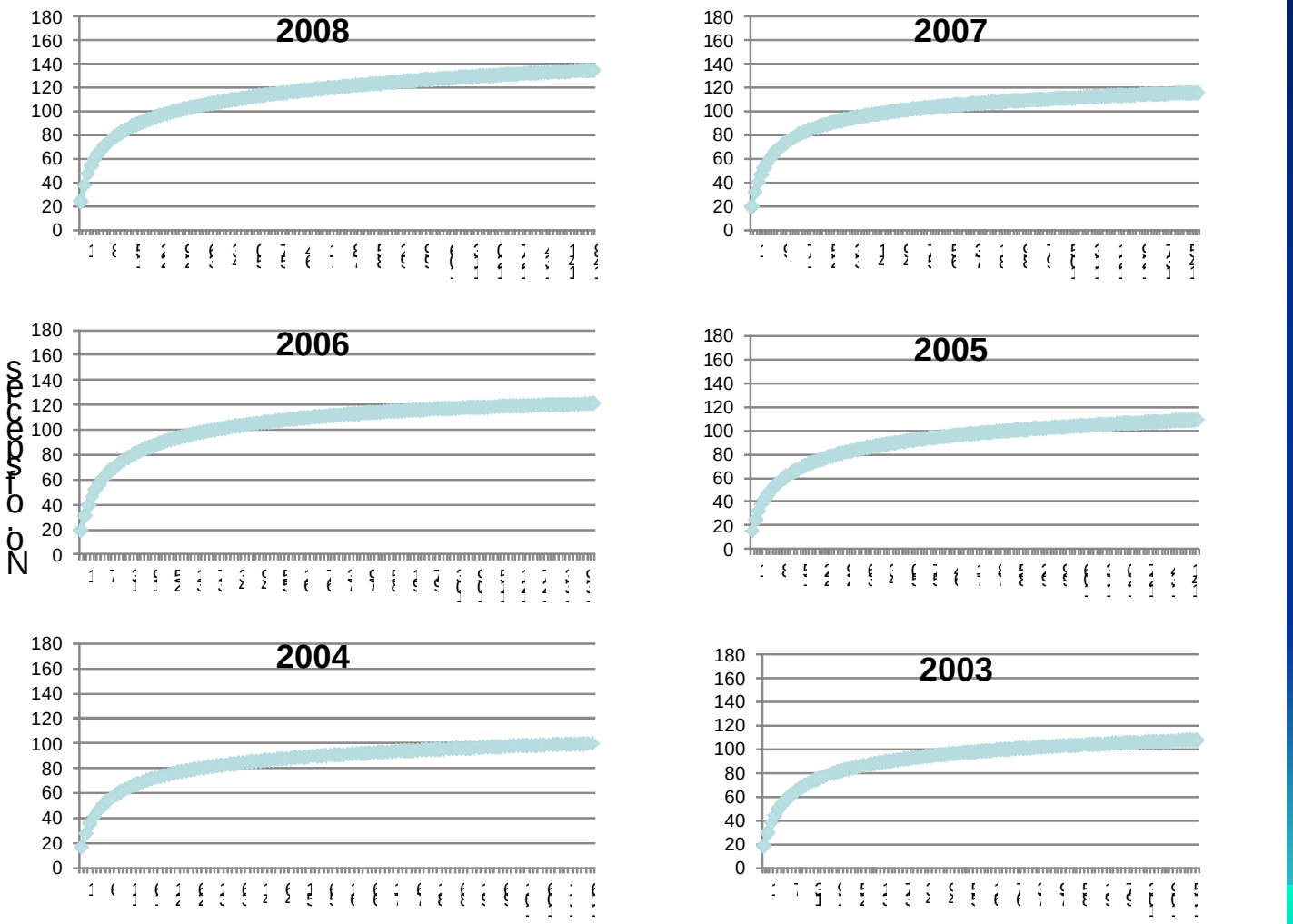
Avian Sample Size

Avian Sample Size



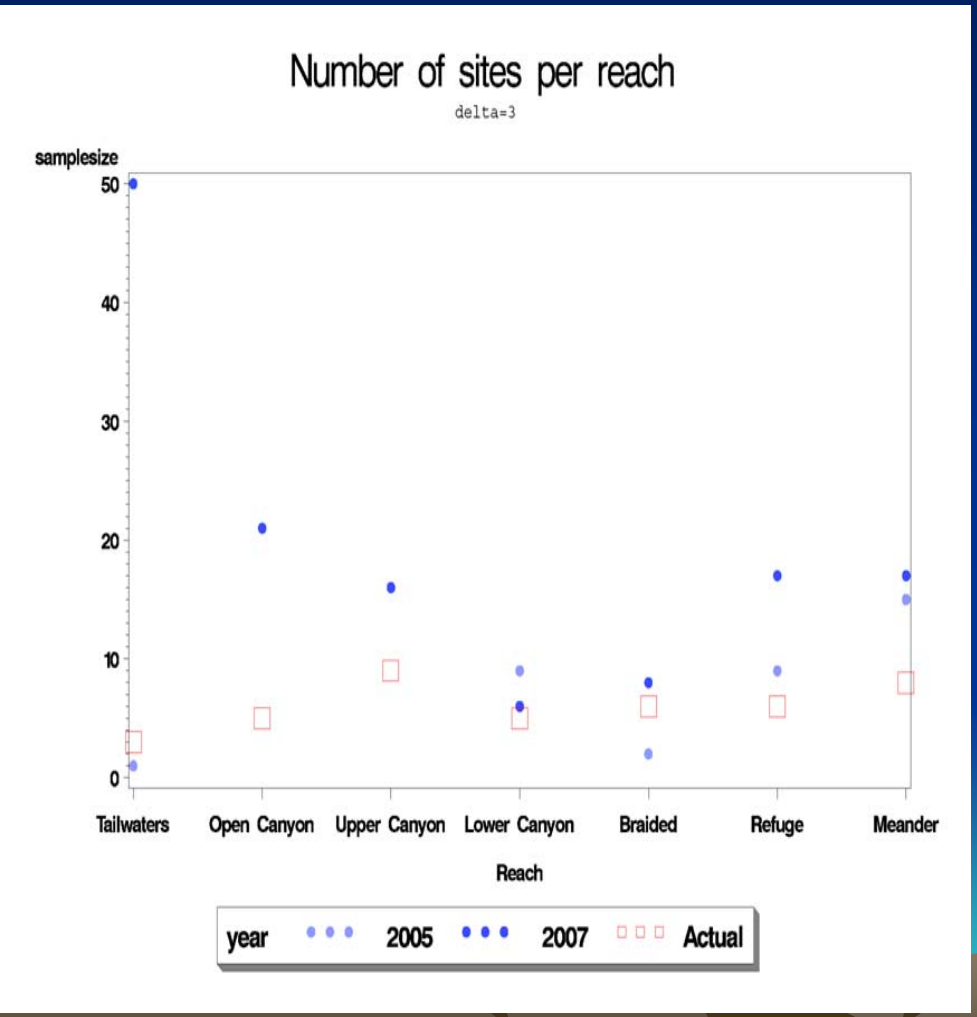


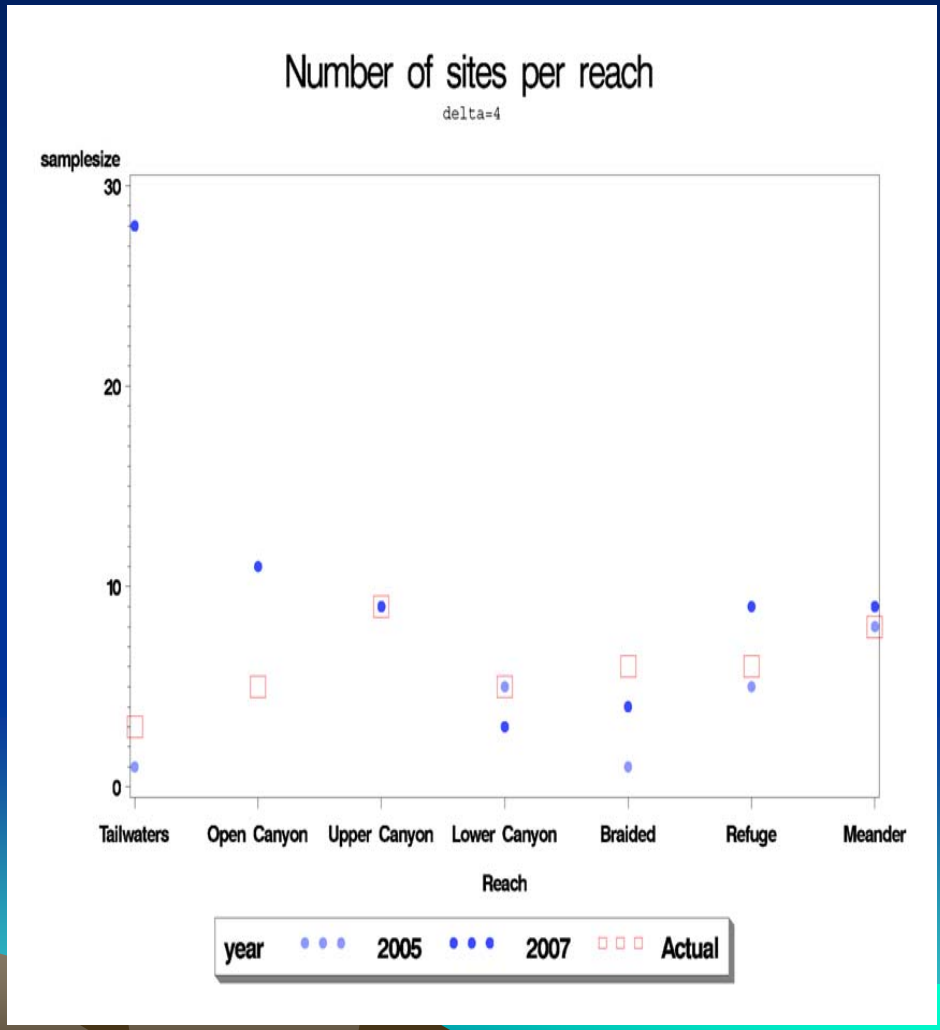
Avian Species Accumulation Curves



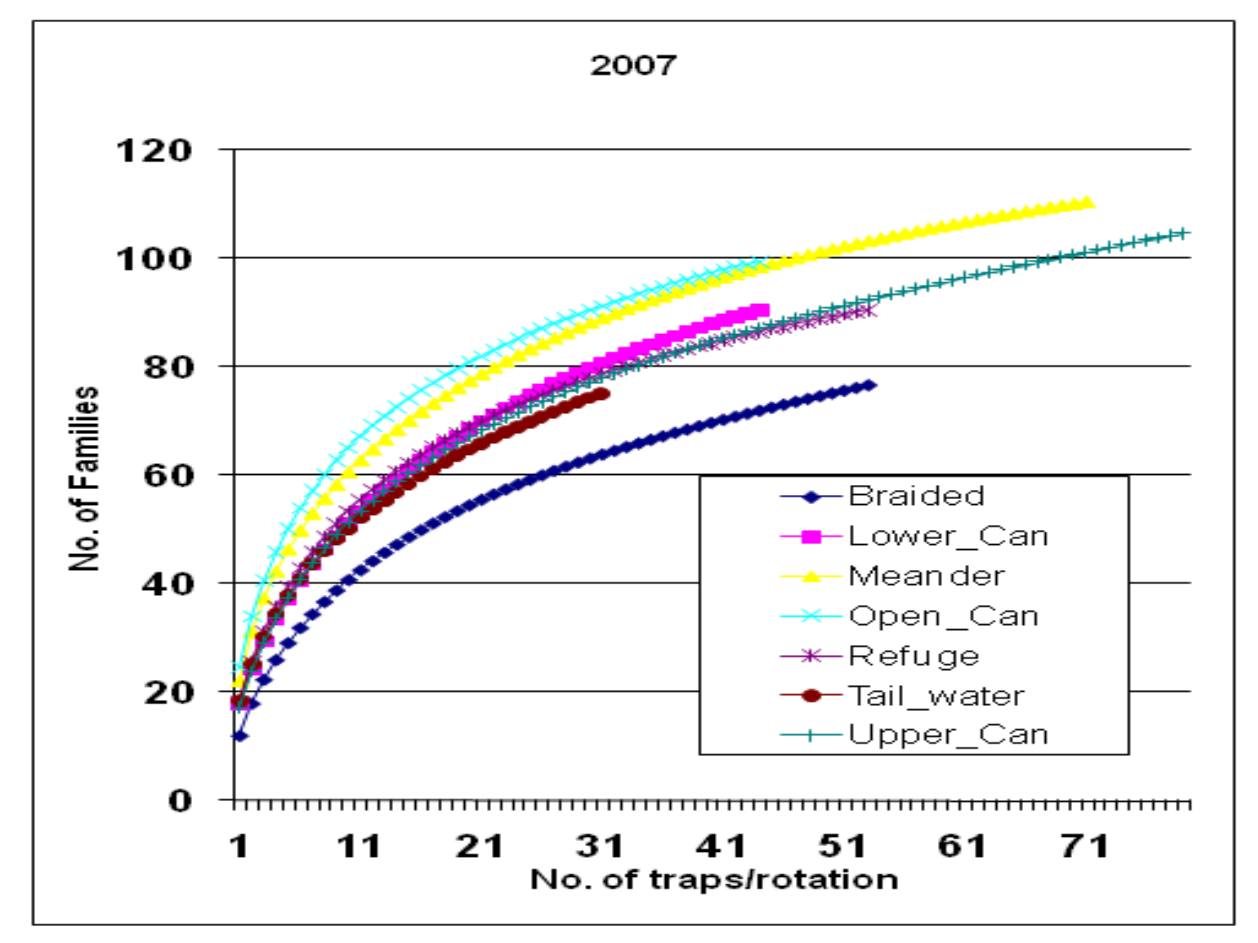
Invertebrate Sample Size

Invertebrate Sample Size





Invertebrate Family Accumulation Curve



Terrestrial Index of Biological Integrity

- Rate Sites based on integrity
  1. Severe alteration
  2. Major alteration
  3. Moderate alteration
  4. Minor alteration
  5. Pristine
- Regress community metrics against site rating
  1. Be independent
  2. Have temporal consistency or stability
  3. Be ecologically meaningful
  4. Be sensitive and responsive to hydro operations, and should
  5. Readily show responses to hydro operations

Current Tasks

- Refine and Finalize IHA and IFA
- Extend IFA into the Floodplain
- Assembling IBI models following Karr (1981) methodology.
  - Define rating systems to assess level of integrity.
- Assemble Indices into IEI matrix
- Continue to bring OLA methodology to the Region

Proposed Tasks for 2010-2012

1. Finalize IBI and IEI Models
    - Develop, Refine, and Finalize Abiotic and Biotic Indices
    - Refine and Finalize Incorporation into IEI
    - Bring the OLA Framework to the Region for Review
2. Bring the Operational Loss Assessment Methodology to the region for review and training.

Proposed Tasks for 2010-2012

3. Develop Protection, Mitigation, Rehabilitation, and Monitoring Plan Using the Phase I Assessment Tools to define mitigation opportunities
    - Develop a written plan to outline and direct protection, mitigation, and rehabilitation
    - Develop a monitoring plan to track and measure effectiveness of mitigation plan

Proposed Tasks for 2010-2012

4. Implementation
    - Implement strategies developed in under Phase 1 and 2.
    - Continue monitoring basin-wide and site specific areas to ensure effectiveness and adaptive management concepts of the Phase 2 Plan.


QUESTIONS?