*A Community on Ecosystem Services*

*December 8-12*, 2014

Washington, DC

# Ecosystem Services and Human Use and Nonuse Losses in NRDA

Dr. Ted Tomasi

Environmental Resources Management

Philadelphia, PA

*The World's Leading Sustainability Consultancy*

ERM

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- Is current NRDA practice (HEA/REA) consistent with an ES perspective?
- To what extent should ES principles be brought into NRDA?
- What should ES analysts learn from NRDA practice?

# NRDA

- Structure, function, services
  - Media to organisms
  - Organism to organism
  - Organism/habitat to people
- Restoration
  - Compensation paid in services
  - Nexus is important
- Legal process
  - Causality
  - Measurable adverse effect

# ES

- Final goods and services
  - Directly valued by people
  - Use values emphasized
  - Non-use recognized
  - Community/social
- Benefit-cost tradition
  - Wide scope for compensation
  - $ values
- Policy/program evaluation context
  - Planning perspective

## Restoration Steps

1. Determine impacts on habitat structure and function relative to baseline
2. Quantify ecological services changes
3. If you have reliable information, measure the change in economic value of services
4. Find restoration that provides PV benefit equivalent to PV loss

## Valuation Steps

1. Determine impacts on habitat structure and function relative to baseline
2. Quantify ecological services changes
3. Measure the change in economic value of services
4. Compare PV benefit to PV costs

# Is HEA/REA Consistent with ES and Economics?

Sometimes

(Restricted Situations)

- Small enough effects
- Small enough changes in baseline over time
- Affected people have similar preferences
- Restoration is "Like for Like"

# Economic Scaling

| | | |
|---|---|---|
| Added over People | | Added over People |
| Added over Time | = | Added over Time |
| Value of Injured Services | | Value of Restored Services |

Injury Debit

Restoration Credit

# Effect of Restrictions

**Added over People**

(Same Preferences)

**Added over Time**

(Small & Constant)

**Value per Unit** (Like-for-Like)

**X**

**Units of Injured Services**

=

**Added over People**

(Same Preferences)

**Added over Time**

(Small & Constant)

**Value per Unit** (Like-for-Like)

**X**

**Units of Restored Services**

Injury Debit

Restoration Credit

# HEA/REA

**Added over Time**

**Units of Injured Services**

=

**Added over Time**

**Units of Restored Services**

Injury Debit

Restoration Credit

# Like-for-Like What?

- Same resource structure or function?
- Same services provided?
  - All Intermediate and final services?
  - Only final services?
- Economic values?

***Required Degree of Match Between Restoration and Injury is Key Factor in Restoration Cost***

# Functions, Services, and Values

- **Ecosystem Structure and Function**
  - Biological, chemical, physical, ecological descriptions and processes
- **Ecological Services**
  - Beneficial outcomes to people
  - Ecological production function relates structural and function (inputs) to services (outputs)
- **Service Values**
  - Economic concept of Willingness-to-Pay (WTP) to have more services
  - Maximal fungibility/substitution

## 1. Structure/Function

Marsh:

Area

Stem density & height

Channels

Sediments

Area

Biological communities

Numbers of fish/birds

## 2. Services

Catching fish

(Catch rate)

Storm surge protection (Houses protected)

Bird watching

Knowing about birds??

## 3. Value

Utility/$$$$

# Like-for-Like – What?

**LfL: Structure and Function**

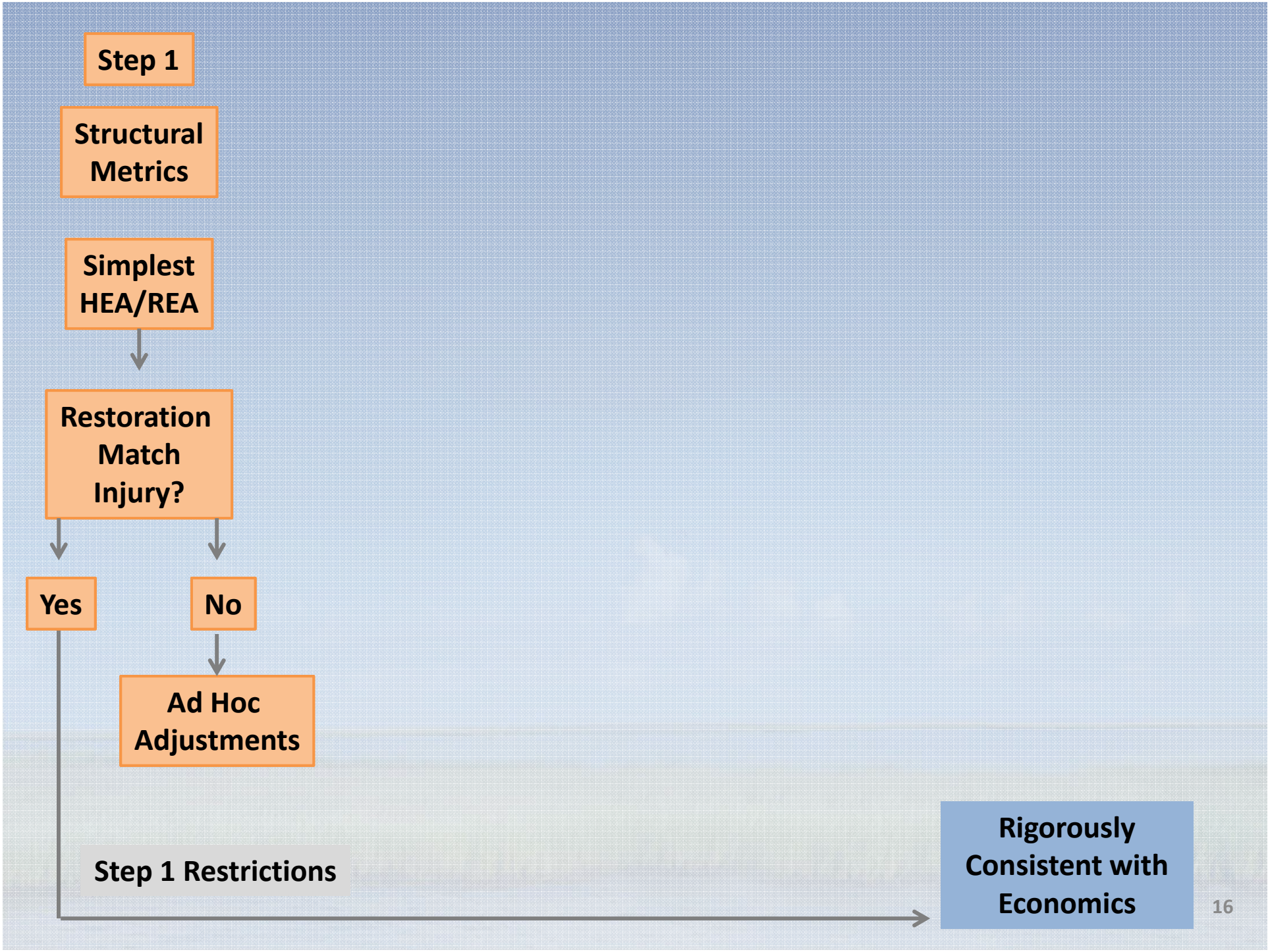
- Limited/no substitution
- Double/under counting
  - Intermediate -v- final services
  - Marsh for fish + marsh for birds + marsh for plants = too much marsh

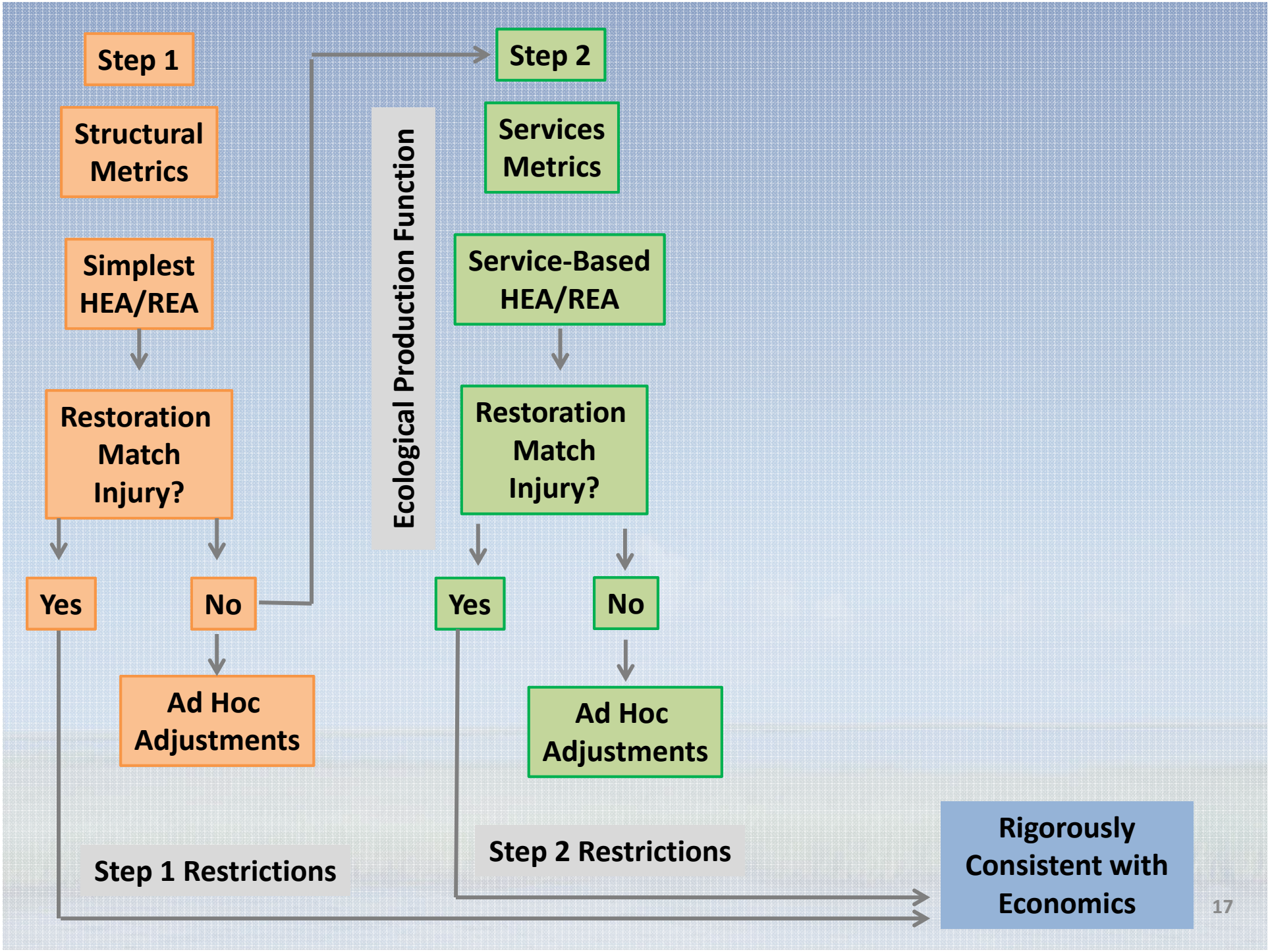
**LfL: Services**

- Basis for substitution
- Basis for eliminating double and under counting

**LfL: Values**

- Done all the time for use values (e.g. recreation)
- Non-use values – mega-problems


Step 1
Structural Metrics
Simplest HEA/REA
Restoration Match Injury?
Yes
No
Ad Hoc Adjustments
Step 1 Restrictions
Rigorously Consistent with Economics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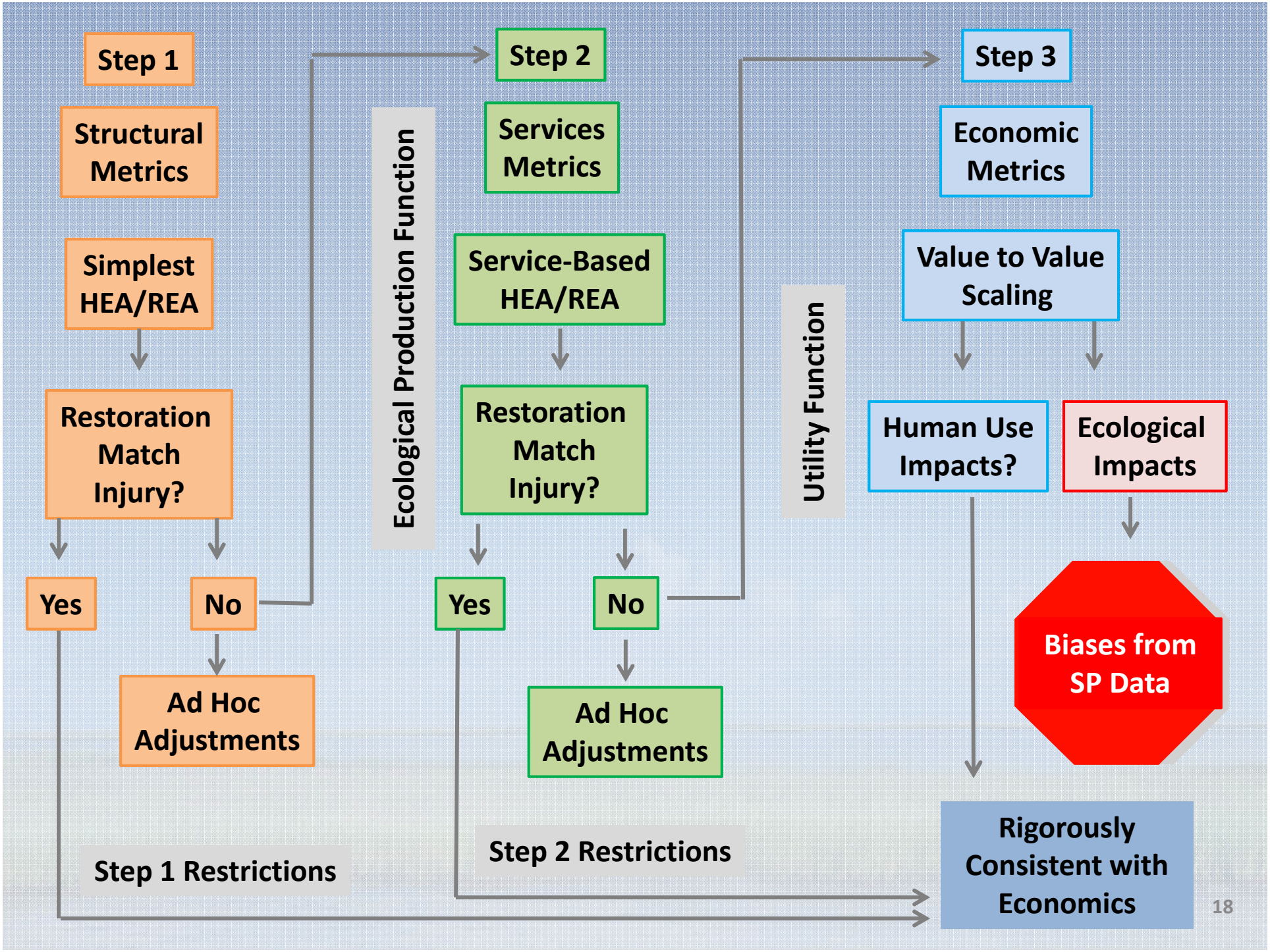
Restoration Match Injury?
Yes
No
Ad Hoc Adjustments
Step 1 Restrictions
Ecological Production Function
Step 2
Services Metrics
Service-Based HEA/REA
Restoration Match Injury?
Yes
No
Ad Hoc Adjustments
Step 2 Restrictions
Rigorously Consistent with Economics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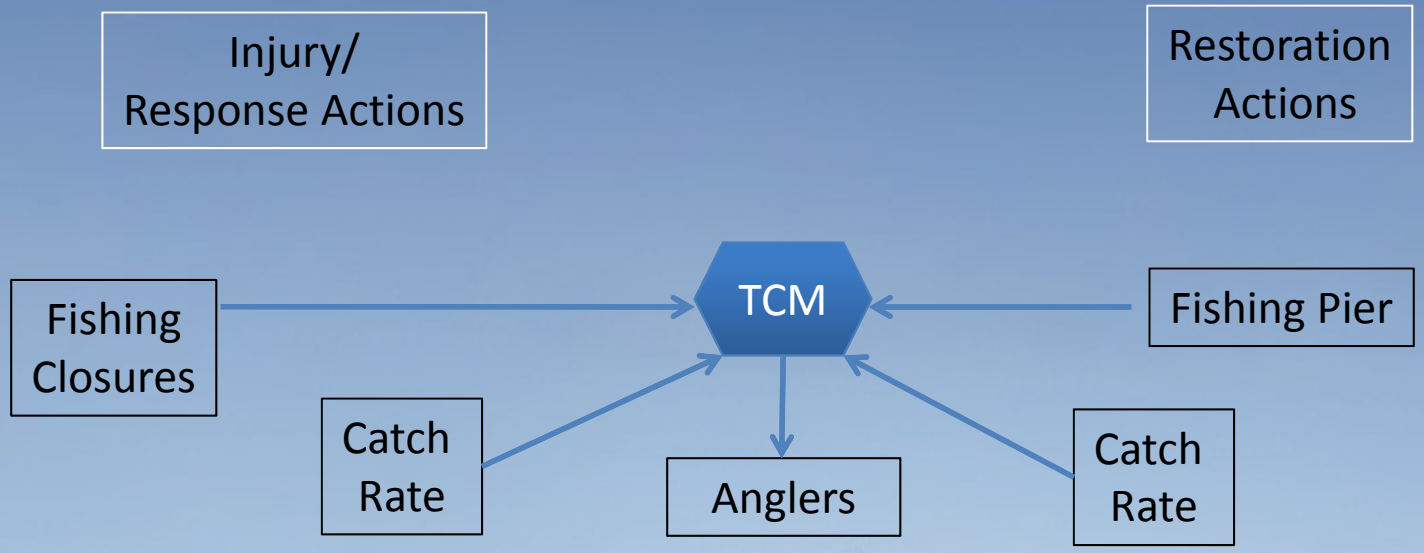
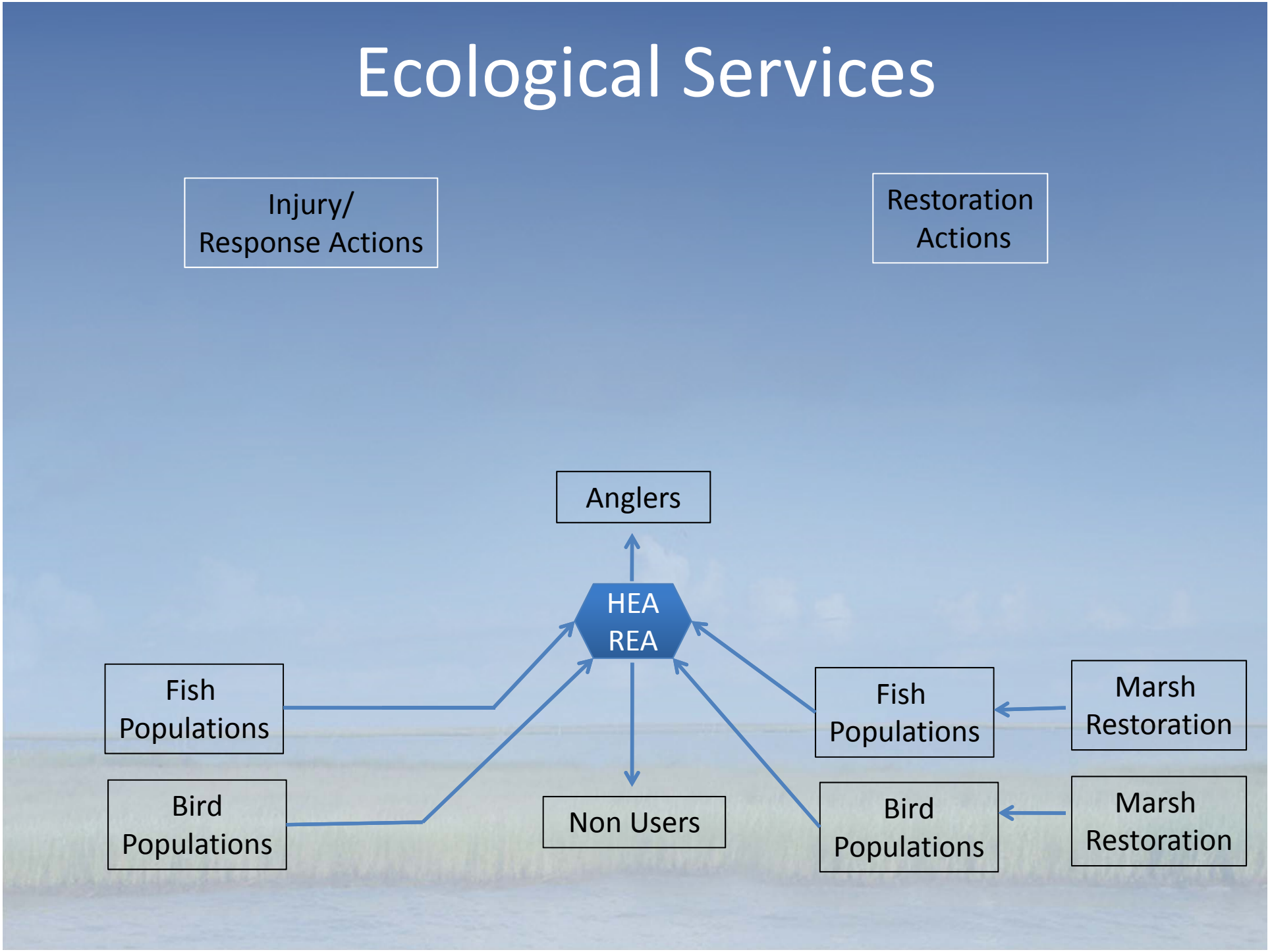
Utility Function
Step 3
Economic Metrics
Value to Value Scaling
Human Use Impacts?
Ecological Impacts
Biases from SP Data
Rigorously Consistent with Economics

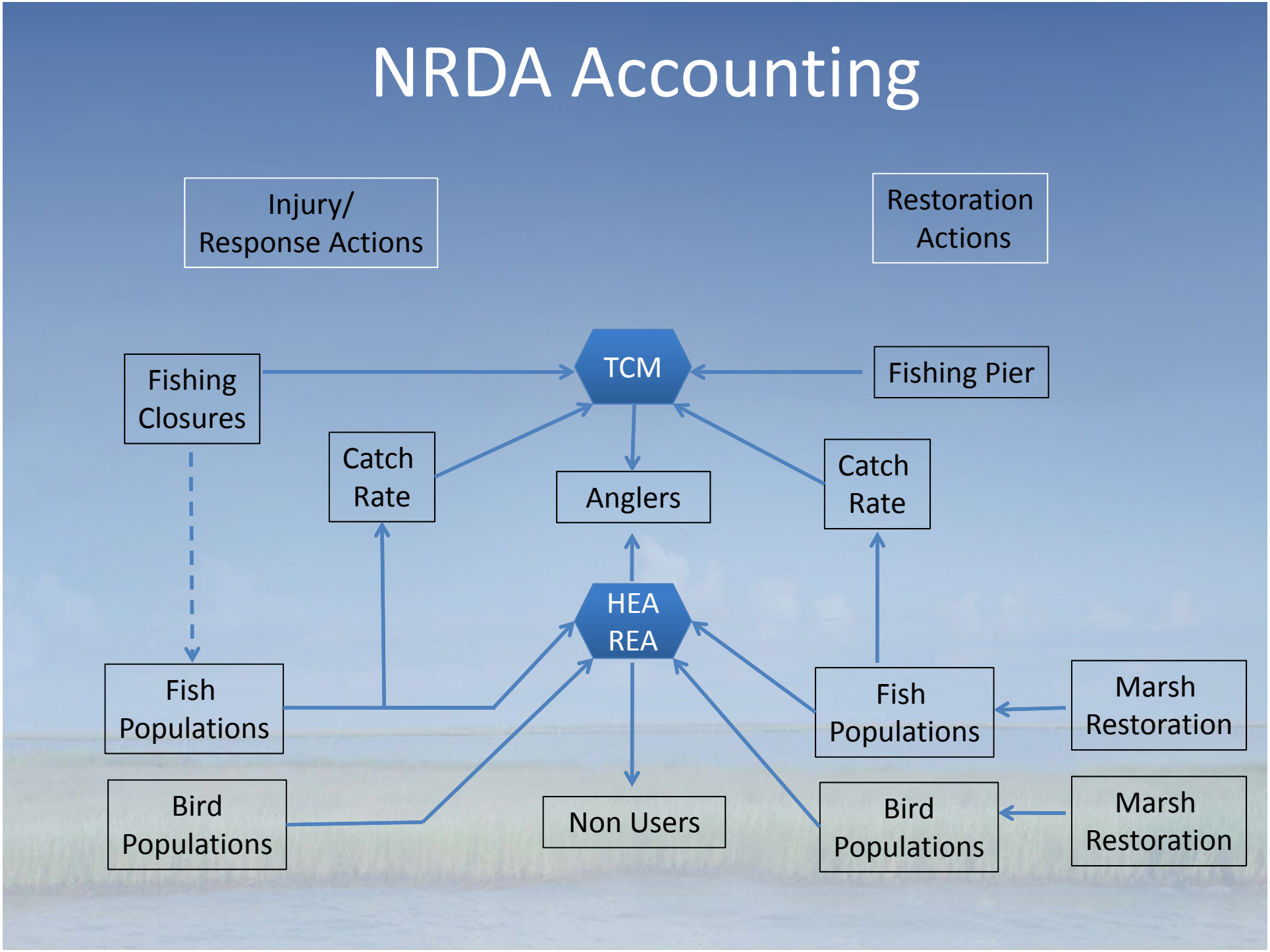
# Human Use Services



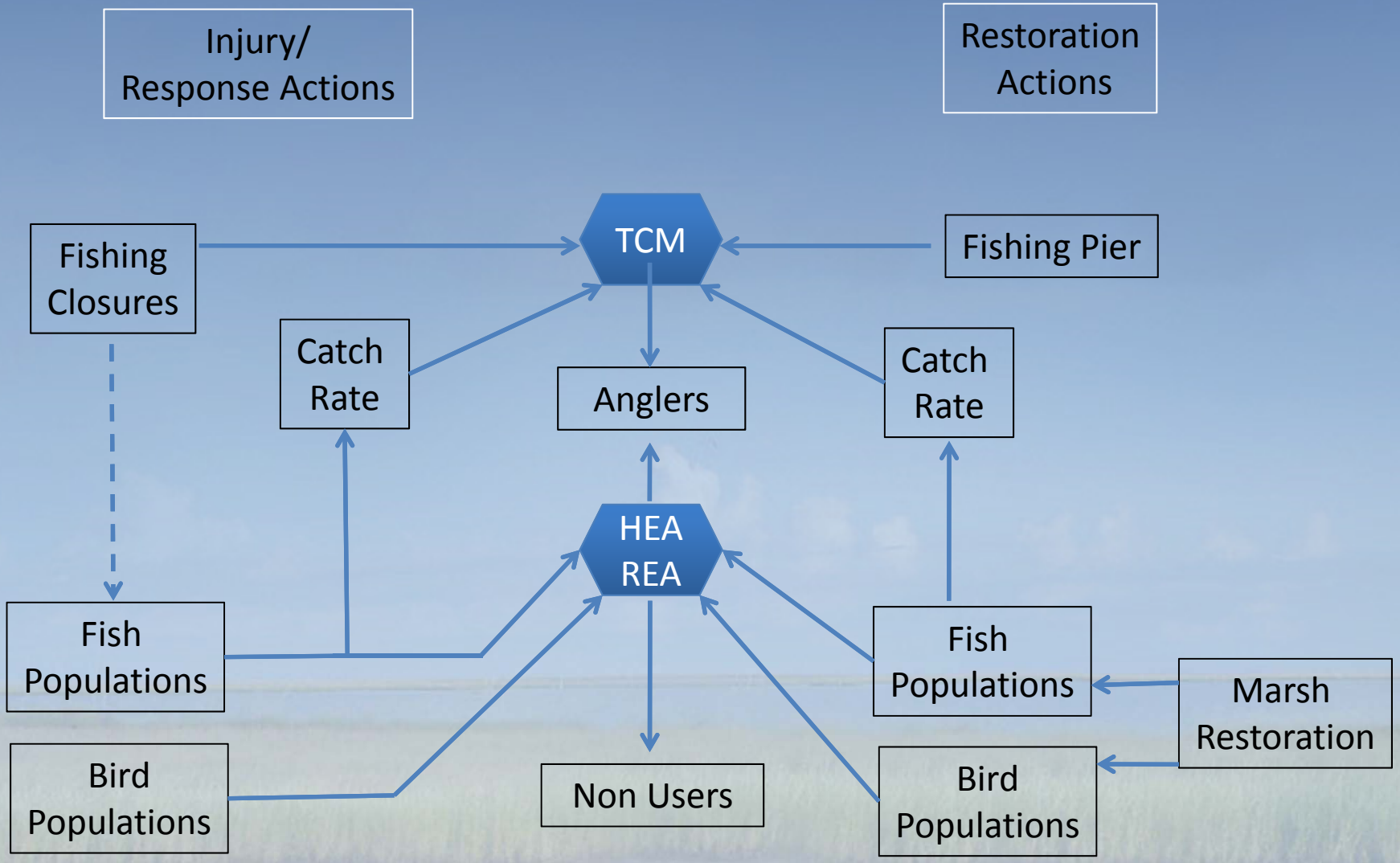
# Ecological Services



# NRDA Accounting



# Blended Approach



# We Don't Know *Exactly* What a HEA DSAY is

BUT

We May Know *Enough* to Resolve NRD Cases

AND

We May be Minimizing Errors *relative to* Valuations for Non-Use Values

USING

In-Kind Compensation

Not Monetization

# Complex Measurement Needs a Coherent Conceptual Framework

***"He who loves practice without theory is like the sailor who boards ship without a rudder and compass and never knows where he may be cast."***

*Leonardo da Vinci*