

# Two Non-Traditional Concepts about Large River Reference Conditions:

From Recent Experience on the  
Upper Mississippi River

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<sup>3</sup> University of Massachusetts



Visualizing large, working river goals - perhaps this ...



but not this.




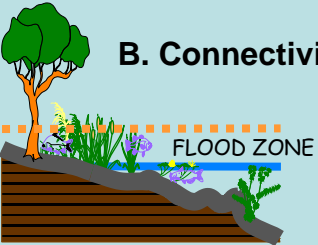
# Basin Conditions

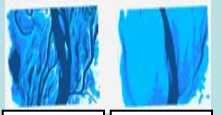
## An Adaptive Management

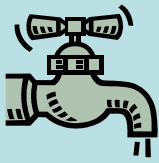



# River Key Ecosystem Attributes

**A. Bio-relationships** 

**B. Connectivity**  FLOOD ZONE

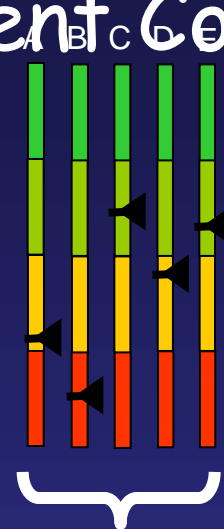
**C. Habitat**   
Then Now

**D. Flow** 

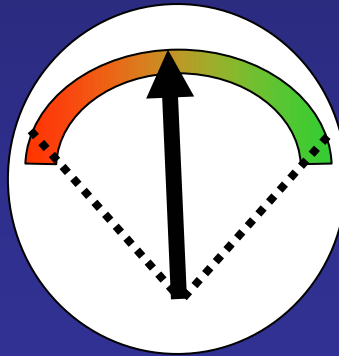
**E. Water Quality** 



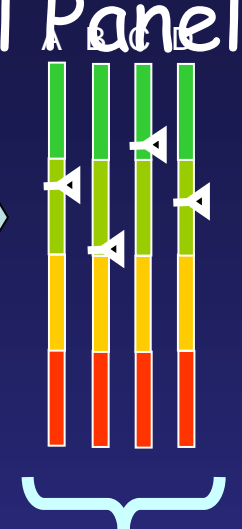
# Indicators



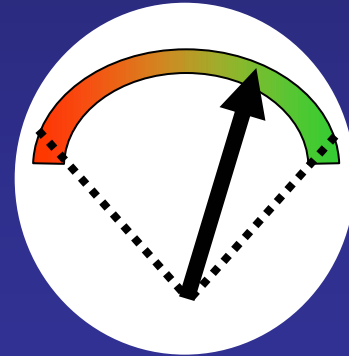
# River Ecosystem Health



# Indicators



# Regional Economic Health



Today -

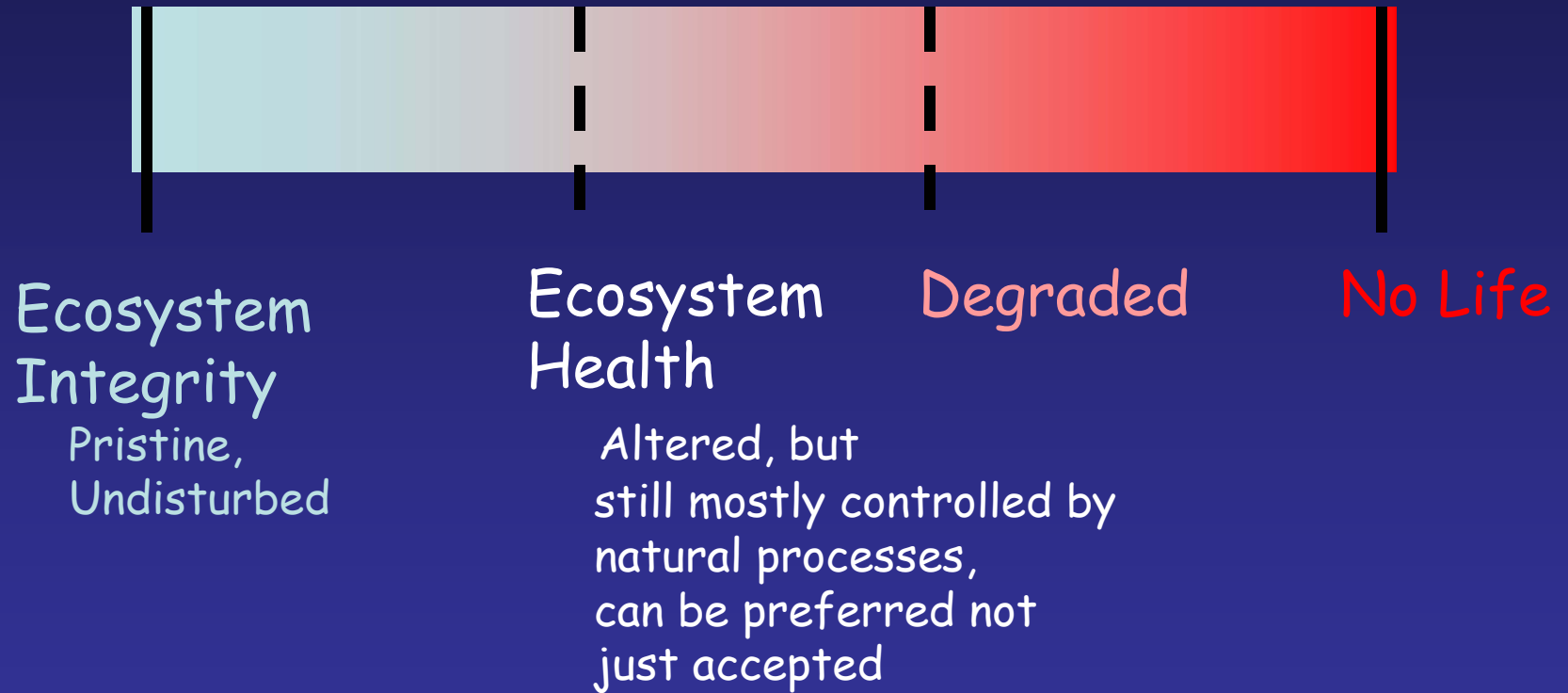
1. "Virtual Reference Condition"

2. "Collective Minimal Standards"

**Almost Equal** Phrases on the Upper Mississippi River

"Virtual  
Reference  
Condition"    ?  
=    "Desired  
Future  
Condition"    ?  
=    "River  
Ecosystem  
Health"

# Spectrum of Ecosystem Conditions\*



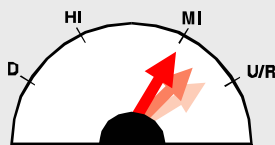
\* Modified from Karr and Chu (1999)

# Ecological Assessments of Three Reaches of the Upper Mississippi River

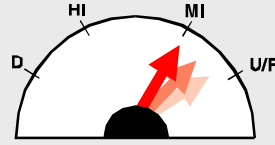
## Ecosystem Criteria

1. Viable native populations and their habitats

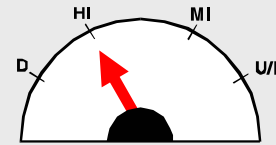
Upper Impounded Reach (Pools 1-13)



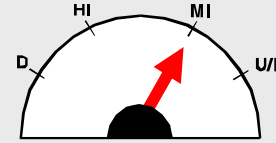
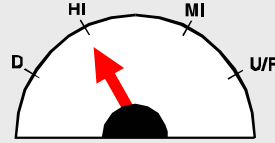
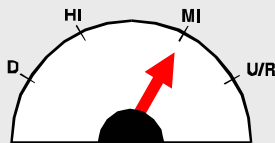
Lower Impounded Reach (Pools 14-26)



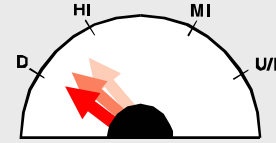
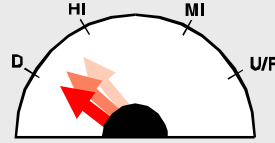
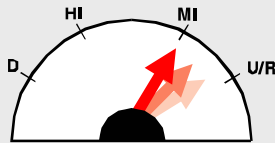
Un-Impounded Reach (St. Louis to Cairo)



2. Ability to recover from disturbance

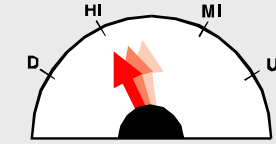
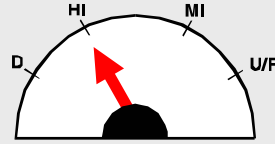
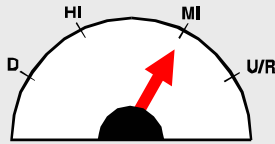


3. Sustainability

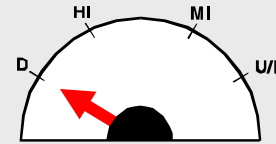
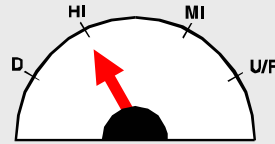
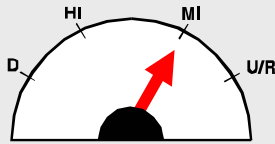


## Floodplain River Criteria

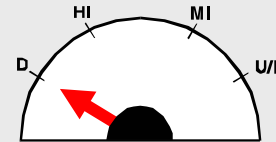
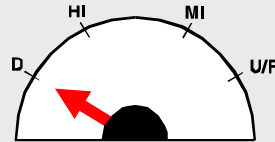
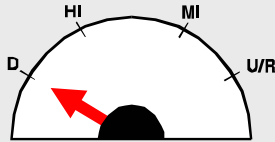
4. River provides basin services



5. Annual channel/floodplain connectivity



6. Long-term structural dynamics (such as meandering)



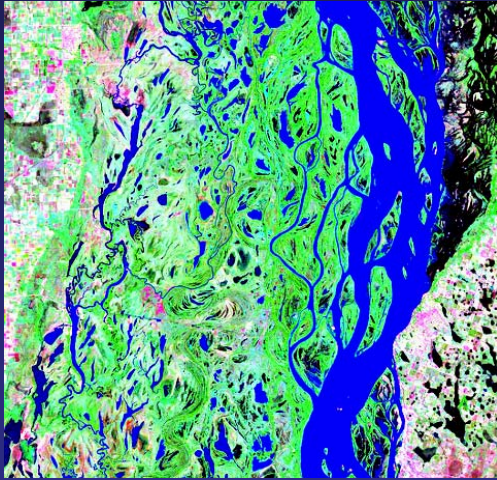
## Problems with Initial "Report Card":

1. Limited quantitative methods
2. Limited participation by public

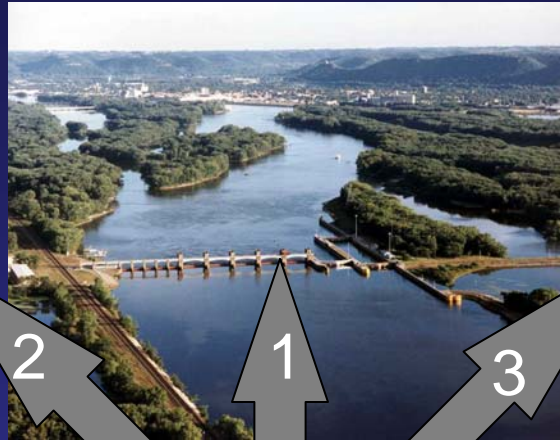
# Reference Conditions

(ala J. Nestler at International Aquatic Modeling Group, 2000-2001)

## Middle Paraná River



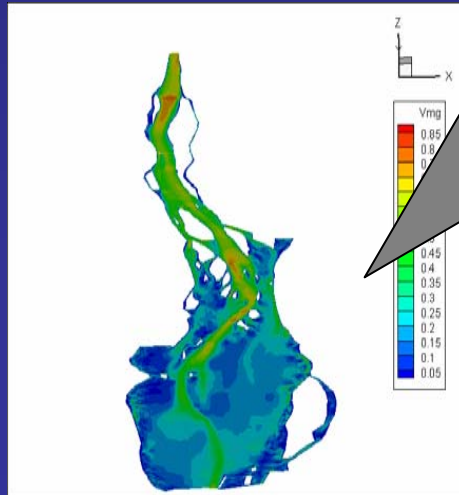
## Existing River



## Historical River



## Virtual Reference



NSF

## Existing Reference



2

1

3

4

# Nestler's Virtual Reference Condition concepts -

1. Needed to bridge gap between incremental and synthetic approach
2. Multi-variable and based on first principles
3. From model calibrated to historic states, internal sites, and external systems.

Question #1: How many variables does it take to adequately address first principles?

## But, the actual UMR recipe (FOR V.R.C) -

1. Take 2000+ stakeholder needs ...
2. Blend and reduce
3. Separate by essential ecosystem characteristic
4. Present as pseudonym for total "desirable future conditions"

## Question #2

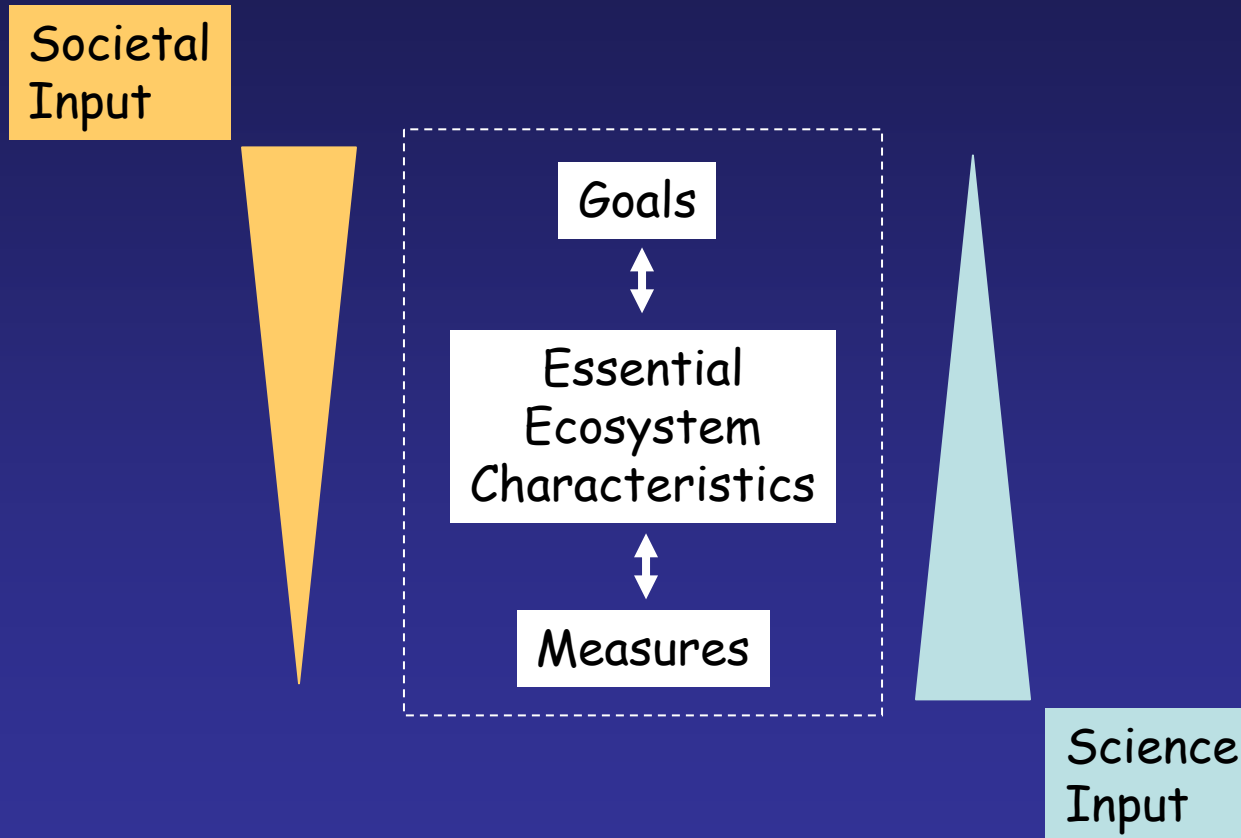
Is establishing the

"Virtual Reference Condition"

an objective or subjective task?

## Getting the Goal-setting Process Right -

AN ECOSYSTEM REPORT CARD NEEDS TO BE  
SCIENTIFICALLY-CREDIBLE AND  
SOCIAALLY ACCEPTABLE

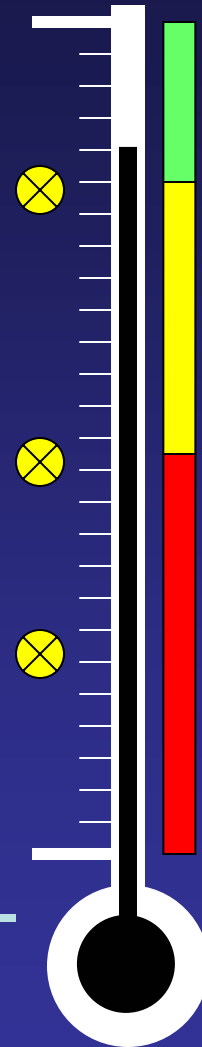


Source: Harwell, et al. (1999)

# Science and Public Contributions

USGS →

Units  
(ie. mg/l)



Desirable

Concern

Unacceptable

TNC  
And  
Other  
Stakeholders

Objective

Subjective

Measurable  
Indicator  
of an EEO  
Characteristic



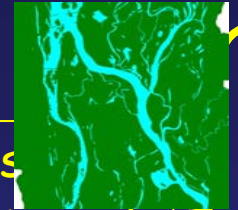
Response Threshold

# Virtual Reference Condition Approach 1: Based on History

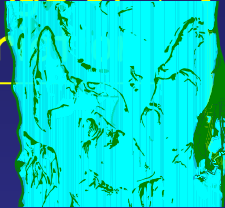
1890



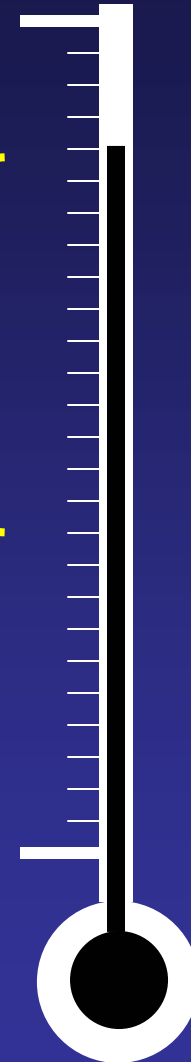
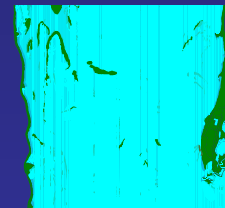
His  
Range of  
Var



1939



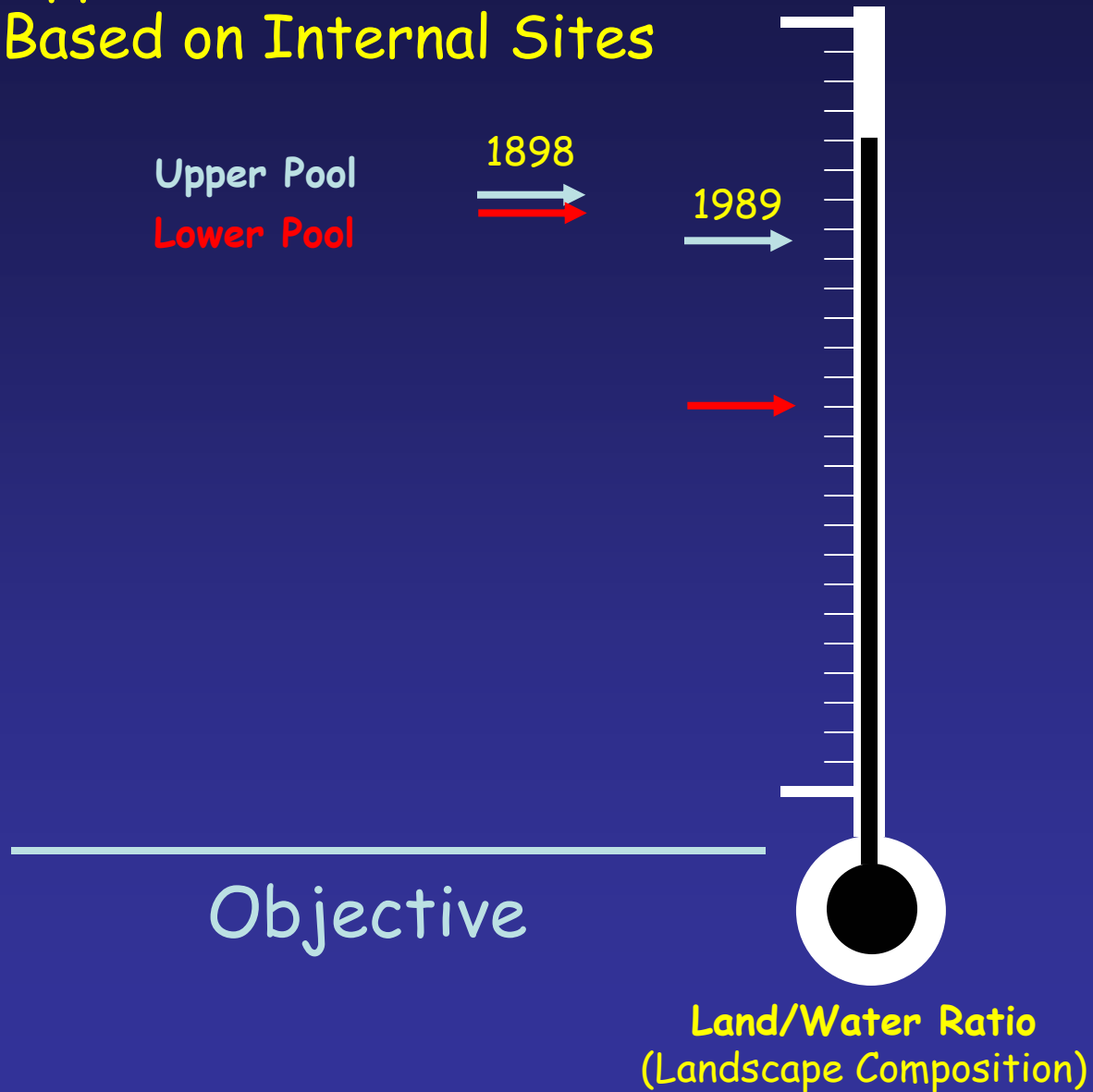
1989



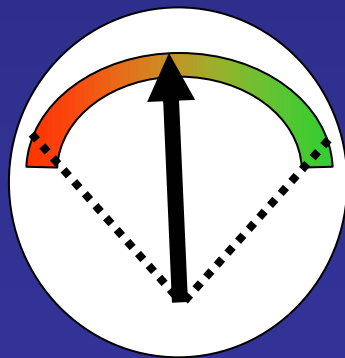
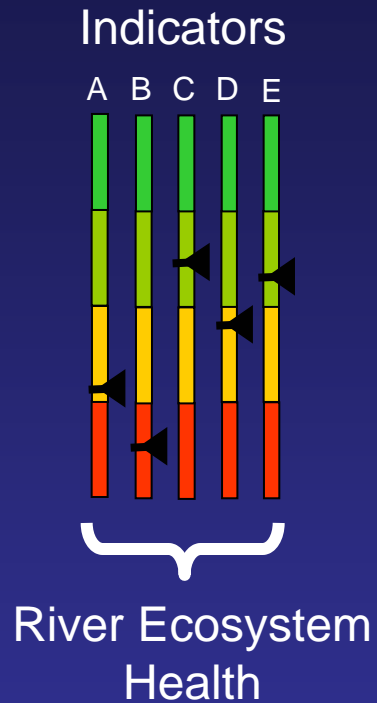
Objective

Land/Water Ratio  
(Landscape Composition)

## Approach 2: Based on Internal Sites



# But what happens when we try to synthesize variables?



mg/l  
+ acres  
+ invasive species  
+ ..  
+ ..

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???

Question #3: Can a Multi-variable approach be Objective?

*"Collective Minimal Standards"?*

# The UMR Navigation-Ecosystem Sustainability Program (N.E.S.P.)

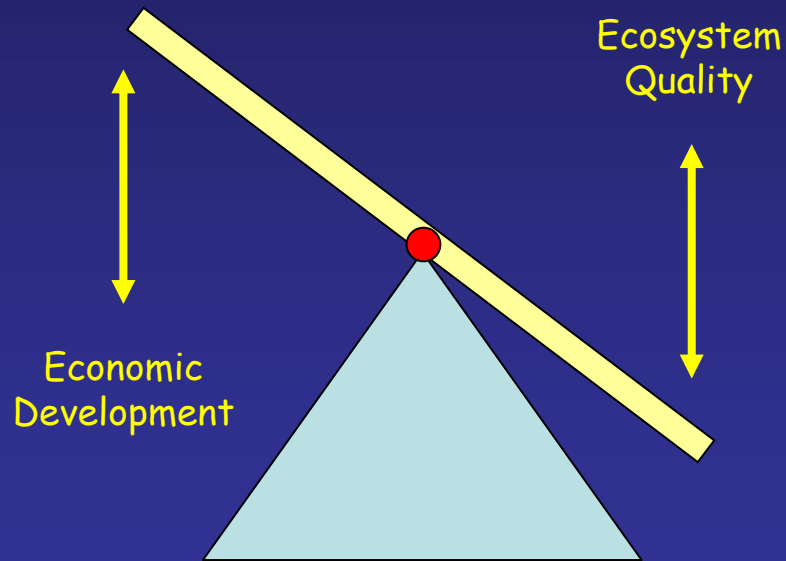
Goal = Economic and Ecosystem Sustainability

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Scope of TNC's Great Rivers Center for Conservation and Learning

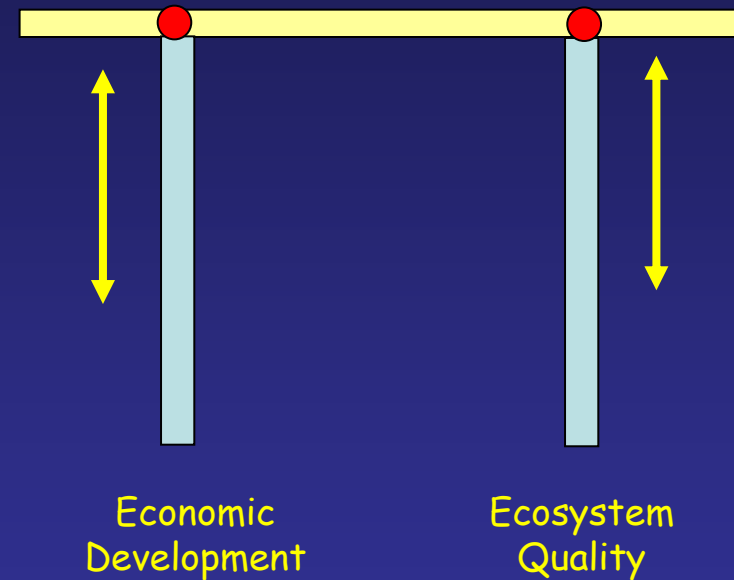
Total  
System Quality =  $f(\text{economy}) + f(\text{ecosystem}) + f(\text{culture})$

# Two Models of Economic/Ecosystem Relationships



(a)

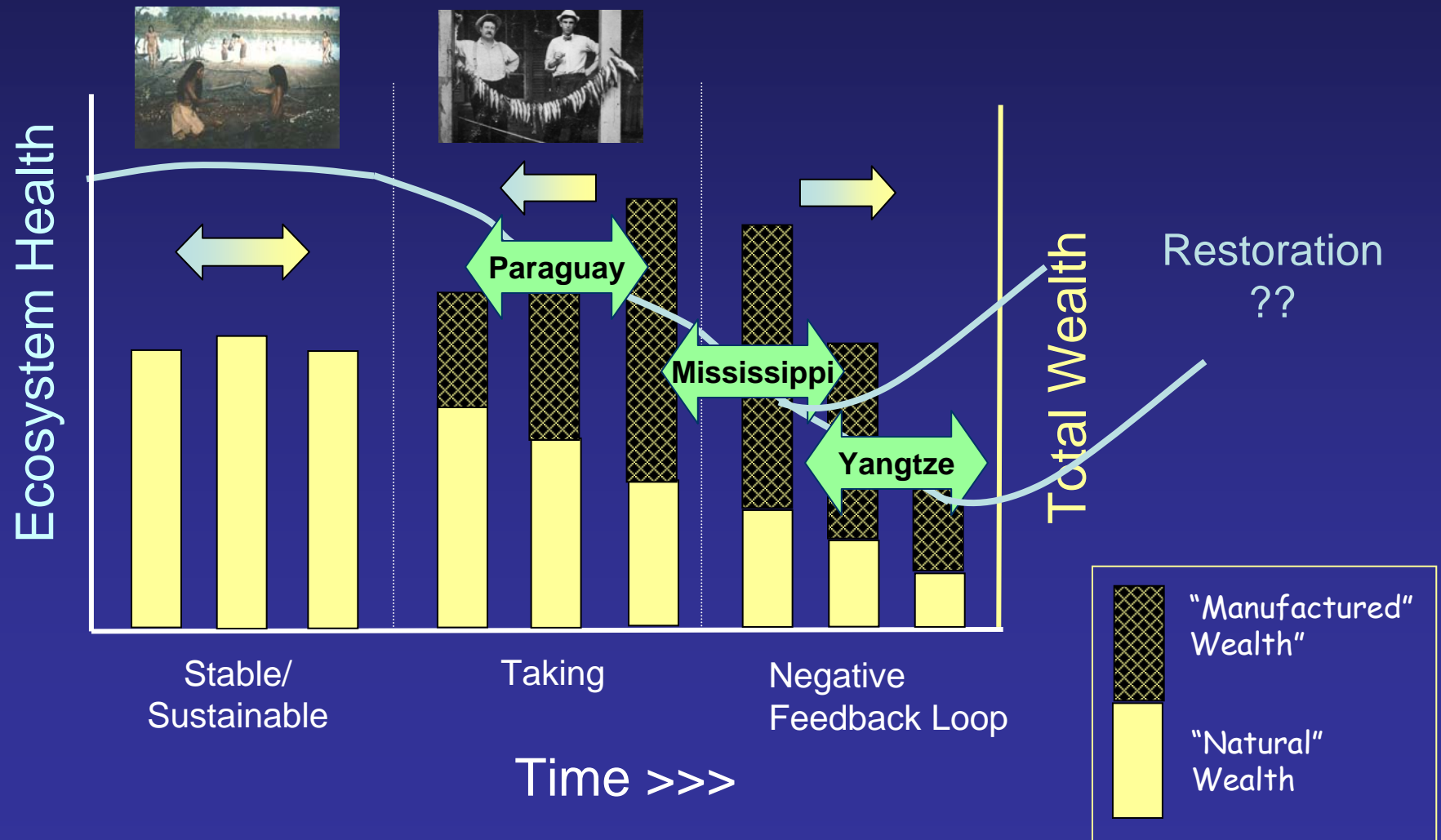
Co-dependency



(b)

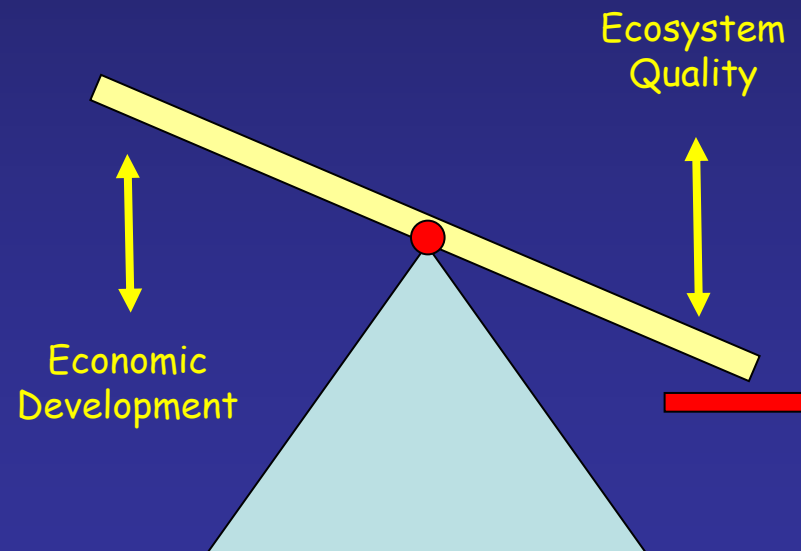
Independency

# Theoretical Health/Wealth Relationships During 3 Stages of Natural Resource Use



## Question #4: Under the co-dependency model -

Don't we have to establish minimally acceptable standards as well as objectives?



## Review of Questions:

1. Do reference conditions have to be **objective**?
2. **How many** variables are necessary to adequately address first principles?
3. Can a **multi-variable approach** be objective?
4. **Minimal standards** as well as objectives?