Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation
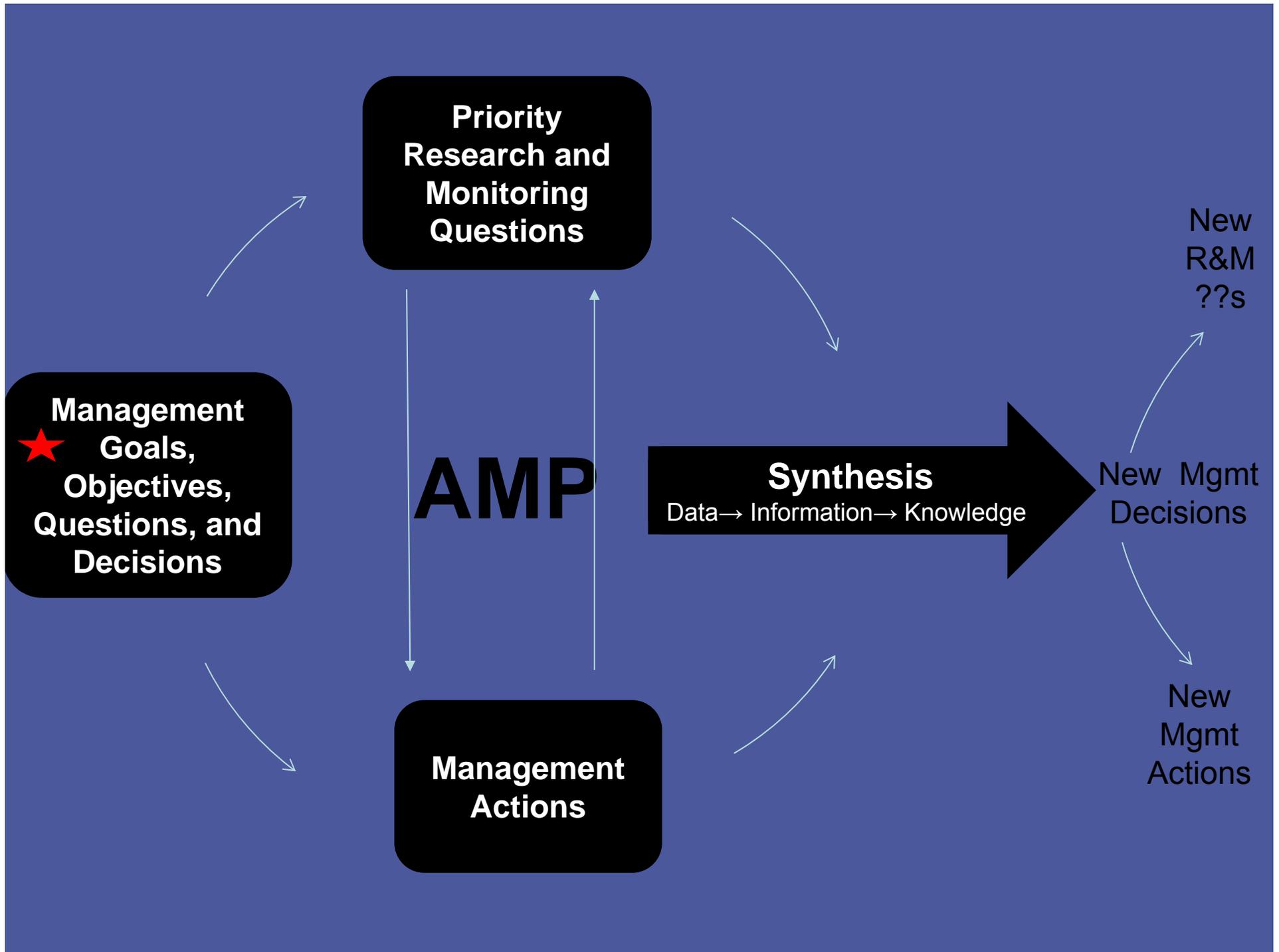
LCR MSCP
Adaptive Management
Conceptual Ecological Models
March 12, 2014

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Why do we need CEMs

- Create an explicit link between the <u>science</u> activities and restoration <u>site management</u>

- A framework for meeting LCR MSCP's conservation measures

Big Picture

- Species Conceptual Ecological Models
  - Identify what is known and what needs to be known based on current conditions and <u>management</u>
- Evaluate multiple species models at a LCR MSCP CA
  - Identify the multi-species constraints and the site constraints given the goals of the HCP.

Conceptual Ecological Models in Adaptive Management

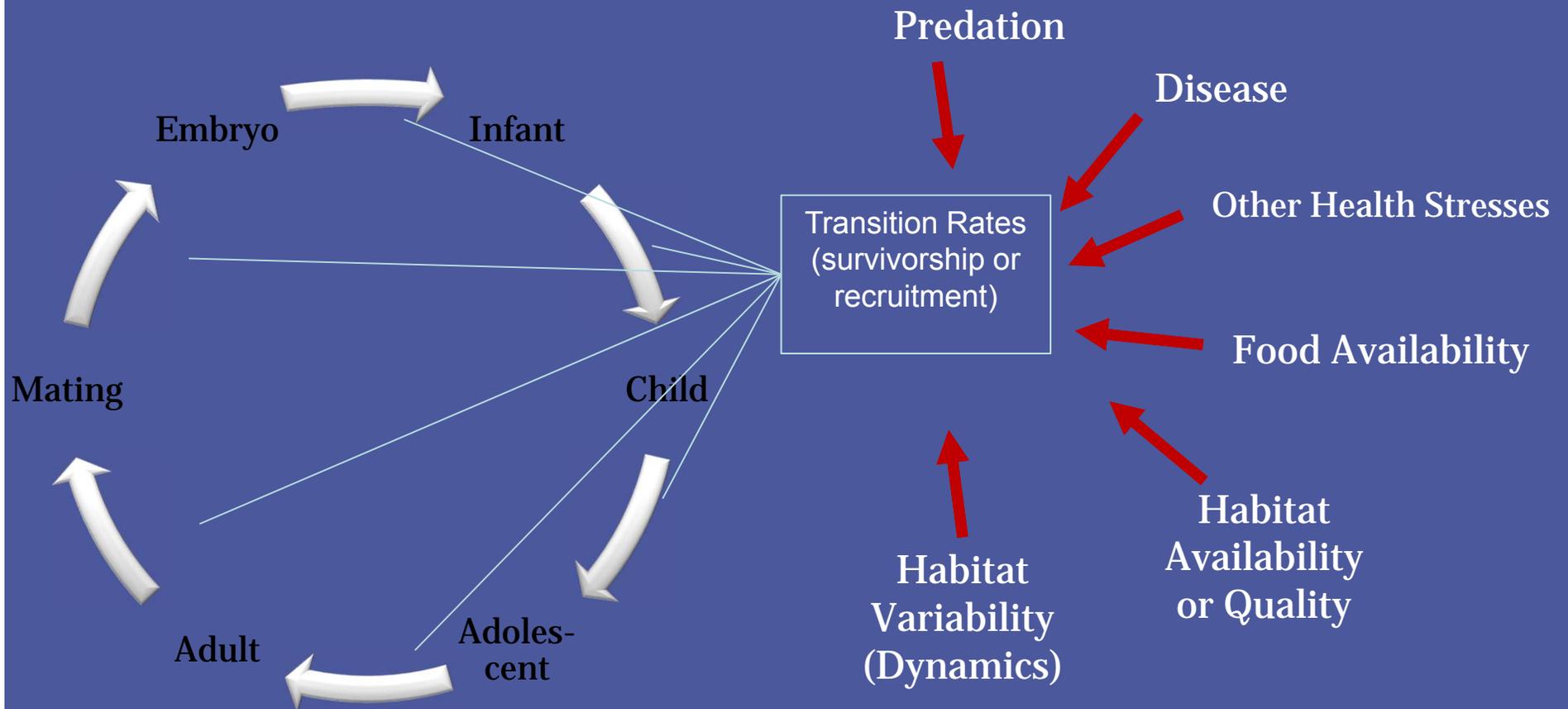**Conceptual Ecological Models for Managed Species or Ecosystems Summarize...**

- What is known, with what certainty
- Critical areas of uncertain or conflicting science
- Crucial components of species/system and environment to monitor
- How we expect the species/system to change in response to:
  - Management actions
  - Other factors

Conceptual Ecological Models in Adaptive Management

Conceptual Ecological Models ...
- Identify monitoring needs
- Identify crucial knowledge gaps to fill
- Identify crucial hypotheses demanding testing
- Provide a framework for identifying potential management experiments to ...
  - Improve resource condition
  - Increase knowledge of how resource "works"
- Are crucial tools for working in "novel" ecosystems

Species Life History: Natural Stresses

Embryo

Infant

Mating

Child

Adult

Adoles-cent

Predation

Disease

Other Health Stresses

Transition Rates (survivorship or recruitment)

Food Availability

Habitat Variability (Dynamics)
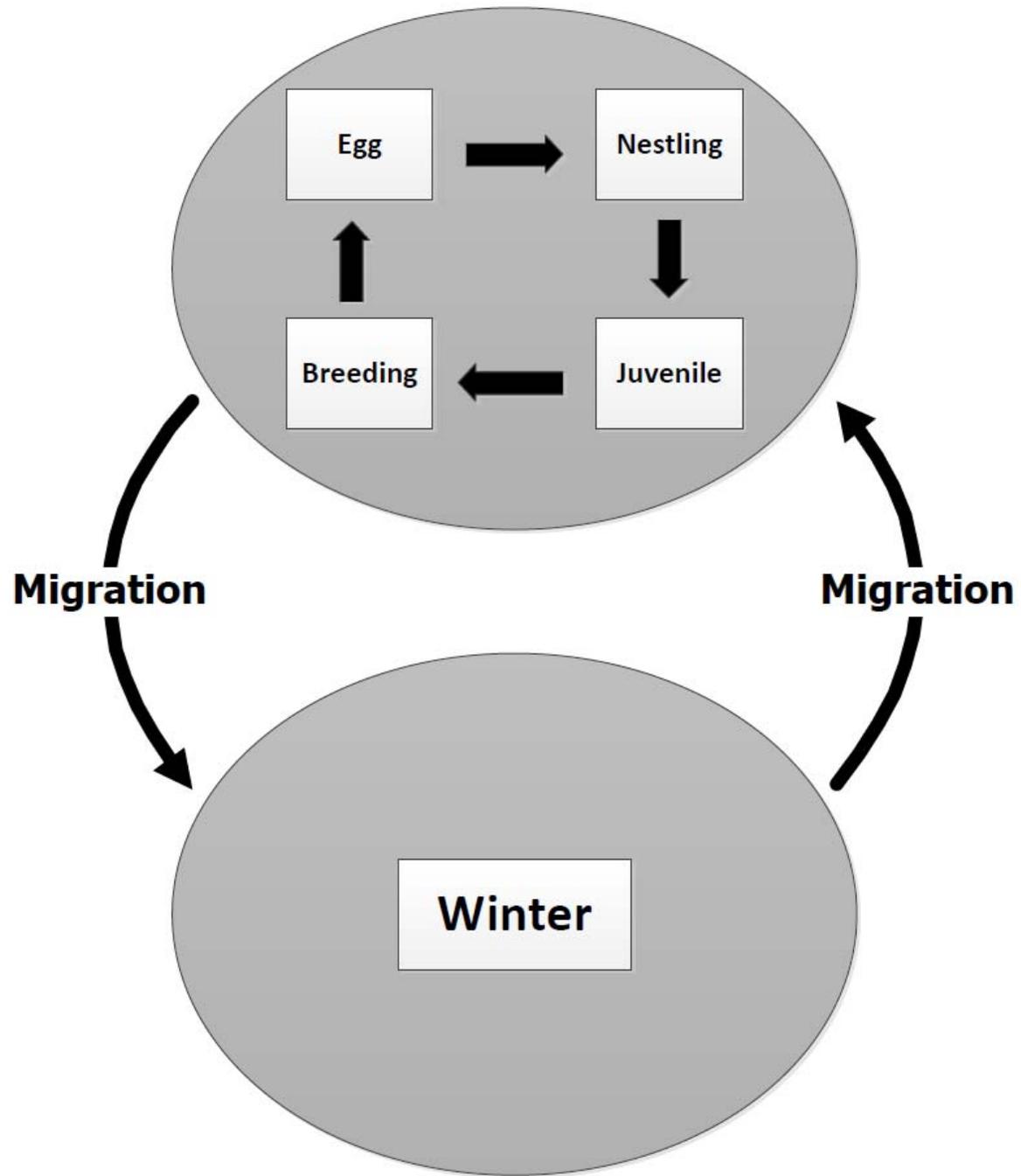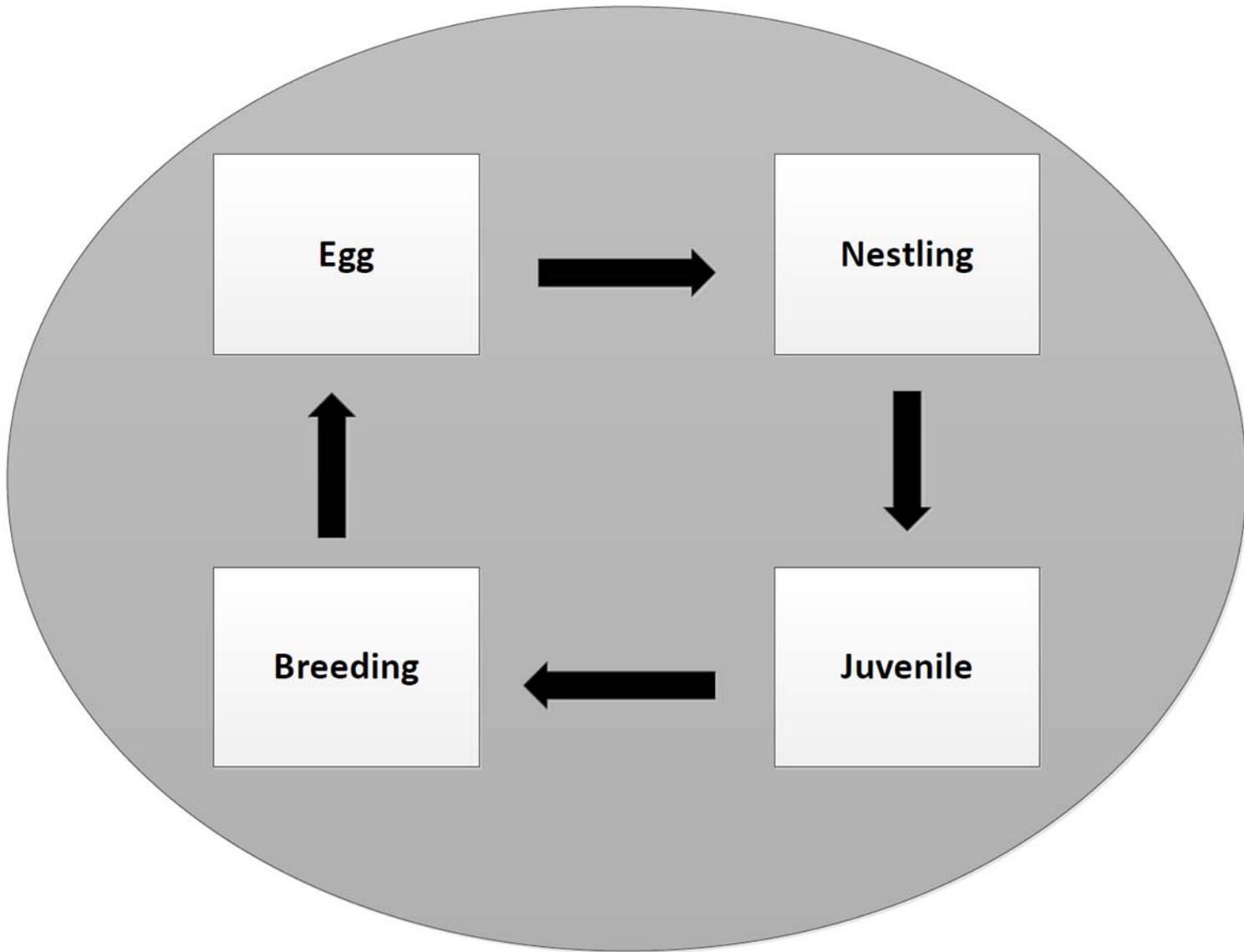
Habitat Availability or Quality

SWFL and YBCU

Photo by SSRS

Critical Biological Activities & Processes

- **Consist of**
  - **Activities in which a species _must_ engage to sustain an acceptable rate of transition**
  - **Biological processes that critically shape the rate of transition (+ or –)**

Activities & Processes

Pesticide Application

Mainstem Water Storage-Delivery Management

Fire Management

Grazing

Mechanical Thinning

Natural Thinning

Planting Regime

Nuisance Species Introduction & Management

Local Hydrology

Food Availability

Brood Size | Temperature | Humidity | Patch Size | Linear Width | Community Type | Understory Density | Predator Density | Canopy Cover | Tree Density | Matrix Community

Previous Year's Use

Anthropogenic Disturbance

Distance to Occupied Patch

Genetic Diversity, and Infectious Agents

Foraging

Nest Attendance

Nest Site Selection

Temperature regulation

Predation

Disease

Fecundity

Survival

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Critical Habitat Elements

- Specific habitat conditions that…
  - Are necessary or sufficient for the critical activities and processes to take place, or…
  - Can interfere with these critical activities and processes

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Patch-scale

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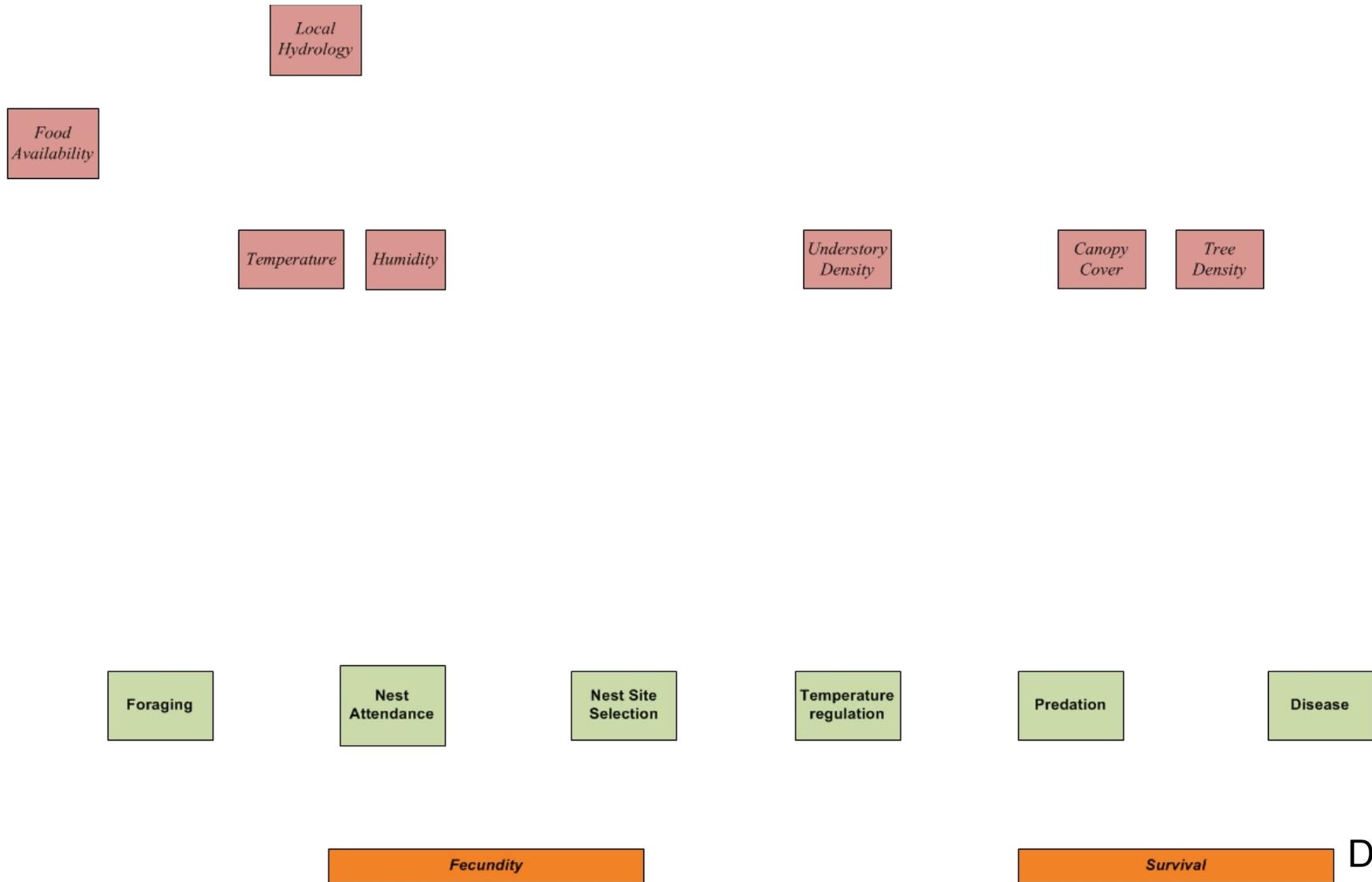
Temperature regulation

Predation

Disease

Fecundity

Survival

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Microclimate

Local Hydrology

Food Availability

Temperature

Humidity

Understory Density

Canopy Cover

Tree Density

Foraging

Nest Attendance

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Other factors

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Controlling Factors

- **Environmental conditions and dynamics that determine the abundance, spatial and temporal distribution, and quality of key habitat elements**
- **Includes natural and anthropogenic factors**

Pesticide Application | Mainstem Water Storage-Delivery Management | Fire Management | Grazing | Mechanical Thinning | Natural Thinning | Planting Regime | Nuisance Species Introduction & Management

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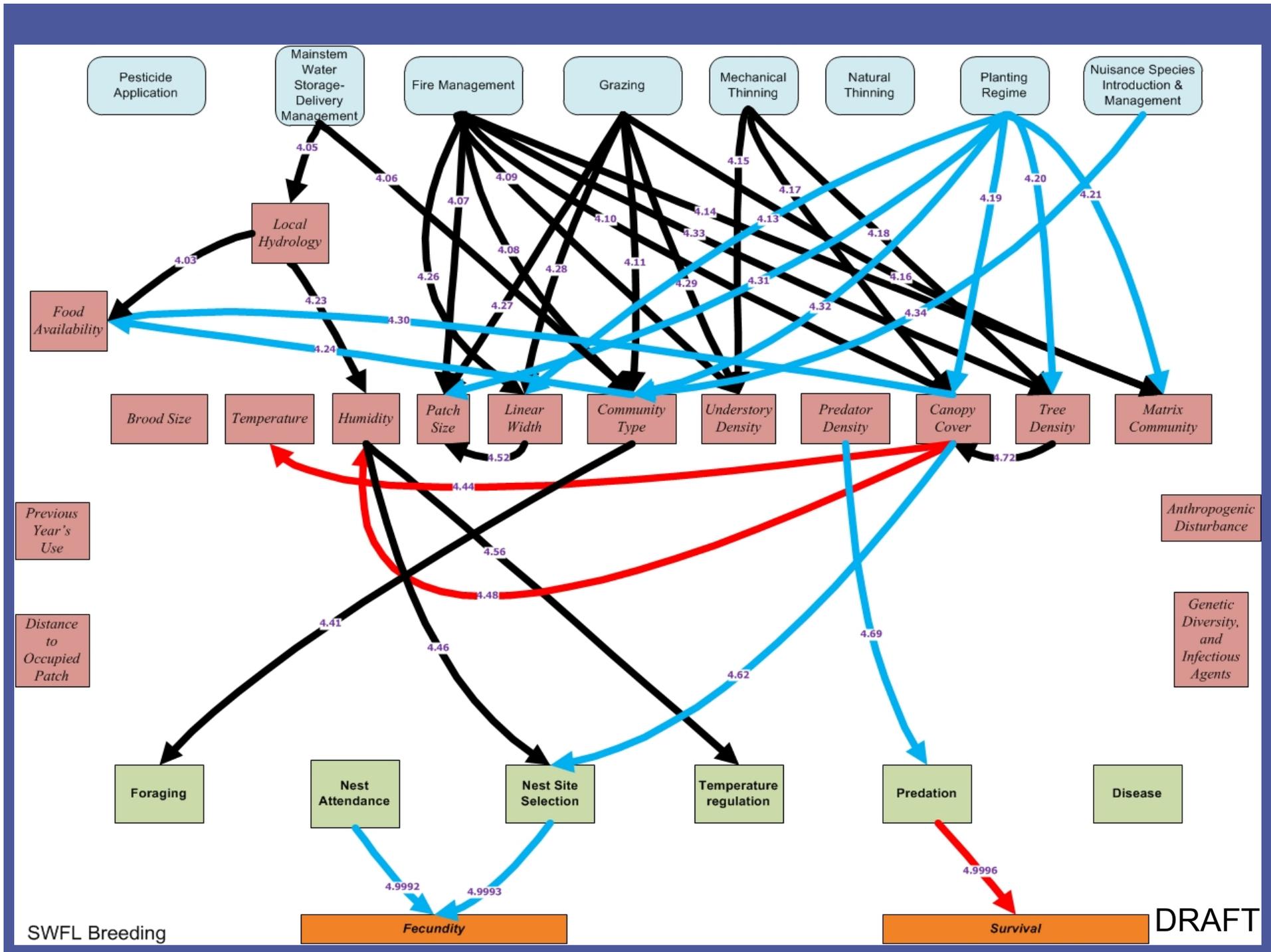Foraging | Nest Attendance | Nest Site Selection | Temperature regulation | Predation | Disease

Fecundity | Survival

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Causal Relationships (linkages)

- **Distribution, abundance, condition, or rate of affected node depends on distribution, abundance, condition, or rate of causal node**
- **Form "causal chains" and "webs"**
- **Identifies _direct_ relationships**

Linkage magnitudes

- High-magnitude Links
  - **Low understanding (thick red)**
  - **Medium understanding (thick blue)**
  - **High-understanding (thick black)**
- Medium-magnitude Links
  - **Low understanding (medium red)**
  - **Medium understanding (medium blue)**
  - **High-understanding (medium black)**

Linkage magnitudes cont.

- Low-magnitude Links
  - Low-understanding (thin red)
  - Medium-understanding (thin blue)
  - High-understanding (thin black)
- Unknown-magnitude Links
  - *Low-understanding (thin gray)*

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SWFL Breeding

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SWFL Breeding

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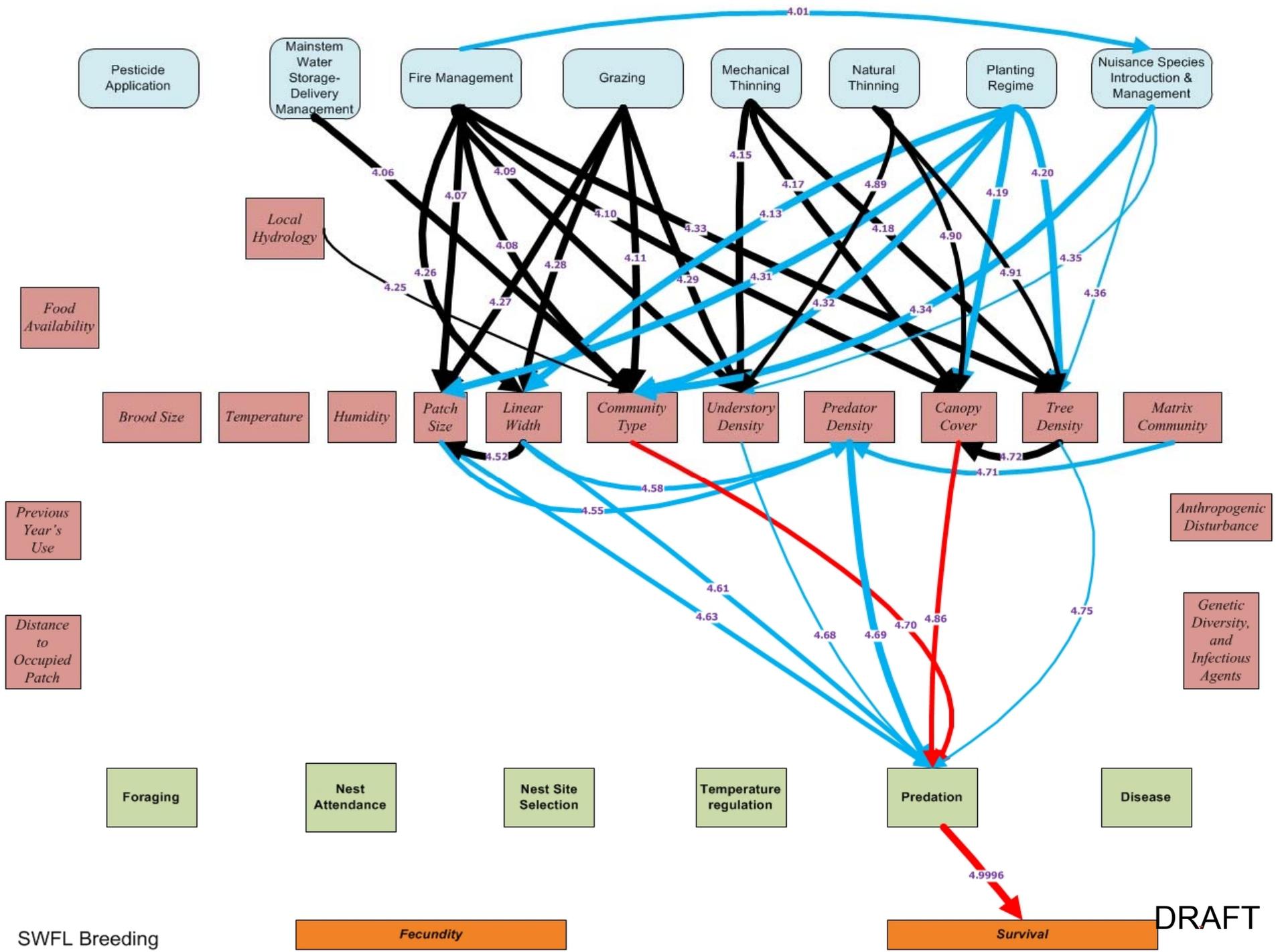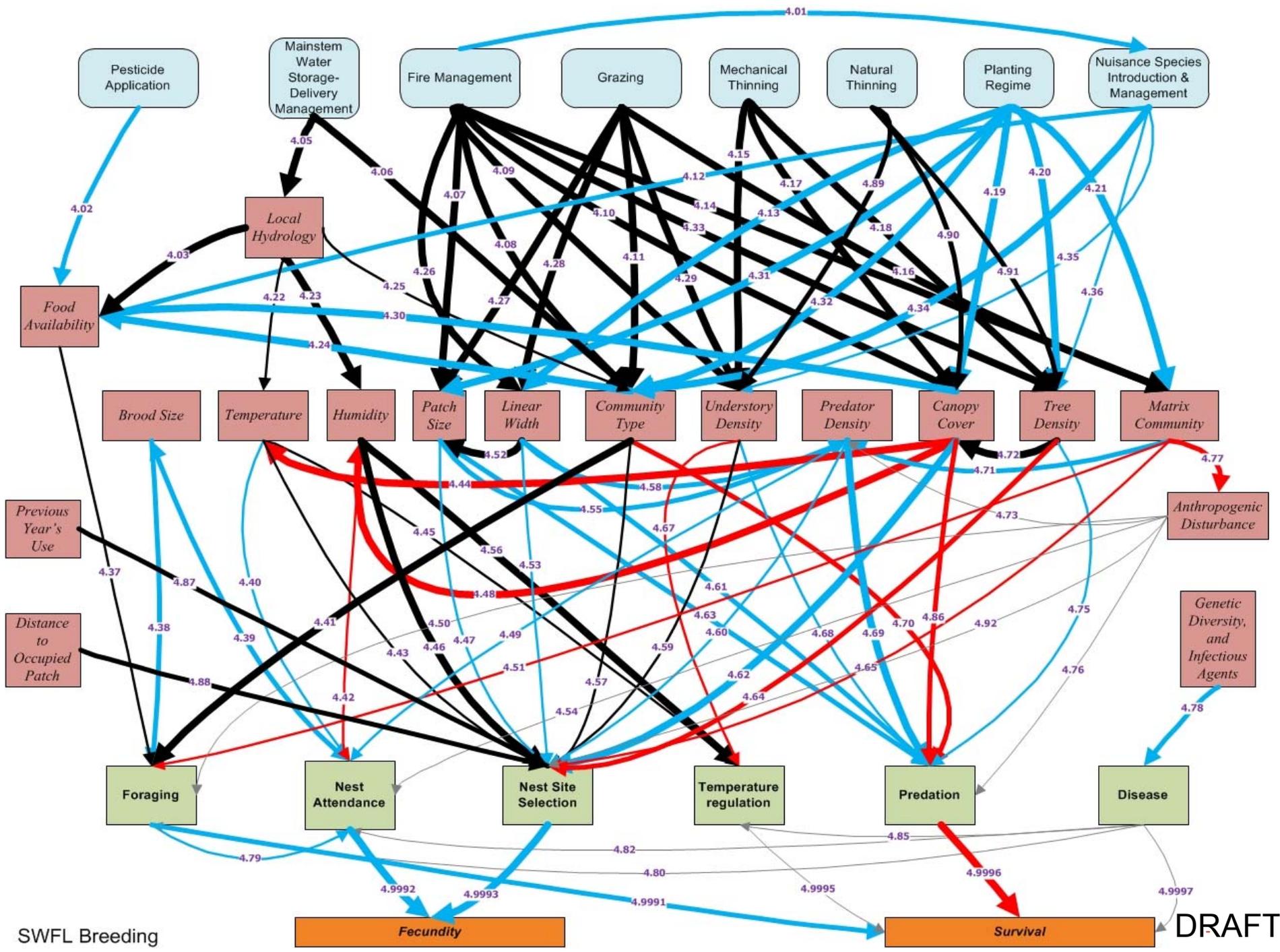
SWFL Breeding

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SWFL Breeding
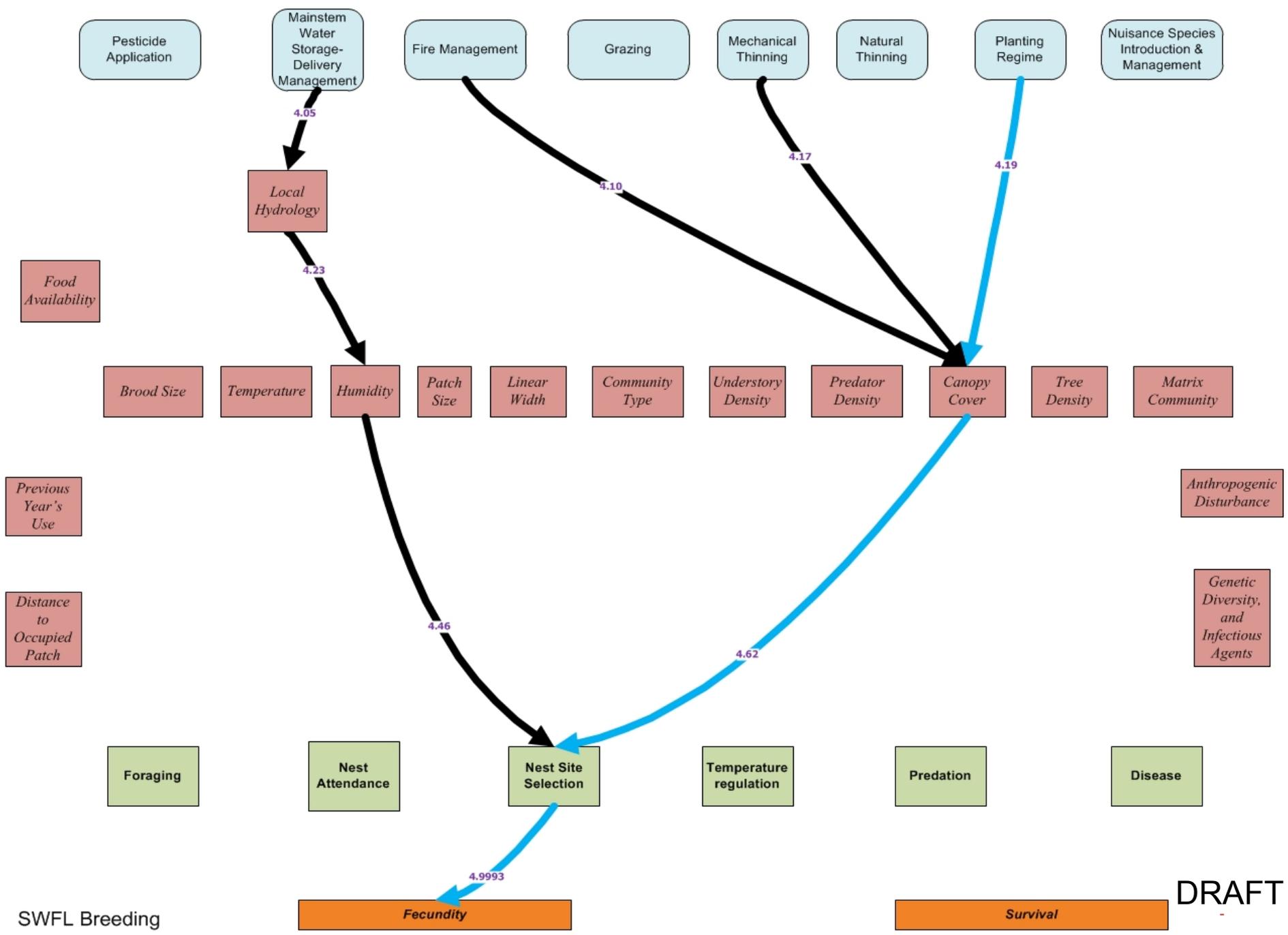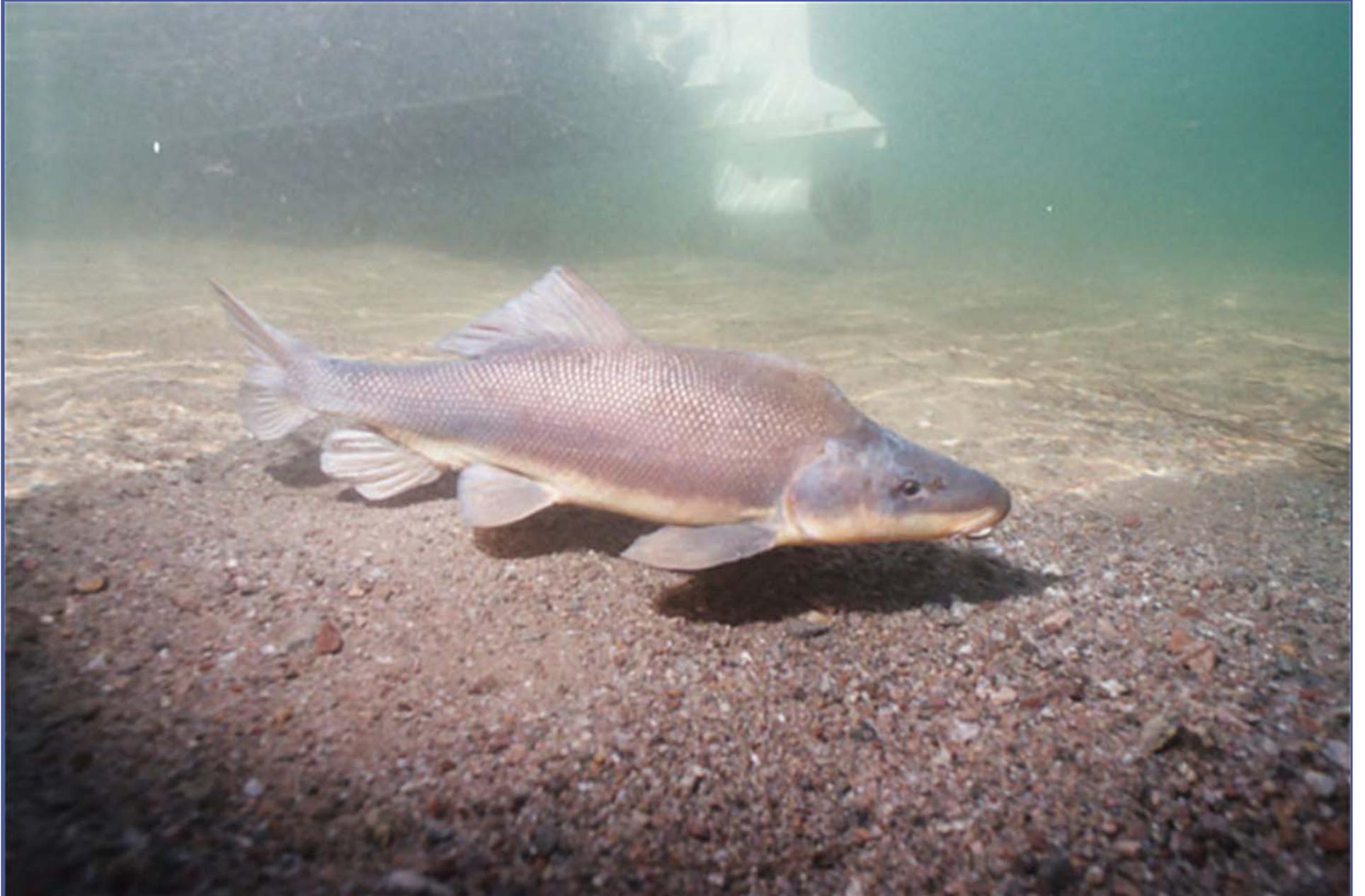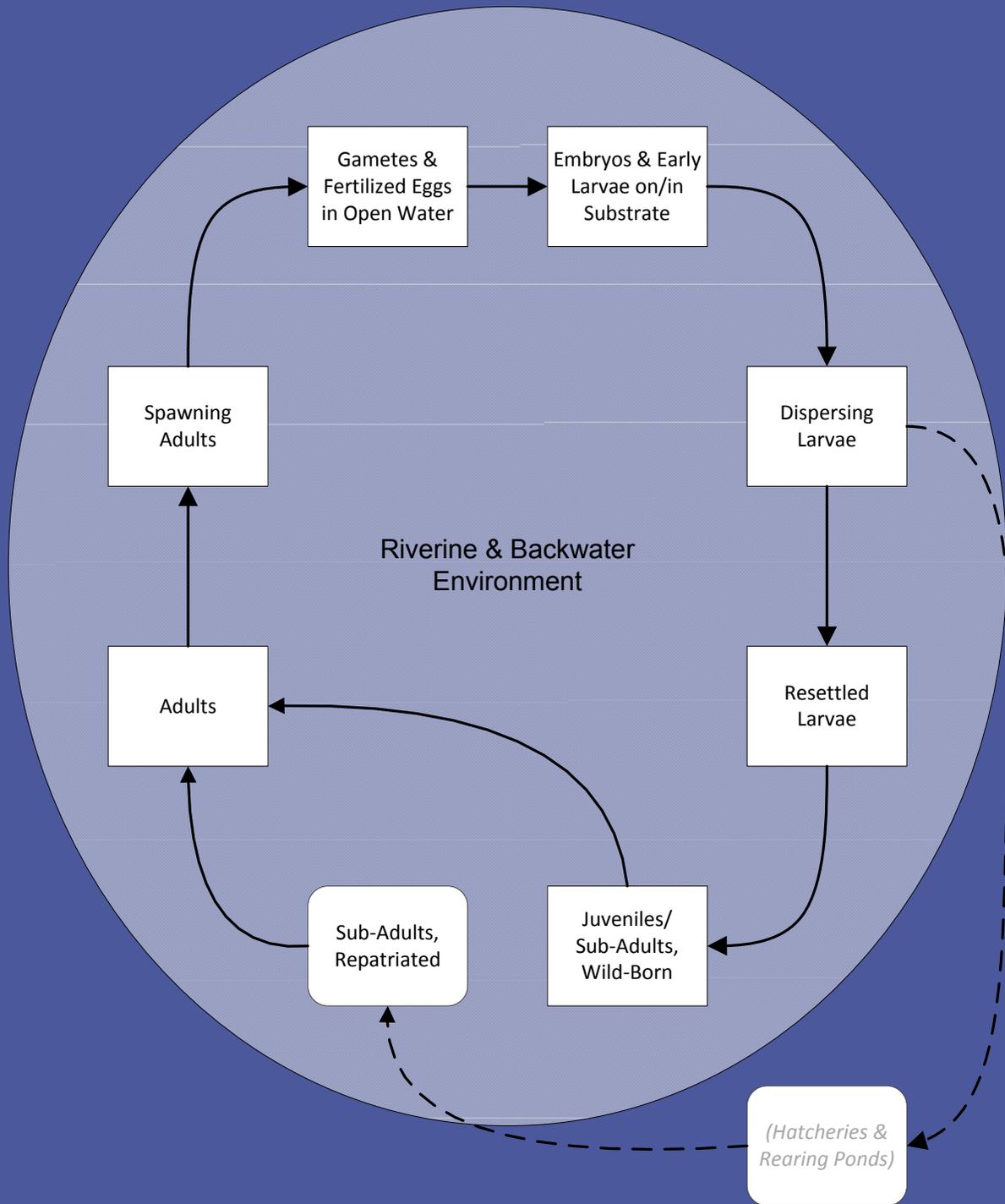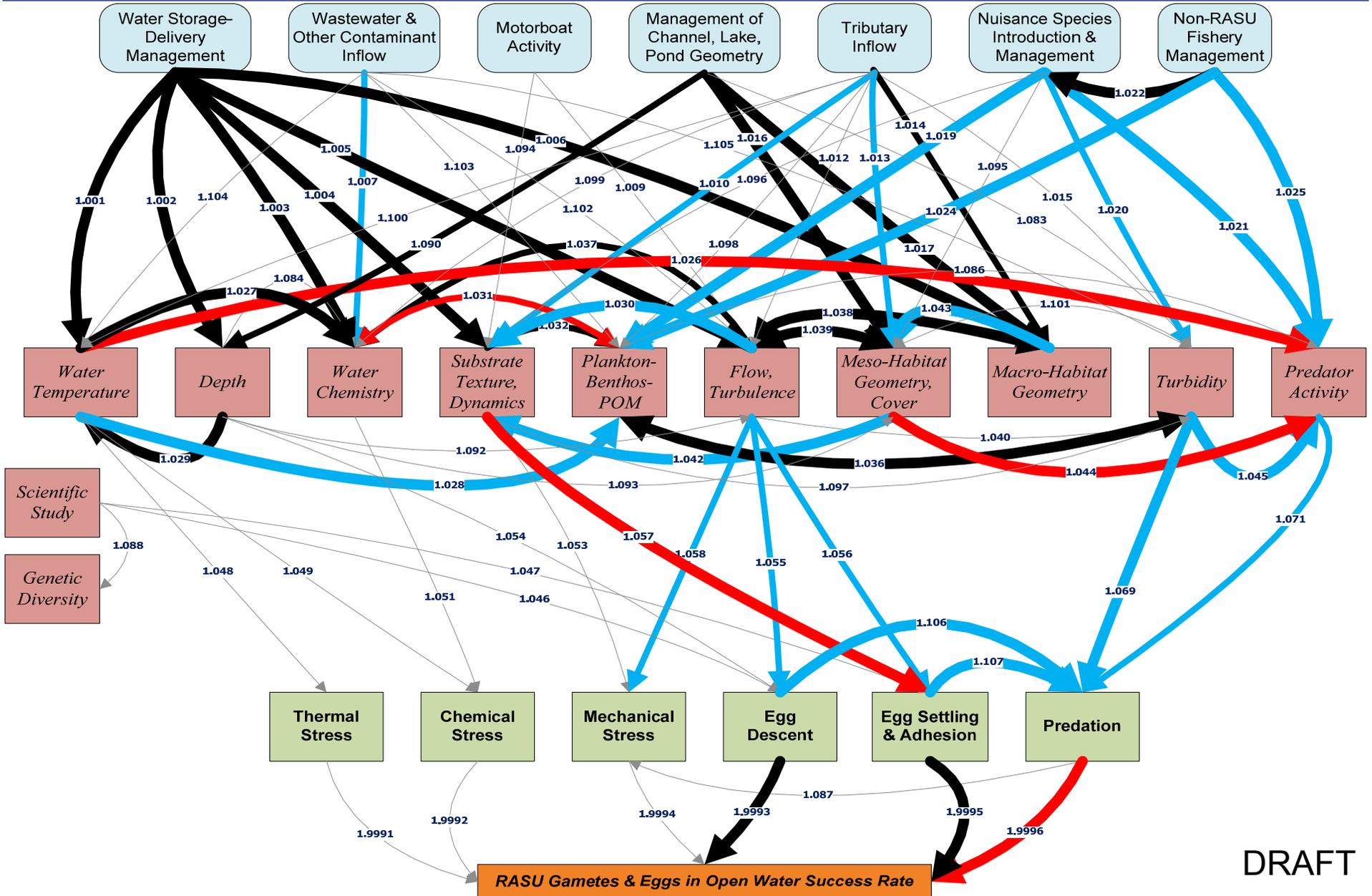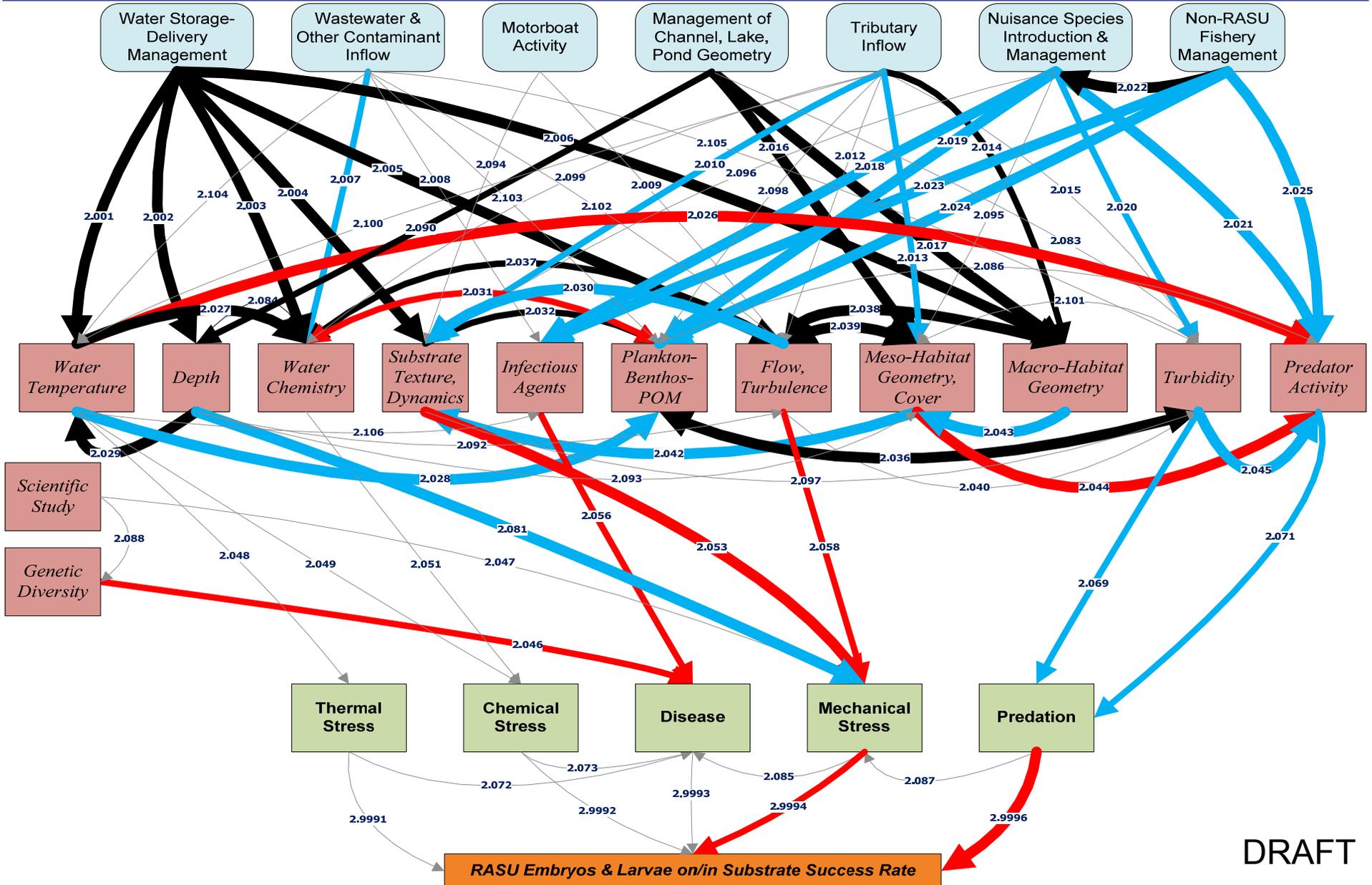
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SWFL Breeding

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SWFL Breeding

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4.05

Local Hydrology

4.23

Food Availability

4.10

4.17

4.19

Brood Size

Temperature

Humidity

Patch Size

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Distance to Occupied Patch

Genetic Diversity, and Infectious Agents

4.46

4.62

Foraging

Nest Attendance

Nest Site Selection

Temperature regulation

Predation

Disease

4.9993

Fecundity

Survival

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Anthropogenic Disturbance

Patch Phenology

Genetic Diversity, and Infectious Agents

Foraging

Nest Attendance

Nest Site Selection

Molt

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YBCU Breeding

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4.05

4.06

4.07

4.08

4.10

4.11

4.13

4.17

4.18

4.19

4.20

4.26

4.27

4.28

4.31

4.32

4.33

4.34

Local Hydrology

Food Availability

4.23

Brood Size

Temperature

Humidity

Patch Size

Linear Width

Community Type

Understory Density

Predator Density

Canopy Cover

Tree Density

Matrix Community

4.52

4.72

4.90

Anthropogenic Disturbance

Patch Phenology

4.46

4.47

4.57

4.62

Genetic Diversity, and Infectious Agents

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4.9993

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Braun et al. 2014
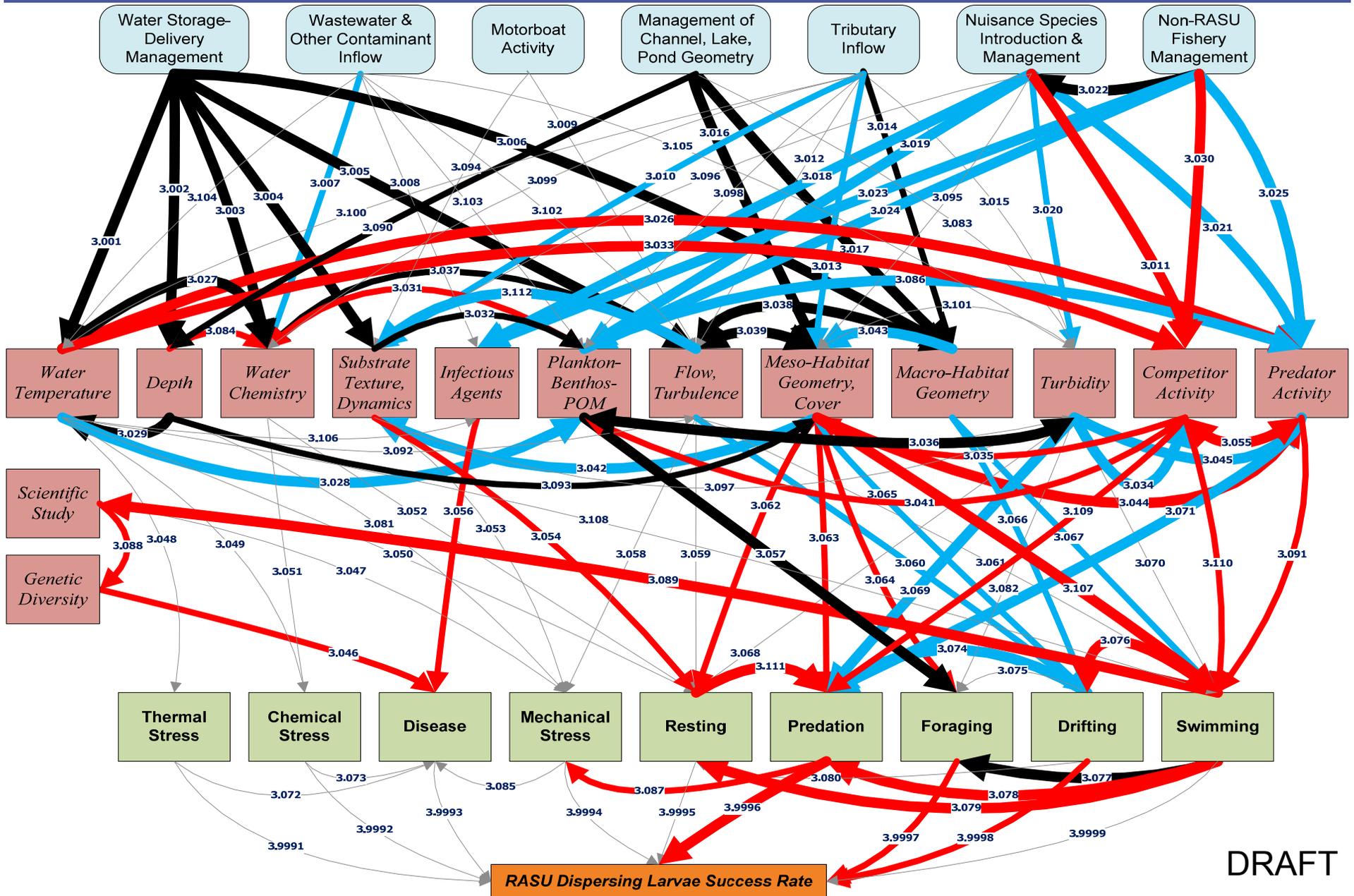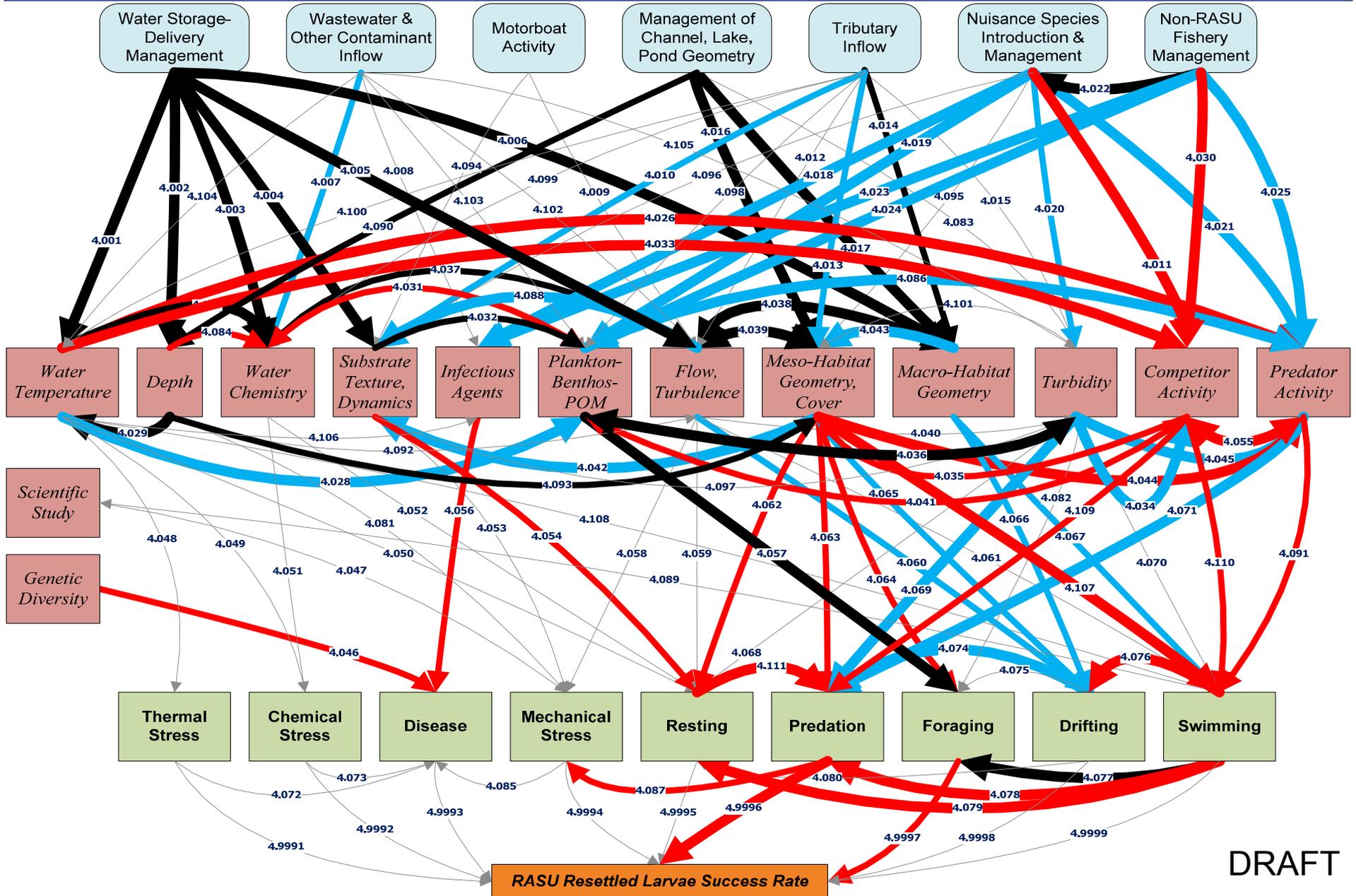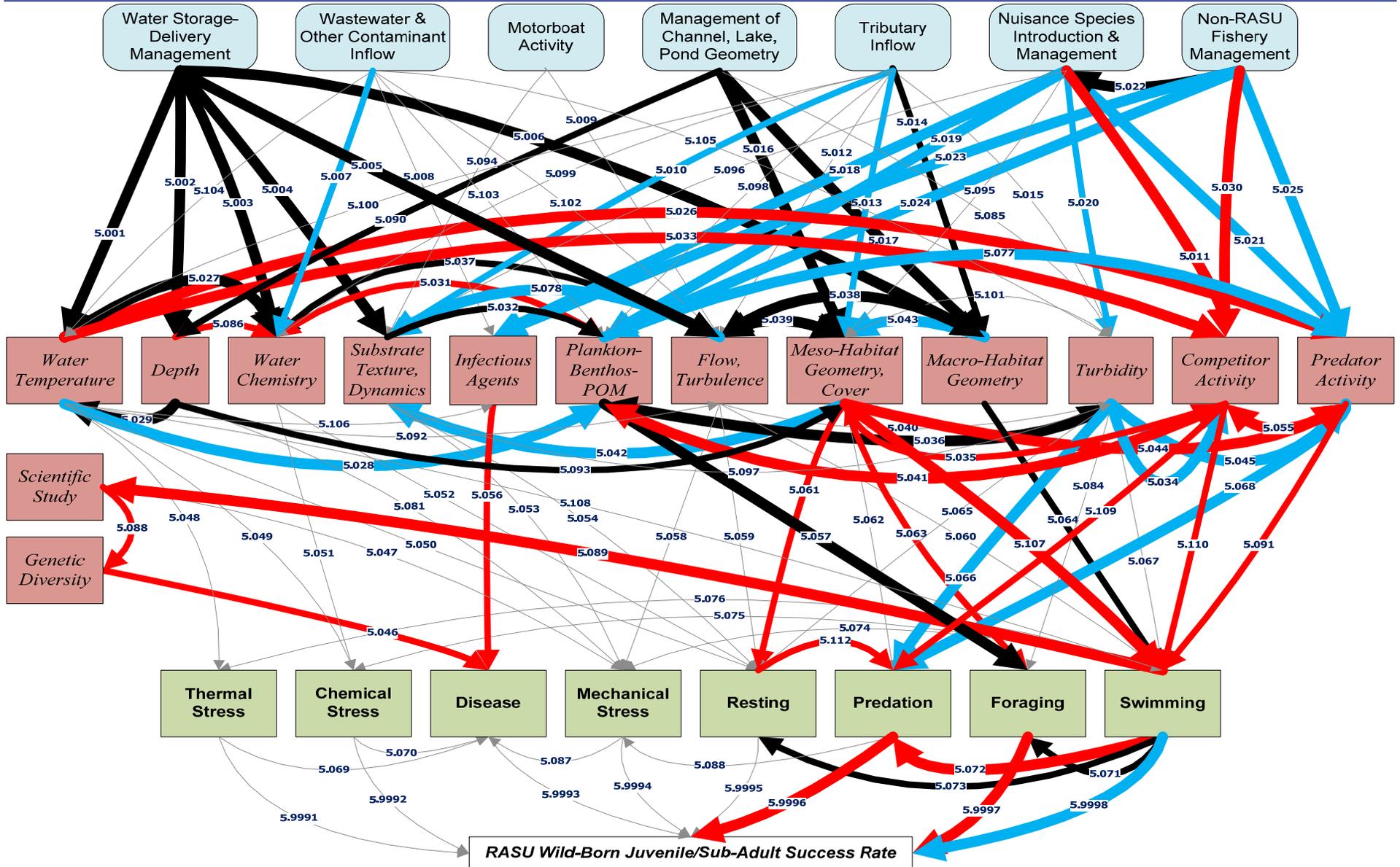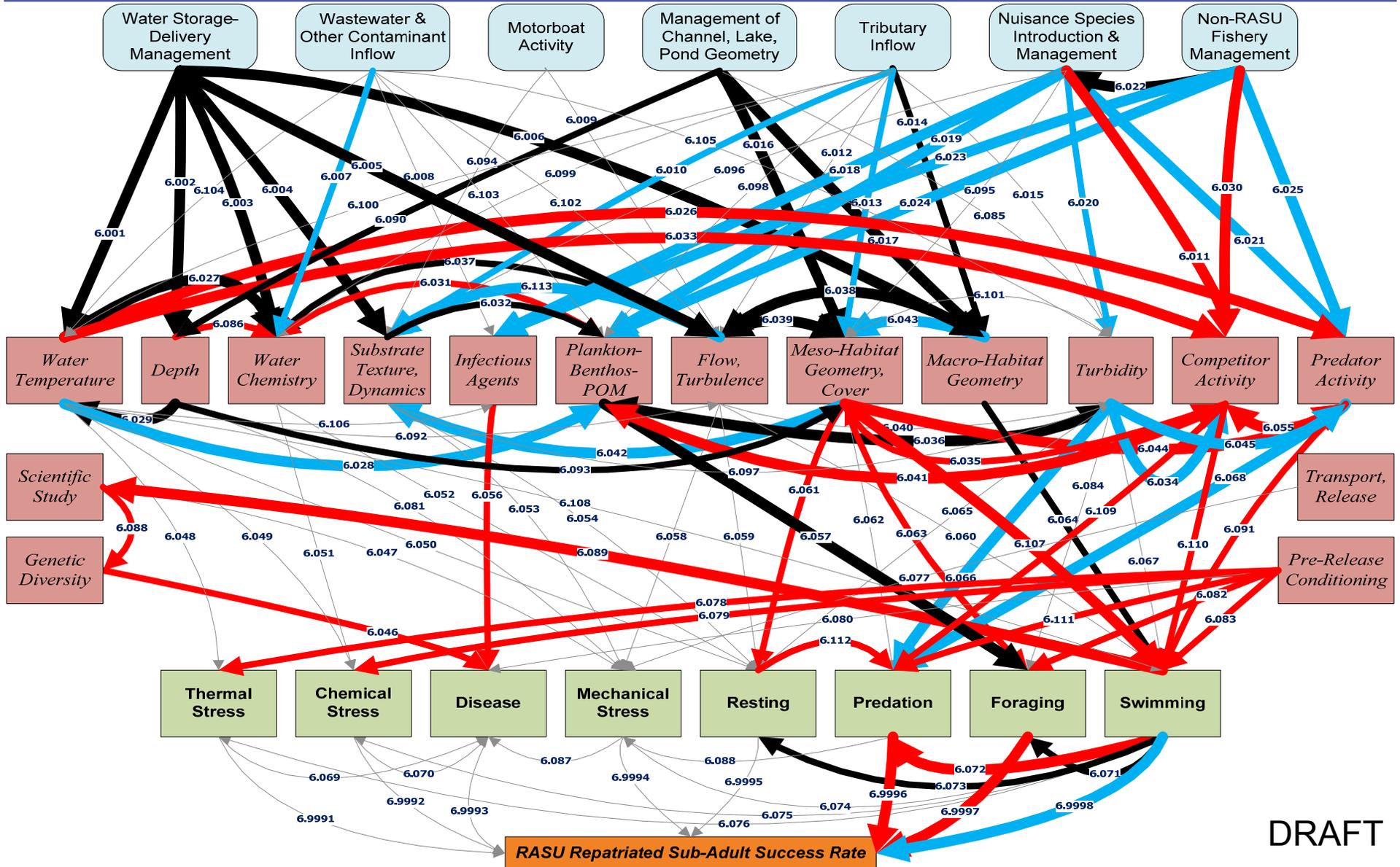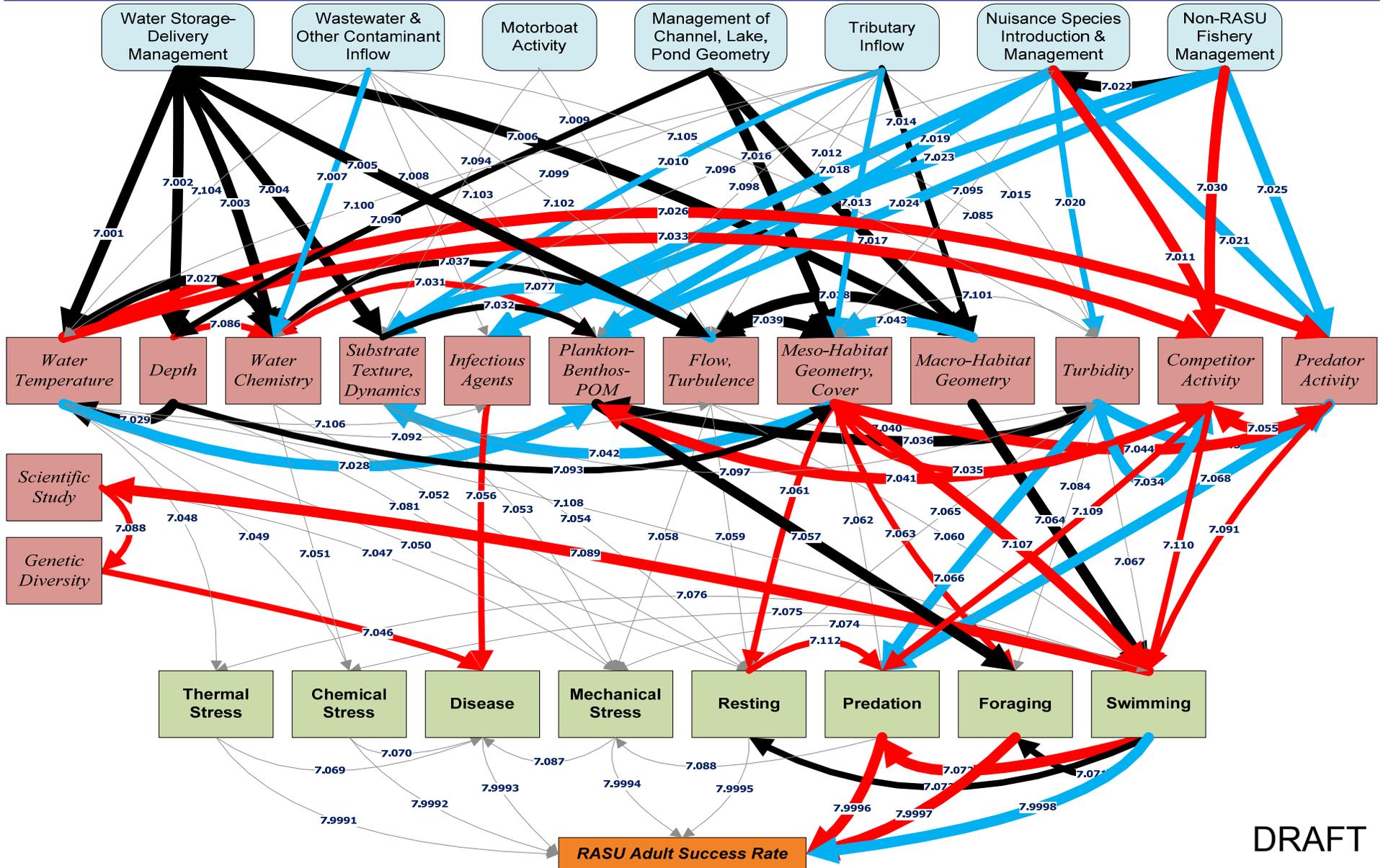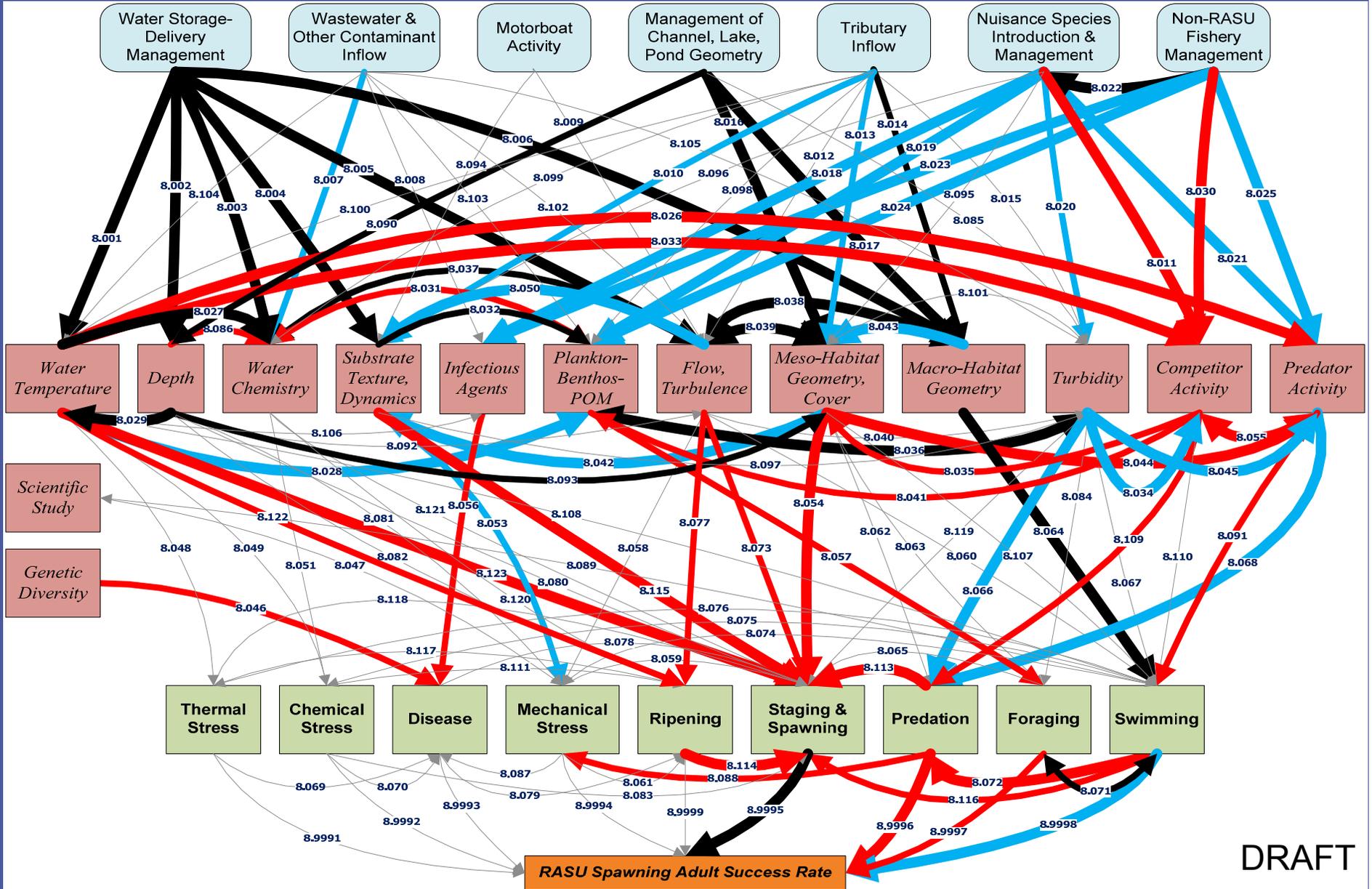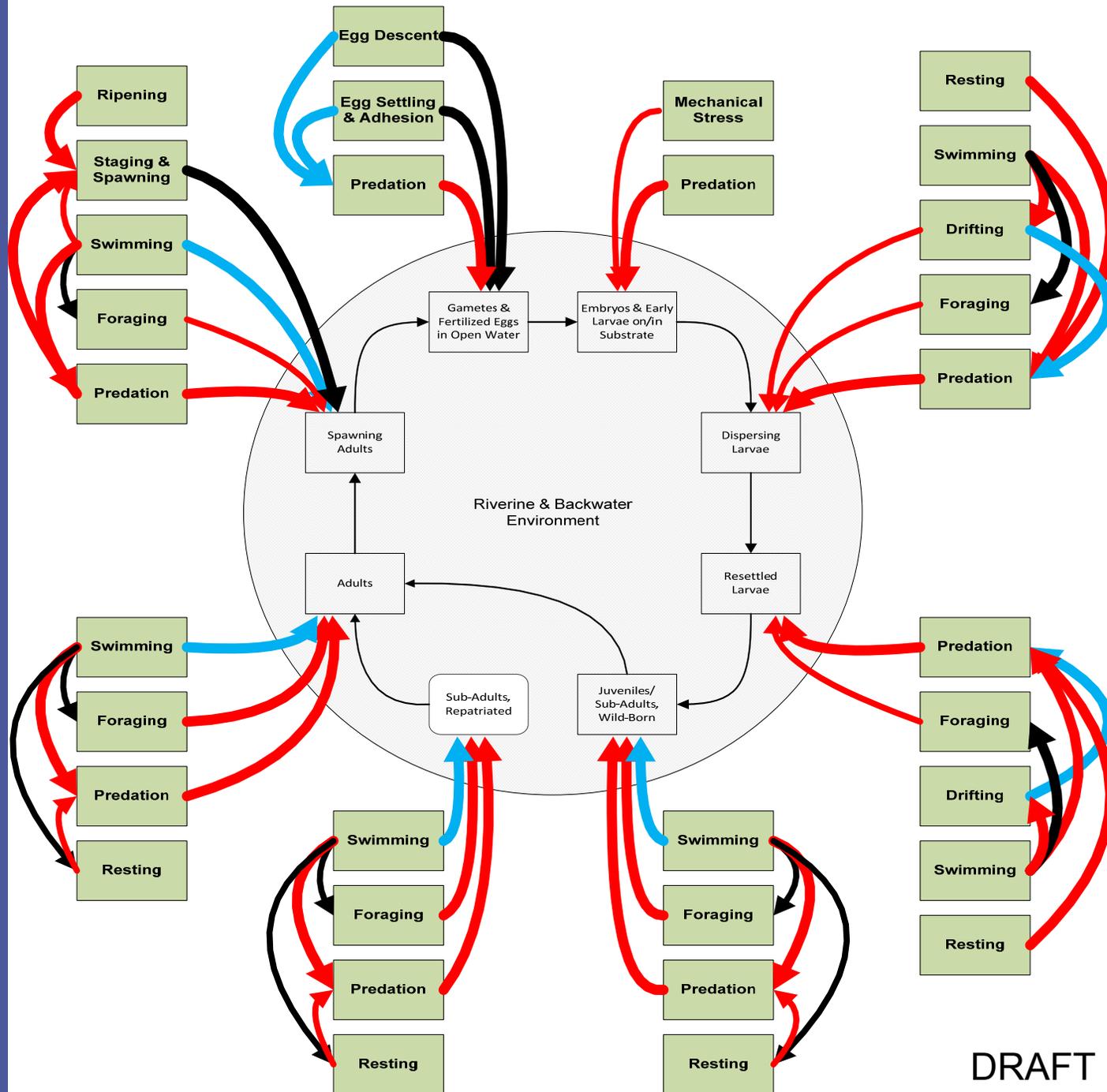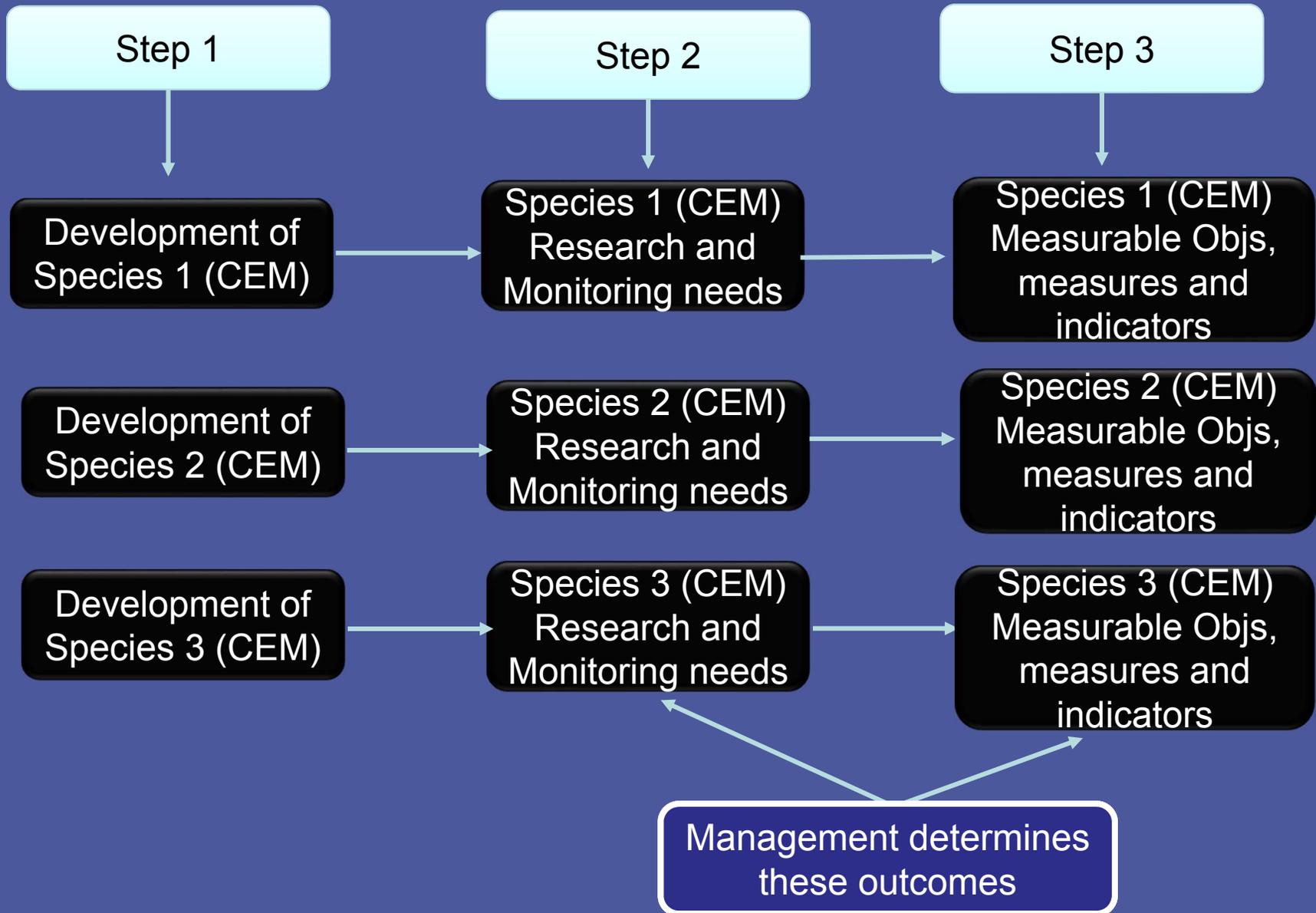
Causal linkages were adapted from:
http://www.dfg.ca.gov/ERP/conceptual_models.asp.

Williams, J.G. 2010. Sacramento-San Joaquin Delta Regional Ecosystem Restoration Implementation Plan Ecosystem Conceptual Model, Life History Conceptual Model for Chinook Salmon and Steelhead. Delta Regional Ecosystem Restoration Implementation Plan, Sacramento, CA. http://www.dfg.ca.gov/ERP/conceptual_models.asp.

DiGennaro, B., Reed, D., Swanson, C., Hastings, L., Hymanson, Z., Healey, M., & Siegel, S. (2012). Using conceptual models and decision-support tools to guide ecosystem restoration planning and adaptive management: An example from the Sacramento–San Joaquin Delta, California. *San Francisco Estuary and Watershed Science*, *10*(3), 1–15. Retrieved from http://escholarship.org/uc/item/3j95x7vt