



**A PROGRAM IN
STATISTICAL SURVEY
DESIGN AND ANALYSIS
FOR AQUATIC RESOURCES**

**STARMAP: THE PROGRAM AT
COLORADO STATE UNIVERSITY**

**SPACE-TIME AQUATIC RESOURCES
MODELING AND ANALYSIS PROGRAM**

SCOTT URQUHART, DIRECTOR of STARMAP

FUNDING SOURCE

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THIS TALK

STARMAP

- ◆ **STARMAP**

- OBJECTIVES AND VISION
- PROJECTS
- COORDINATION

- ◆ **A CROSS-PROJECT THRUST**

- DEVELOP MODELS & METHODS TO SUPPORT

- ▼ STATE & TRIBAL USE OF PROBABILITY-BASED SITE SELECTION

STARMAP'S MAJOR OBJECTIVES

- ◆ **TO ADVANCE**
 - ▼ THE SCIENCE OF STATISTICS
 - ▼ TECHNIQUES OF HIERARCHICAL SURVEY DESIGN AND ALLIED TECHNIQUES
 - ▼ SPATIAL AND TEMPORAL MODELING
- ◆ **TO DEVELOP AND EXTEND THE EXPERTISE ON DESIGN AND ANALYSIS TO THE STATES AND TRIBES**

STARMAP'S MAJOR OBJECTIVES

CONTINUED

- ◆ **TO EXPAND THE CADRE OF GRADUATES WITH**
 - **EXPERTISE AND EXPERIENCE IN**
 - ▼ **SURVEY DESIGN AND ANALYSIS**
 - ▼ **NEEDED TO SUCCESSFULLY MONITOR THE CONDITION OF**
 - **THE NATION'S AQUATIC RESOURCES**

STARMAP'S VISION

◆ PERSPECTIVE:

- A SEARCHING ANALYSIS OF A REAL, MODERATELY COMPLEX, DATA SET ALMOST ALWAYS GENERATES QUESTIONS WHOSE ANSWER CALLS FOR AN EXTENSION OF EXISTING STATISTICAL THEORY OR METHODOLOGY.

STARMAP'S VISION

CONTINUED

- ◆ SUCH RESEARCH OPPORTUNITIES WILL BECOME PROBLEMS ATTACKED BY
 - IN ORDER OF COMPLEXITY
 - ▼ MASTERS STUDENTS
 - ▼ DOCTORAL STUDENTS
 - ▼ POST-DOCTORAL FELLOWS
 - ▼ AFFILIATED FACULTY SUPERVISORS

STARMAP'S VISION

CONTINUED - 2

- ◆ THE IDENTIFICATION OF THOSE QUESTIONS REQUIRES
- ◆ A STRONG WORKING RELATIONSHIP BETWEEN
 - THE STATISTICIAN AND
 - THE (SUBJECT MATTER) SCIENTIST
- ◆ STARMAP WILL FOSTER SUCH RELATIONSHIPS

STARMAP'S FUNDING ALLOCATION

(ALL 12-MONTH BASIS)

- ◆ DIRECTOR - 0.60 FTE
- ◆ FACULTY - 0.75 FTE
- ◆ GRADUATE STUDENTS - 3 FTE
- ◆ POST DOCTORAL FELLOWS - 2 FTE
- ◆ STAFF 1.00 FTE - 2 YEARS, ONLY
- ◆ AMPLE FUNDS FOR COLLABORATION & PROFESSIONAL TRAVEL
- ◆ SUBCONTRACTORS (\$185K → \$120K)

STARMAP PROJECTS

- ◆ COMBINING ENVIRONMENTAL DATA SETS - JENNIFER HOETING
- ◆ LOCAL ESTIMATION - JAY BREIDT
- ◆ INDICATOR DEVELOPMENT - DAVE THEOBALD
- ◆ OUTREACH - SCOTT URQUHART
- ◆ ADMINISTRATION & COORDINATION - NEXT TOPIC

COORDINATION

- ◆ **MAJOR RESPONSIBILITY OF BOTH PROGRAM DIRECTORS**
 - **CSU/OSU - EACH DIRECTOR IS FUNDED ON THE OTHERS' ADMIN BUDGET**
 - ▼ **INTERCHANGE VISITS**
 - **EX: STEVENS & GITELMAN AT CSU IN JANUARY**
 - **THESE JOINT CONFERENCES**
 - ▼ **FREQUENT E-MAILS & PHONE TALKS**
 - **DIRECTORS HAVE VISITED SUBCONTRACTORS**

COORDINATION - AT CSU

- ◆ FREQUENT COMMUNICATION AMONG ALL PI'S
 - SEVERAL JOINT PLANNING MEETINGS LAST FALL
 - SEMINAR LAST SPRING
 - BACK AND FORTH WITH LANDSCAPE ECOLOGY
 - INTERACTION WITH AQUATIC BIOLOGISTS
 - ▼ POFF & BLEDSOE AT CSU
 - ▼ STAR MEETING IN DENVER NEXT WEEK

COORDINATION - EXTERNAL TO CSU/OSU

◆ COLLABORATOR COMMUNITIES

● ESTUARINE & GREAT LAKES INDICATOR DEVELOPMENT (EaGLes)

▼ ATTEND "ALL HANDS MEETINGS"

- PRESENT INFORMATION ABOUT OUR PROGRAMS

● EMAP - PERSONAL CONTACT

▼ SOURCE OF NEW PROBLEMS

- EX: ACID RAIN REPORT TO CONGRESS - TREND
AT PROBABILITY & "HAND-PICKED" SITES
» OPPORTUNITIES FOR PROJECTS 1 & 2

COORDINATION - EXTERNAL TO CSU/OSU

CONTINUED

◆ COLLABORATOR COMMUNITIES

▼ SUB-STATE REGIONAL ENVIRONMENTAL AUTHORITIES

- SOUTHERN CALIFORNIA COASTAL WATER RESEARCH PROJECT (SCCWRP)
- SAN FRANCISCO ESTUARY INSTITUTE

▼ EPA PERSONNEL

- REGIONS 8, 9 & 10
- HEADQUARTERS
 - » OFFICE OF RESEARCH AND DEVELOPMENT
 - » OFFICE OF WATER
 - » TRIBAL SCIENTIFIC COUNCIL

COORDINATION - EXTERNAL TO CSU/OSU

CONTINUED 2

◆ COLLABORATOR COMMUNITIES

▼ EPA PERSONNEL

- ...
- EPA LABS
 - » WESTERN ECOLOGY LAB - CORVALLIS
 - » MIDWESTERN ECOLOGY LAB - DULUTH, MN
 - » EASTERN ECOLOGY LAB
 - » ECOSYSTEMS RESEARCH DIVISION
 - » LAS VEGAS LAB - LANDSCAPE ECOLOGY
- STATE PERSONNEL
 - » MAINLY AT OSU, SO FAR

A CROSS-PROJECT THRUST

- ◆ FLOW AND FLOW STATUS
- ◆ EPA DIRECTIVES TO STATES AND TRIBES
 - PROBABILITY SAMPLING
- ◆ OBSTACLES TO ACCURATE PROBABILITY-BASED SAMPLING
- ◆ AVAILABLE DATA
- ◆ MODELS UNDER DEVELOPMENT
 - MULTIPLE PROJECTS IN STARMAP

FLOW AND FLOW STATUS

STARMAP

- ◆ FLOW - AN INDICATOR OF BASE FLOW QUANTITY
- ◆ FLOW STATUS
 - PERENNIAL
 - NON-PERENNIAL
- ◆ CLIENT: STATE AND TRIBAL WATER QUALITY AGENCIES
 - REPORTING UNDER 305b OF CLEAN WATER ACT

IMPORTANT LEGISLATION

CLEAN WATER ACT (CWA), AS AMENDED

- ◆ **Section 305-Water Quality Inventory**
 - **(b) Biennial Report to Congress**
 - ▼ **Summary of info provided by States & Tribes**
- ◆ **Section 303 - Water Quality Standards and Implementation Plans**
 - **(d) Identifying Degraded Waters**
 - ▼ **Plans to Eliminate Degrading Factors**
 - **Computation of "Total Daily Maximum Loads"**

EPA's CURRENT GUIDANCE for 305b

- States and territories are encouraged to use probabilistic designs for water quality assessments and to include reports of these assessments with their Integrated Reports.

▼ SOURCE: The Total Maximum Load (TMDL) Program, Office of Water, November 19, 2001. Memorandum concerning "2002 Integrated Water Quality Monitoring and Assessment Report Guidance"

A MAJOR PROBLEM FOR PROBABILITY-BASED SAMPLING OF WATER BODIES

- PROBABILITY-BASED SELECTION OF SITES RELIES ON A "FRAME" OR LIST OF POTENTIAL SITES
- THE NATIONAL HYDROGRAPHY DATASET (NHD) - BASED ON "BLUE LINES" ON USGS MAPS IS THE ONLY PRACTICALLY AVAILABLE FRAME MATERIALS
- ◆ MAJOR PROBLEM = FRAME ERRORS

FRAME ERRORS

TO BE DOCUMENTED SHORTLY

- ◆ **WATER BODY SIZE**
 - **IMPORTANCE OF SIZE WILL BE ADDRESSED SHORTLY**
- ◆ **FLOW STATUS -- re PERENNIAL**
 - **IDENTIFIED AS PERENNIAL, BUT NOT**
 - ▼ **WASTES EFFORT OF FIELD CREWS**
 - **IDENTIFIED AS NON-PERENNIAL, BUT REALLY IS PERENNIAL**
 - ▼ **MISSED RESOURCE**
 - ▼ **INACCURATE ASSESSMENT**

EMAP-West Stream/river Length (km \pm 95% CI)

from Peck, et al (2002) - EMAP symposium

Frame Source	RF3 Frame Size	Evaluated "Perennial"	Evaluated Non-perennial
RF3 Coded Perennial (Perennial Survey)	656,706	501,060 \pm 15,590	128,328 \pm 12,709
RF3 Coded Non-perennial (Non-perennial Survey)	1,628,980	112,537 \pm 21,278	1,469,277 \pm 63,515
Total	2,285,686	613,597 \pm 26,378	1,597,605 \pm 64,774

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COMMENTS ON THE DISTRIBUTION OF WATER BODY SIZES - SO WHAT

- ◆ FOR "USE" AREA IS IMPORTANT
 - RECREATION
 - REARING HABITAT - SHRIMP TO GEESE
 - DOMESTIC & INDUSTRIAL WATER USERS - EVEN VOLUME
- ◆ FOR PRESERVATION OF "BIOLOGICAL DIVERSITY" NUMBERS ARE VERY IMPORTANT

COMMENTS ON THE DISTRIBUTION OF WATER BODY SIZES - SO WHAT II

- ◆ PROBABILITY-BASED SAMPLING HAS TO BALANCE NUMBER AGAINST SIZE
 - REGARDLESS OF WATER BODY TYPE
 - THIS PRECLUDES SIMPLE RANDOM SAMPLING
- ◆ CONSEQUENCE: VARIABLE PROBABILITY/VARIABLE DENSITY SAMPLING HAS TO BE USED

PREREQUISITE FOR ACCURATE SITE SELECTION

- AN ACCURATE FRAME
- SPATIALLY (REGIONAL) CONSISTENCY
- CRITICAL FOR CREDIBILITY AMONG WATER RESOURCE MANAGERS
- ◆ THE NEED: GOOD PREDICTORS OF
 - WATER BODY SIZE
 - PERENNIAL STATUS

PREDICTION OF WATERBODY SIZE

STARMAP

- ◆ INITIAL EFFORT - STREAMS - MAHA
 - OVERCOMES LIMITATIONS OF
 - ▼ STRAHLER ORDER
 - ▼ REGIONAL INCONSISTENCIES DUE TO VARIABLE DENSITY OF "BLUE LINES" ON USGS MAPS (SEE MAP ON THE WALL)
 - INITIAL EFFORT: GET WATERSHED
 - AREA
 - PREDICTOR CHARACTERISTICS
 - GAUGED FLOW (PERHAPS ONLY "BASE FLOW")



PREDICTION OF PERENNIAL STATUS

- ◆ IMMEDIATELY AVAILABLE DATA
 - EMAP WESTERN PILOT STUDY
 - ▼ SURVEY OF TRACES LABELED "NON-PERENNIAL"
 - 100 PER WESTERN STATE; DATA NOW AT CSU
 - STARMAP NOW COMPILING ASSOCIATED LANDSCAPE INFORMATION
 - ▼ SITE EVALUATION FROM SITES SELECTED ON TRACES LABELED "PERENNIAL"
 - ON GOING WORK IN EMAP-WEST

PREDICTION OF PERENNIAL STATUS: *OTHER POTENTIAL DATA SOURCES*

- ◆ **MAIA - ORIGINAL SAMPLING INCLUDED ALL TRACES**
 - **REGARDLESS OF PERENNIAL CLASS**
- ◆ **OTHER SURVEYS**
 - **REGION 7**
 - **VARIOUS STATES**
- ◆ **OTHER SURVEYS POSSIBLE IF METHODOLOGY WORKS**

EXPECTED OUTPUTS

- ◆ MODELS TO INCORPORATE INTO SITE SELECTION PROGRAMS
- ◆ MORE GENERALLY, STATISTICAL METHODS TO SUPPORT THOSE MODELS
- ◆ A RANGE OF GIS TOOLS USEFUL FOR AQUATIC MONITORING
- ◆ CONTINUED

EXPECTED OUTPUTS

STARMAP

◆ ...

◆ AN EXPERIENCE BASE

● FUTURE GENERATIONS OF ENVIRONMENTAL STATISTICIANS

▼ ORIENTED TOWARD AQUATIC SCIENCES

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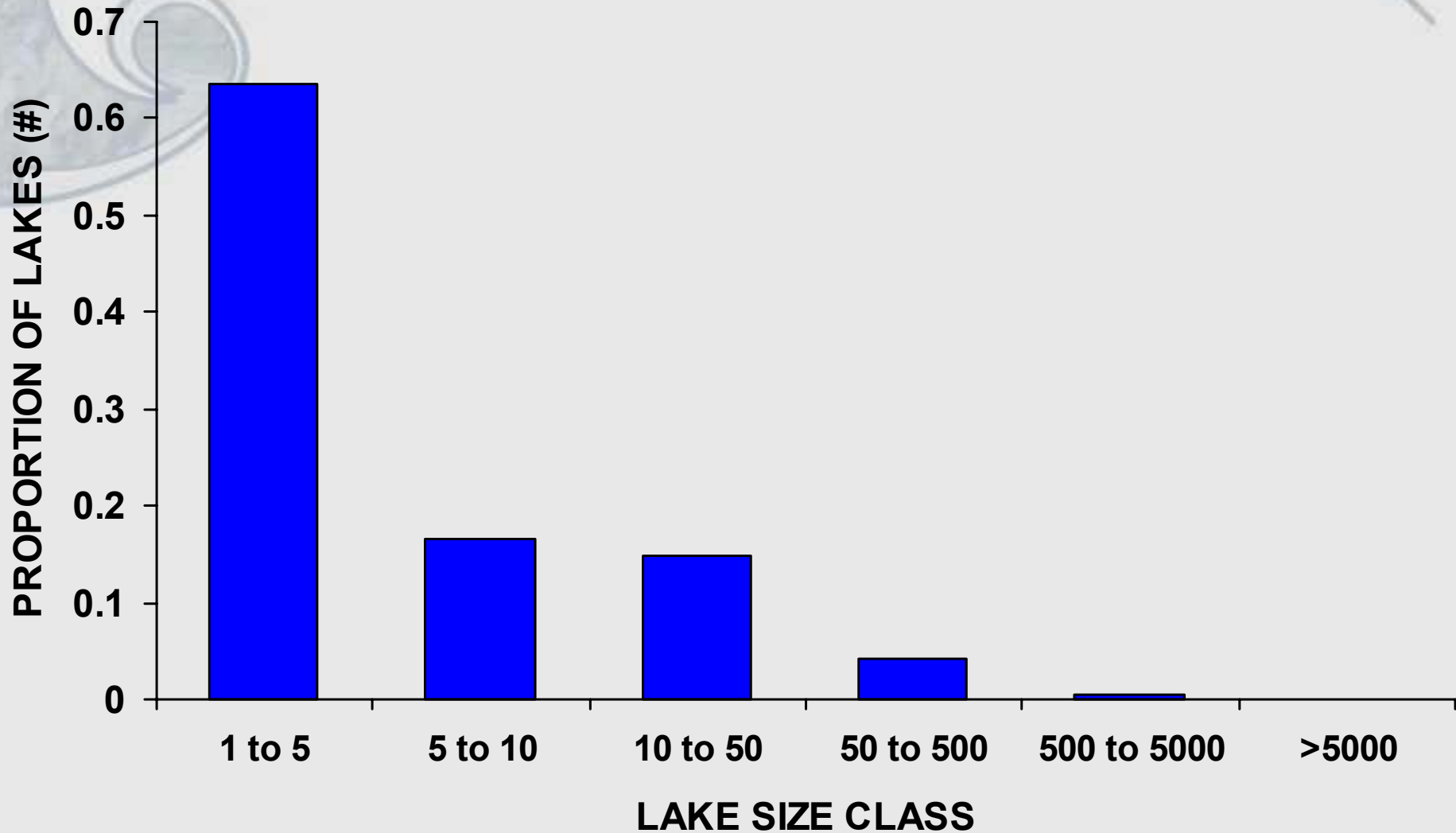
STARMAP

QUESTIONS ARE WELCOME

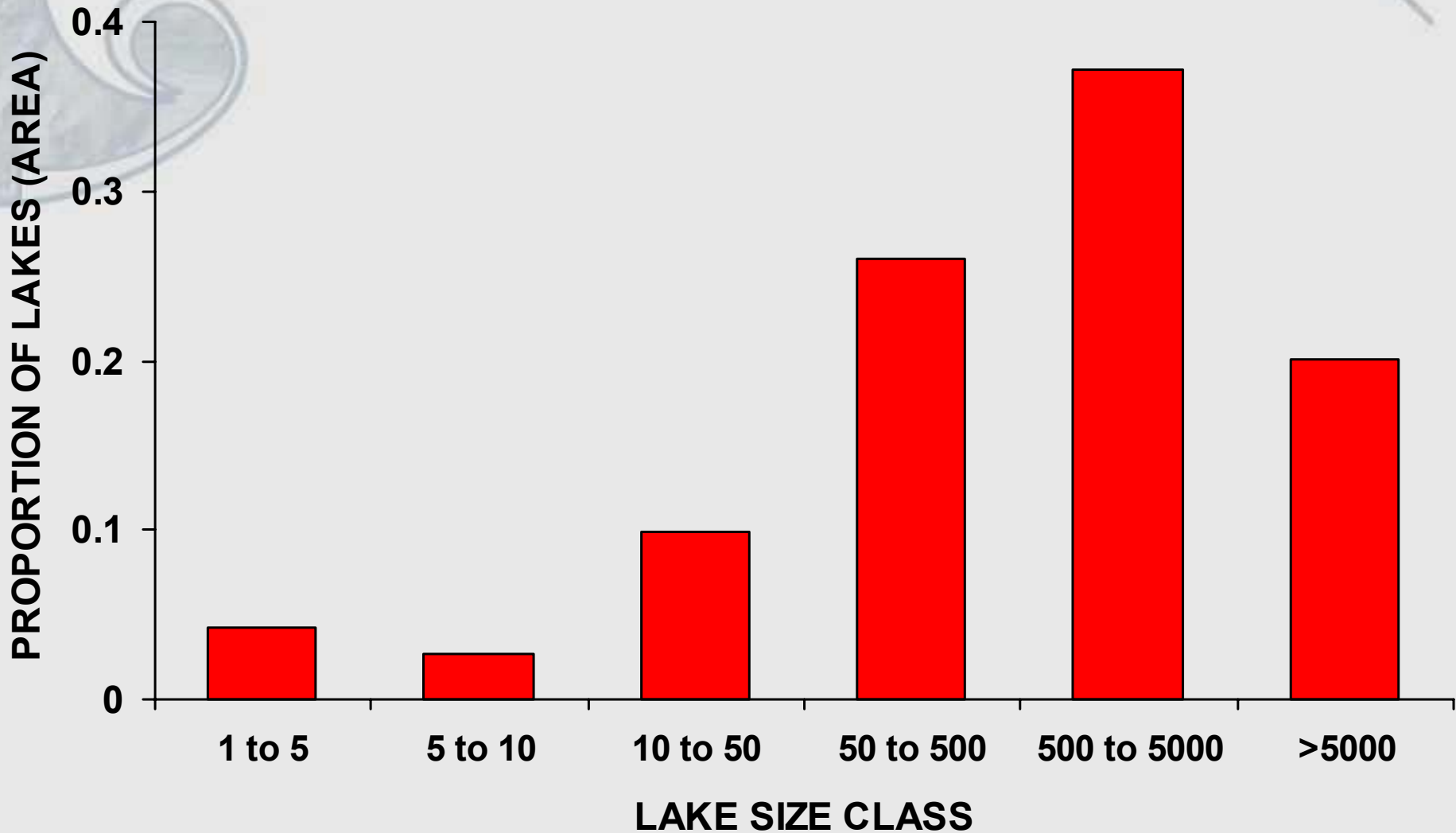
NEXT SPEAKER

- ◆ JENNIFER HOETING
 - LEADER OF PROJECT 1
 - COMBINING ENVIRONMENTAL DATA SETS

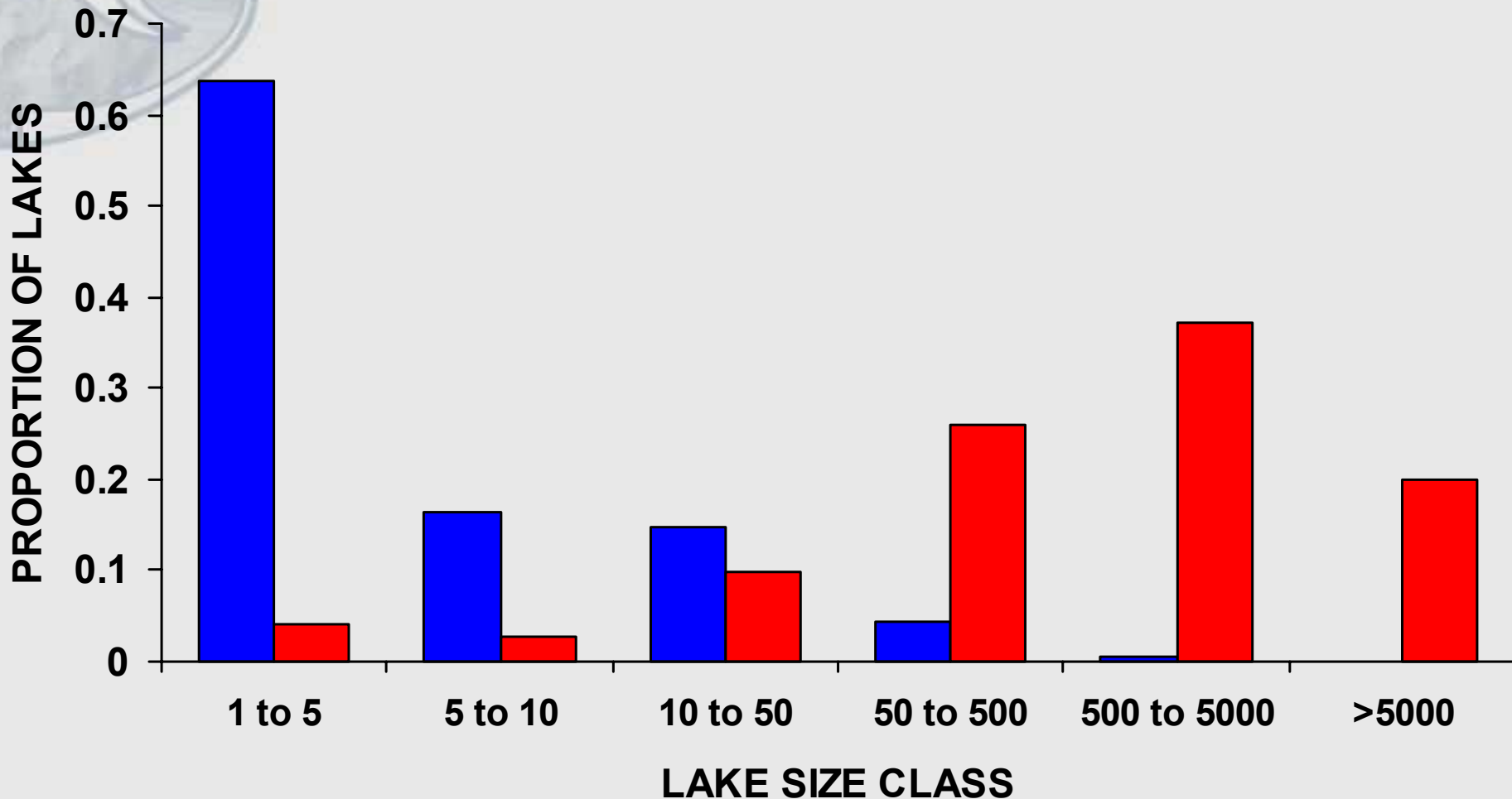
DISTRIBUTION OF LAKE SIZES IN THE CONTERMINOUS US



DISTRIBUTION OF AREA OF LAKES IN THE CONTERMINOUS US BY LAKE SIZE



CONTRAST OF THE DISTRIBUTIONS OF AREA AND NUMBER OF LAKES IN THE CONTERMINOUS US BY LAKE SIZE



COMMENTS ON THE DISTRIBUTION OF WATER BODY SIZES

- ◆ INFORMATION PROVIDED APPLIES TO ALL LAKES IN THE "LOWER 48"
 - A SIMILAR DISTRIBUTION OCCURS IN ALL PARTS OF THE US
- ◆ OTHER KINDS OF WATER BODIES
 - SAME KIND OF PATTERN
 - ▼ STREAMS & RIVERS
 - ▼ WETLANDS
 - ▼ ESTUARIES