DRAFT REPORT
from
PEER REVIEW PANEL
on

THE TERRESTRIAL COMPONENT

of the
BIOLOGICAL RESOURCES PROGRAM

of
THE GRAND CANYON MONITORING
and
RESEARCH CENTER

#1

OVERVIEW OF TODAY'S TALK

- THE PANEL & ITS CHARGE
- OUR "FACT FINDING" PROCESS
  - MATERIALS PROVIDED
  - THE TRIP
  - SUBSEQUENT MATERIALS
- SKETCH OF FINDINGS
- THE MAJOR FINDING, ONLY A PREVIEW
- OTHER FINDINGS
- QUESTIONS ASKED OF THE PANEL
- THE MAJOR FINDING - IN SOME DETAIL
- DISCUSSION FROM THE FLOOR

#2

THE PANEL

- MEMBERSHIP
  - N. Scott Urquhart, Statistics, Monitoring Design, Chair
  - Gregor T. Auble, Riparian Ecology
  - John G. Blake, Avian Ecology and Community Ecology
  - Douglas T. Bolger, Conservation Biology, Landscape Ecology, Birds
  - Timothy Gerrodette, Monitoring Design
  - Scott G. Leibowitz, Landscape Ecology
  - David C. Lightfoot, Desert Ecology, Entomology
  - Alan H. Taylor, Geography, Conservation Biology

#3

THE PANEL'S CHARGE

- WAS MORE OPEN ENDED THAN MANY
  - QUESTIONS WERE POSED, BUT
  - PANEL WAS ENCOURAGED TO CONSIDER THE ENTIRE TERRESTRIAL PROGRAM
- IN CONSULTATION WITH BARBARA RALSTON, ACTING DIRECTOR, BIOLOGICAL RESOURCES, THE PANEL HAS
  - EVALUATED THE CURRENT PROGRAM
    - IDENTIFIED SOME SUBSTANTIAL OBSTACLES
  - SUGGESTS FUTURE DIRECTIONS FOR THE TERRESTRIAL PART OF THE BIOLOGICAL PROGRAM, MONITORING IN PARTICULAR

#5

OUR "FACT FINDING" PROCESS MATERIALS PROVIDED

- 11 DOCUMENTS:
  - 1998 ADWG/TWG Management Objectives & Information needs
  - Kearsley & Ayers 1996 & 1997. The effects of interim flows from Glen Canyon dam on riparian vegetation ...
  - Melis, *et. al.* (undated). Draft prospectus for evaluating GCMRC monitoring protocols for the Colorado River ecosystem.
  - Noss, *et. al.* (undated). Report of Kanab ambersnail review panel .....
  - Phillips & Jackson. 1999. Monitoring Huaiapai ethnobotanical resources .....

OUR "FACT FINDING" PROCE MATERIALS PROVIDED - continued

- Spence, *et. al.* 1998 & 1999. ...Monitoring birds ...
- Stevens, *et. al.* 1997. Ecology of Kanab ambersnail ...
- Webb, *et. al.* 1999. Downstream effects of Glen Canyon ... in "The controlled flood in the Grand Canyon"
- Wohl , *et. al.* 1999. GCMRC Protocols Evaluation Program - Physical Resources Monitoring Peer Review Panel.

OUR "FACT FINDING" PROCESS THE TRIP

- SOME PICTURES
  - THE TRIP
  - MAJOR "SCIENCE" STOPS

OUR "FACT FINDING" PROCESS SUBSEQUENT MATERIALS

- 16 PUBLICATIONS
- VERY SIGNIFICANT AMONG THESE:
  - THE NATIONAL RESEARCH COUNCIL. 1999. DOWNSTREAM: ADAPTIVE MANAGEMENT OF GLEN CANYON DAM AND THE COLORADO RIVER ECOSYSTEM
  - GCMRC. 1997. THE GRAND CANYON MONITORING AND RESEARCH CENTER LONG-TERM MONITORING AND RESEARCH STRATEGIC PLAN. OBTAINED FROM http://www.gcmrc.gov

CAVEAT

- SUBSEQUENT FINDINGS MAY APPEAR CRITICAL, OR EVEN NEGATIVE. NEVERTHELESS,
  - THE CENTER,
  - ITS PREDECESSOR ORGANIZATIONS,
  - ITS CONTRACTORS, and
  - ITS COLLABORATORS
- HAVE LEARNED A GREAT DEAL ABOUT MANY ASPECTS OF THE MAIN-STEM CORRIDOR ECOSYSTEM:
  - HYDROLOGY,
  - SEDIMENT TRANSPORT,
  - AQUATIC BIOLOGY, and
  - SOME FEATURES OF ITS TERRESTRIAL BIOLOGY

FINDINGS - OVERVIEW

- MAJOR FINDING: THE CENTER HAS NO COMPREHENSIVE TERRESTRIAL MONITORING STRATEGY
- OTHER FINDINGS CONCERN:
  - SCIENTIFIC DIRECTION
  - SHORT-TERM *versus* LONG-TERM EVENTS
  - SEVERAL IMMEDIATE NEEDS
  - LITTLE INTEGRATION ACROSS DISCIPLINES
  - NO MECHANISM FOR ENSURING LONG-TERM COMPARABILITY OF MONITORING DATA
  - MODELING FOR TERRESTRIAL ECOSYSTEMS
  - KANAB AMBERSNAIL GETS TOO MUCH EFFORT

FINDING 1

SCIENTIFIC DIRECTION

- THERE APPEARS TO BE LITTLE SCIENTIFIC DIRECTION TO THE MONITORING PROGRAM.
  - APPOINT THE SCIENTIFIC ADVISORY BOARD DESCRIBED IN THE LONG-RANGE STRATEGIC PLAN.
  - EMPLOY A CHIEF SCIENTIST.
  - THESE RECOMMENDATIONS HAVE BEEN MADE BEFORE, MOST RECENTLY BY THE NATIONAL RESEARCH COUNCIL.

FINDING 2

SHORT-TERM *versus* LONG-TERM

- THE CENTER HAS FOCUSED ON SHORT-TERM EVENTS, RATHER THAN ON LONG-TERM RESPONSE.
  - ENDEAVOR TO GET THE ADAPTIVE MANAGEMENT WORK GROUP TO INCORPORATE A LONG-TERM PERSPECTIVE INTO THEIR "INFORMATION NEEDS."
  - PLANT AND ANIMAL POPULATIONS TAKE YEARS TO MANIFEST A RESPONSE TO MODERATE EVENTS.
  - INCORPORATE THIS PERSPECTIVE INTO MONITORING PLANS AND METHODOLOGIES.

FINDING 3
SEVERAL IMMEDIATE NEEDS

- THE CENTER HAS SEVERAL IMMEDIATE NEEDS BEFORE A COMPREHENSIVE MONITORING PROGRAM CAN BE IMPLEMENTED.
  - COMPLETE A RELEVANT GIS COVERAGE OF THE ENTIRE RIVER CORRIDOR.
  - COMPLETE A CURRENT LAND-COVER MAP.
  - SELECT A RANDOM SAMPLE OF SPATIALLY DISTRIBUTED STUDY SITES.
  - DEVELOP AND CODIFY COST EFFECTIVE INDICATORS AND PROTOCOLS FOR PLANTS & BIRDS
  - DEVELOP PROTOCOLS TO ENCOURAGE INTER-DISCIPLINARY COOPERATION; IMPLEMENT IN RFPs

FINDING 4
LITTLE INTEGRATION ACROSS DISCIPLINES

- THERE APPEARS TO BE LITTLE INTEGRATION ACROSS DISCIPLINES.
  - ENCOURAGE COOPERATION (REQUIRE IN RFP's)
    - SHARED SAMPLING SITES
    - JOINT RIVER TRIPS
    - AMONG
      - HYDROLOGY
      - SEDIMENT TRANSPORT
      - FISHERIES
      - VEGETATION
      - TERRESTRIAL ANIMALS

FINDING 5
LONG-TERM COMPARABILITY OF MONITORING DATA

- THERE APPEARS TO BE NO MECHANISM TO ENSURE LONG-TERM COMPARABILITY OF MONITORING DATA ACROSS CONTRACTORS AND CENTER PERSONNEL.
  - DEVELOP PROTOCOLS FOR
    - EVALUATING RESPONSES
    - SELECTING STUDY SITES
  - BEFORE ANY FURTHER PROPOSALS FOR TERRESTRIAL STUDIES ARE REQUESTED
    - ENSURE NEW CONTRACTORS ARE TRAINED IN THESE PROTOCOLS

FINDING 6
MODELING FOR TERRESTRIAL ECOSYSTEMS

- INSUFFICIENT EMPHASIS HAS BEEN PLACED ON DEVELOPING MODELS THAT WILL PREDICT THE EFFECT OF DAM OPERATIONS ON TERRESTRIAL ECOSYSTEMS.
  - DEVELOP A TERRESTRIAL ECOSYSTEM MODEL
    - DETAIL = THAT OF CURRENT AQUATIC MODEL
  - USE = ADDRESSING "WHAT IF" MANAGEMENT QUESTIONS REGARDING DAM OPERATIONS

FINDING 7

KANAB AMBERSNAIL GETS TOO MUCH EFFORT

- THE EFFORT DEDICATED TO THE KANAB AMBERSNAIL IS OUT OF PROPORTION WITH WORK ON OTHER FIELD COMPONENTS.
  - IS POPULATION AT VASEY'S PARADISE REALLY THE KANAB AMBERSNAIL?
  - REDUCE THE SCALE & FREQUENCY OF CURRENT MONITORING EFFORTS
    - USE MINIMALLY INVASIVE METHODS
  - MINIMIZE DISRUPTION OF OTHER ENDEMIC SNAIL SPECIES CAUSED BY TRANSLOCATION OF THE VASEY'S PARADISE POPULATION.

Q_1: DO METHODS AND SITES ADEQUATELY ADDRESS MANAGEMENT OBJECTIVES FOR TERRESTRIAL RESOURCES?

- NO.
  - AMBITIOUS SET OF INFORMATION NEEDS FOR TERRESTRIAL RESOURCES
    - SITES AND SPECIES ARE LIMITED IN
      - SPATIAL COVERAGE - NOT ENTIRE CORRIDOR
      - FOR EXAMPLE, WHAT ABOUT RIVER MARGIN BARS?
      - TAXONOMIC COVERAGE - LIMITED SET OF SPECIES

Q_2: COULD THE CURRENT MONITORING SITES BE AUGMENTED WITH ADDITIONAL RANDOM SITES TO SERVE AS INDEX SITES FOR MONITORING BY GEOMORPHIC REACH?

- YES, WITH APPROPRIATE DESIGN CONSIDERATIONS
- PANEL SUGGESTS AN ALTERNATE MONITORING PERSPECTIVE.
- CURRENT SITES HAVE SUBSTANTIAL PROMISE AS MODEL DEVELOPMENT SITES.

Q_3: HOW DOES ONE SEPARATE EFFECTS OF DAM OPERATIONS ON TERRESTRIAL RESOURCES FROM NATURAL VARIATION?

- POSSIBLE FOR SUSTAINED EXTREME FLOW EVENTS
- USING DIRECT OBSERVATION:
  - DIFFICULT, IF NOT IMPOSSIBLE, GIVEN
    - VARIABILITY IN DAM OPERATIONS
    - TEMPORAL LAGS IN TERRESTRIAL BIOTA
    - PROBLEM: "TREATMENT" MUST REMAIN CONSTANT TO ALLOW "REPLICATION" THROUGH TIME
- USING INDIRECT METHODS = MODELING HAS SOME PROMISE

Q_4: ARE THERE ELEMENTS OF TERRESTRIAL ECOSYSTEMS THAT NEED FURTHER UNDERSTANDING BEFORE A ROBUST MONITORING EFFORT CAN BE DEVELOPED?

- YES: ARTHROPODS, REPTILES & MAMMALS NEED SUBSTANTIAL WORK
- CURRENT KNOWLEDGE OF BIRDS AND VEGETATION APPEARS SUFFICIENT TO DEVELOP A ROBUST MONITORING PROGRAM,
- *PROVIDED:* MONITORING OBJECTIVES ARE CLEARLY STATED
- BOUNDARIES OF THE INTENDED MONITORING AREA PROBABLY SHOULD BE EXPANDED UP SOME SIDE CANYONS.

EXAMPLE

- CURRENT PROGRAM COULD OVERLOOK IMPORTANT EFFECTS AND ALSO WRONGLY FAULT DAM OPERATIONS WITH BIOTIC CHANGES RESULTING FROM NATURAL OR EXOGENOUS FACTORS
  - INTERDISCIPLINARY COOPERATION
  - COST EFFECTIVE INDICATORS
- ALL TRIPS OBSERVE AND RECORD LOCATION OF BEAVER BURROWS *AND BIGHORN SIGHTINGS*.
  - TREND IN BURROW COUNT <===> # BEAVER
  - BIGHORN GROUP SIZES AT APPROPRIATE TIME OF YEAR <===> IDENTIFY TRENDS IN # BIGHORN BROWSING ON RIVER-SIDE VEGETATION

MAJOR FINDING

- *THE CENTER HAS NO COMPREHENSIVE TERRESTRIAL MONITORING STRATEGY.*
- WHAT DOES THE PANEL FIND LACKING IN A SUBSTANTIAL WAY?
- "INFORMATION NEEDS" CONSTITUTE OUTCOMES OF MONITORING; THEY DO NOT DEFINE REASONED MONITORING OBJECTIVES.
- MONITORING IS THE PERIODIC COLLECTION OF DATA THAT IS USED TO DETERMINE THE CONDITION OF ECOLOGICAL RESOURCES.

MONITORING BIOLOGICAL RESOURCES IMPLIES WHAT ?

- A MONITORING PLAN SHOULD
  - SPECIFY DETAILS FOR SELECTING SITES
  - METHODS FOR EVALUATING RESPONSES
  - FREQUENCY OF REVISITS
  - MAGNITUDE OF EFFECTS TO BE DETECTED (OFTEN EXPRESSED AS STATISTICAL POWER)
  - BE COMPREHENSIVE, YET PRAGMATIC
    - BUDGETARY LIMITS
    - LOGISTICAL CONSTRAINTS
  - APPLY TO SOME WELL DEFINED "POPULATION"

A COMPREHENSIVE MONITORING STRATEGY INCLUDES WHAT?

- A SET OF GENERALIZED CROSS-SPECIES MONITORING OBJECTIVES
  - BASED ON THE ADWG's SPECIFIC INFO NEEDS
- COMPREHENSIVE, INTEGRATED MONITORING DESIGN FOR MEETING THESE OBJECTIVES
  - EXPLICIT TARGET POPULATIONS
  - REPRESENTATIVENESS
    - SPATIAL
    - TAXONOMIC
- IMPLEMENTATION PLAN ....

A COMPREHENSIVE MONITORING STRATEGY INCLUDES WHAT?
CONTINUED

- IMPLEMENTATION PLAN WHICH DESCRIBES DETAILS CONCERNING:
  - MONITORING DESIGN
  - POWER OF DETECTION
  - INDICATOR (RESPONSE) SELECTION
  - SAMPLING PROTOCOLS
  - DATA ANALYSIS
  - DATA MANAGEMENT

SUGGESTED MAJOR COMPONENTS OF A GCMRC MONITORING PROGRAM

- ENDANGERED SPECIES ASSESSMENTS
  - MOST OF THE SPECIFICATION OF THIS IS EXTERNAL TO THE CENTER.
- MONITORING FOR MODEL DEVELOPMENT
  - CURRENT BIOLOGICAL SITES MAY BE GOOD FOR THIS.
- PLANT AND ANIMAL INVENTORY
  - DON'T START ANYTHING NEW UNTIL THIS IS DONE! NEEDS TO BE COMPREHENSIVE.
- LONG-TERM MONITORING OF THE MAIN-STEM CORRIDOR
  - PLAN THIS CAREFULLY!

MONITORING COMPONENT

ENDANGERED SPECIES ASSESSMENTS

- MOST OF THE CONTROL OF THE RESOURCES AND PROTOCOLS ARE EXTERNAL TO THE CENTER.
  - PANEL MAKES A FEW COMMENTS ABOUT BIRDS IN APPENDIX A.2
  - THE RESOURCES DEVOTED TO KANAB (?) AMBERSNAIL APPEAR TO BE OUT OF PROPORTION TO REST OF PROGRAM. CONSIDER
    - CUTTING BACK FREQUENCY, and
    - INTENSITY OF POPULATION EVALUATION
    - MINIMALLY INVASIVE METHODS

MONITORING COMPONENT

MONITORING FOR MODEL DEVELOPMENT

- MODELING PROVIDES A POSSIBILITY OF PROJECTING THE POSSIBLE CONSEQUENCES OF DAM MANAGEMENT ACTIONS. FOR EXAMPLE
  - BIRD ABUNDANCE COULD BE RELATED TO THE VEGETATION COMMUNITY,
  - THE VEGETATION COMMUNITY COULD BE RELATED TO SEDIMENT PARTICLE SIZE AND BEACH ELEVATION,
  - SEDIMENT PARTICLE SIZE COULD BE RELATED TO THE RIVER'S HYDROLOGY, and
  - HYDROLOGY COULD BE RELATED TO DAM OPERATION

MONITORING COMPONENT

MONITORING FOR MODEL DEVELOPMENT

- DAM OPERATIONS

  ===> SEDIMENT CHARACTER AT A POINT

  ===> VEGETATION AT THAT POINT

  ===> LIKELY BIRD COMMUNITY THERE

- SIMILAR TO CURRENT AQUATIC MODEL
- MIGHT REQUIRE "EXPERIMENTS" TO ESTABLISH LIKELY RESPONSES TO VARIOUS CONDITIONS
- LIMITATIONS - PREDICTIONS DEPEND HEAVILY ON "THE MODEL ."

MONITORING COMPONENTS

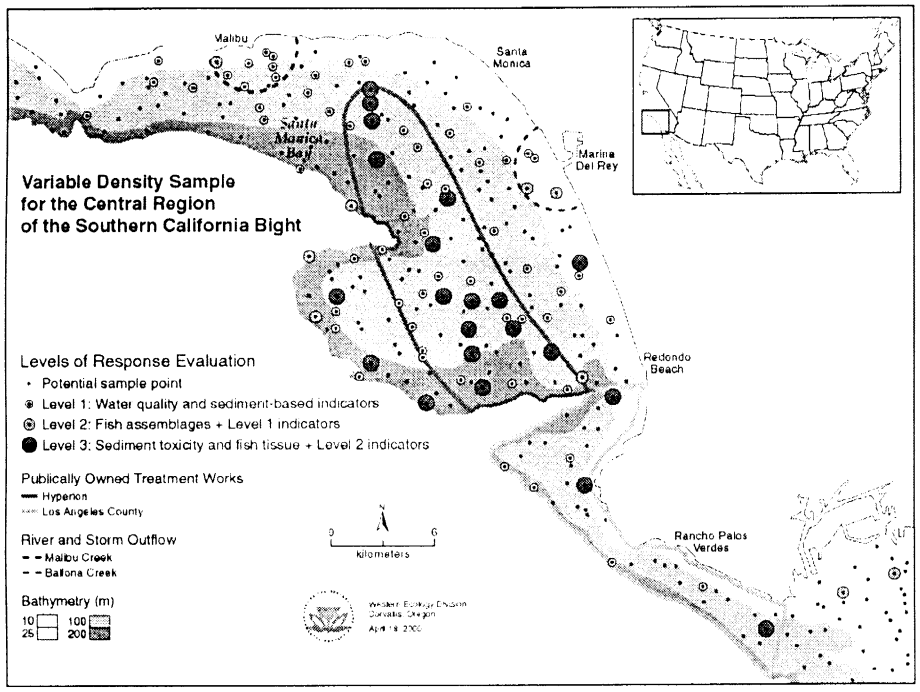
PLANT AND ANIMAL INVENTORY LONG-TERM MONITORING

- DEFINE THE DOMAIN WHICH BOTH ARE TO COVER
  - PANEL STRONGLY RECOMMENDS THE ENTIRE MAIN-STEM CORRIDOR + RELEVANT SIDE CANYONS
- CONDUCT A PROBABILITY SAMPLE OF THAT DOMAIN. PROBABILITY OF POINTS CAN BE VARIED IN MANY PRACTICAL WAYS.
- CONDUCT INVENTORY AT THOSE POINTS;
  - PERHAPS SPREAD OUT OVER FOUR YEARS
    - PERHAPS FOUR TIMES WITHIN EACH YEAR
    - COVERING THE ENTIRE CORRIDOR EACH YEAR

MONITORING COMPONENTS

PLANT AND ANIMAL INVENTORY LONG-TERM MONITORING

- POSSIBILITY
  - USE SAME POINTS FOR LONG-TERM MONITORING or,
  - A SUITABLY CHOSEN SUBSET, EITHER DIRECTION
  - PERHAPS "NEST" VARIABLES TO BE EVALUATED (ILLUSTRATED BELOW)
- HOW TO CHOOSE POINTS?
  - TECHNOLOGY EXISTS TO DO THIS WELL
  - COMPLEX ILLUSTRATION, RATHER THAN THAN HOW



FEATURES OF THE CALIFORNIA BIGHT SAMPLE

- POINT DENSITY VARIED BY
  - NORTH/MIDDLE/SOUTH
  - SHALLOW/MID-DEPTH/DEEP
  - AREAS OF SPECIAL INTEREST
    - WASTE WATER "OUTFALLS"
    - THE "HYPERION"
- INDICATORS EVALUATED (LEAST TO MOST $)
  - WATER CHEMISTRY & SEDIMENT SPECIES
  - FISH ASSEMBLAGE
  - SEDIMENT TOXICITY + FISH TISSUE
- POINTS ARE SPATIALLY BALANCED PROB SAMPLE

ANALOGY TO GCMRC

- VARY SAMPLING RATE, FOR EXAMPLE, BY
  - ELEVATION ABOVE SPECIFIED FLOWS, *e.g.*
    - <10, 10- 25, 25 - 75, >75 mcfs
    - DEBRIS FAN EDDY COMPLEX *vs* RIVER MARGIN
    - GEOMORPHIC REACH
- NEST VARIABLES, *e.g.*
  - VISUAL EVALUATION OF VEGETATION COVER
  - BIRD SURVEYS
  - ARTHROPOD COLLECTION
- REGARD THIS AS AN ***EXAMPLE***, NOT A SUGGESTION

THE BOTTOM LINE

- HAVE REALISTIC EXPECTATIONS, GIVEN THE
  - BUDGET
  - REALITIES OF LIFE CYCLES OF HIGHER ORGANISMS
- DECIDE WHAT THE CENTER SHOULD "TALK" ABOUT
  - SAMPLE THAT "THING" COMPREHENSIVELY
- DECIDE ON "INDICATORS" TO EVALUATE
  - EVALUATE THOSE COST EFFECTIVELY
- DEMAND INTERDISCIPLINARY COOPERATION