Middle Rio Grande Endangered Species Collaborative Program's

2020 Science Symposium

Science & Adaptive Management Tools: Conceptual Ecological Models

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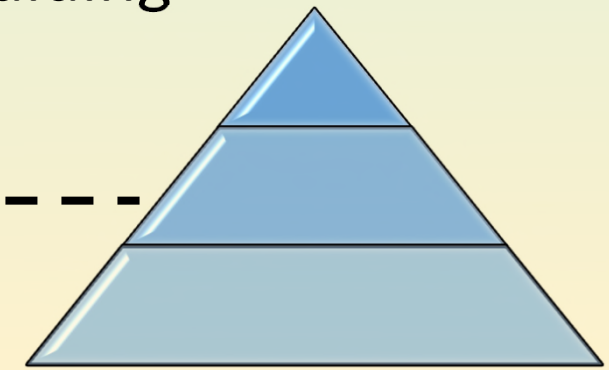
Conceptual Ecological Models – Why?

The Collaborative Program has four primary goals for using CEMs to inform adaptive management:

1. Identify critical scientific uncertainties
2. Make decisions with transparency
3. Communicate effectively among scientists, managers and public
4. Connect management actions, system responses and guiding principles

Photo: Albuquerque Journal

Photo: National Geographic



Conceptual Ecological Models – What?

Drivers are events, conditions and processes that contribute to the success of a species, assemblage or ecosystem (indicator **response**).

Stressors are events, conditions and processes that contribute to failure of the biotic indicator by constraining growth, reproduction or survival.

Natural or Anthropogenic

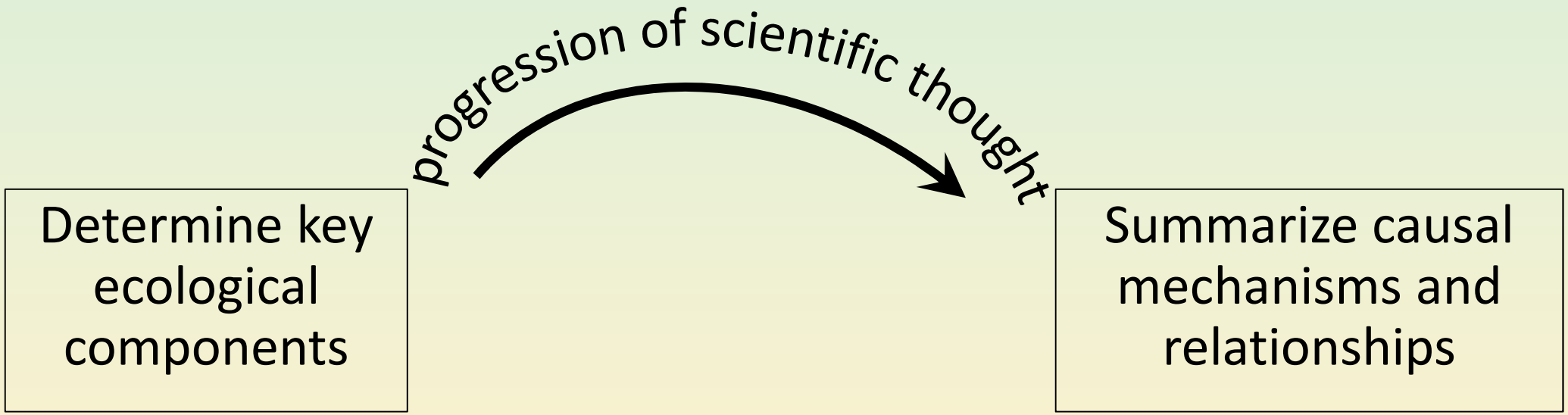
Acute or Chronic

< Tolerance Threshold >

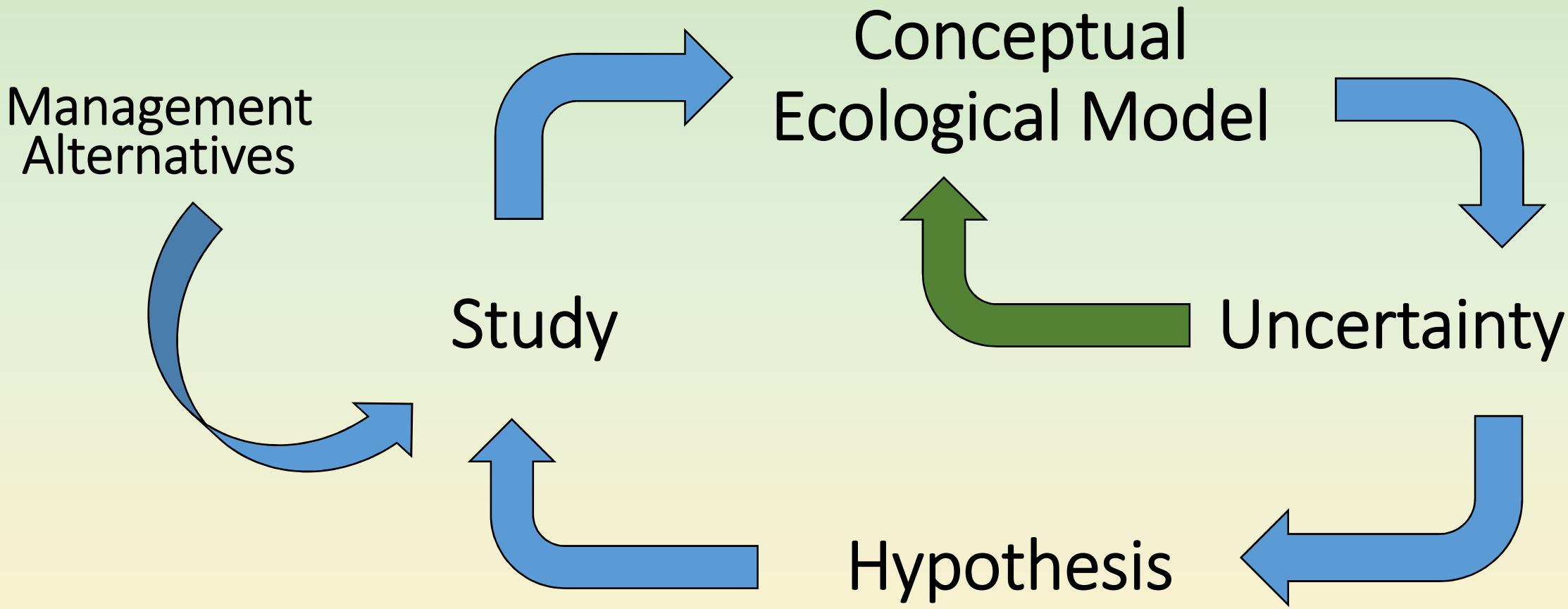
Uncertainty

Conceptual Ecological Models – How?

Non-quantitative planning tools used to identify major drivers and stressors on natural systems, ecological responses to stressors, and the best biological attributes or indicators of these responses.



CEMs – Tools of Adaptive Management



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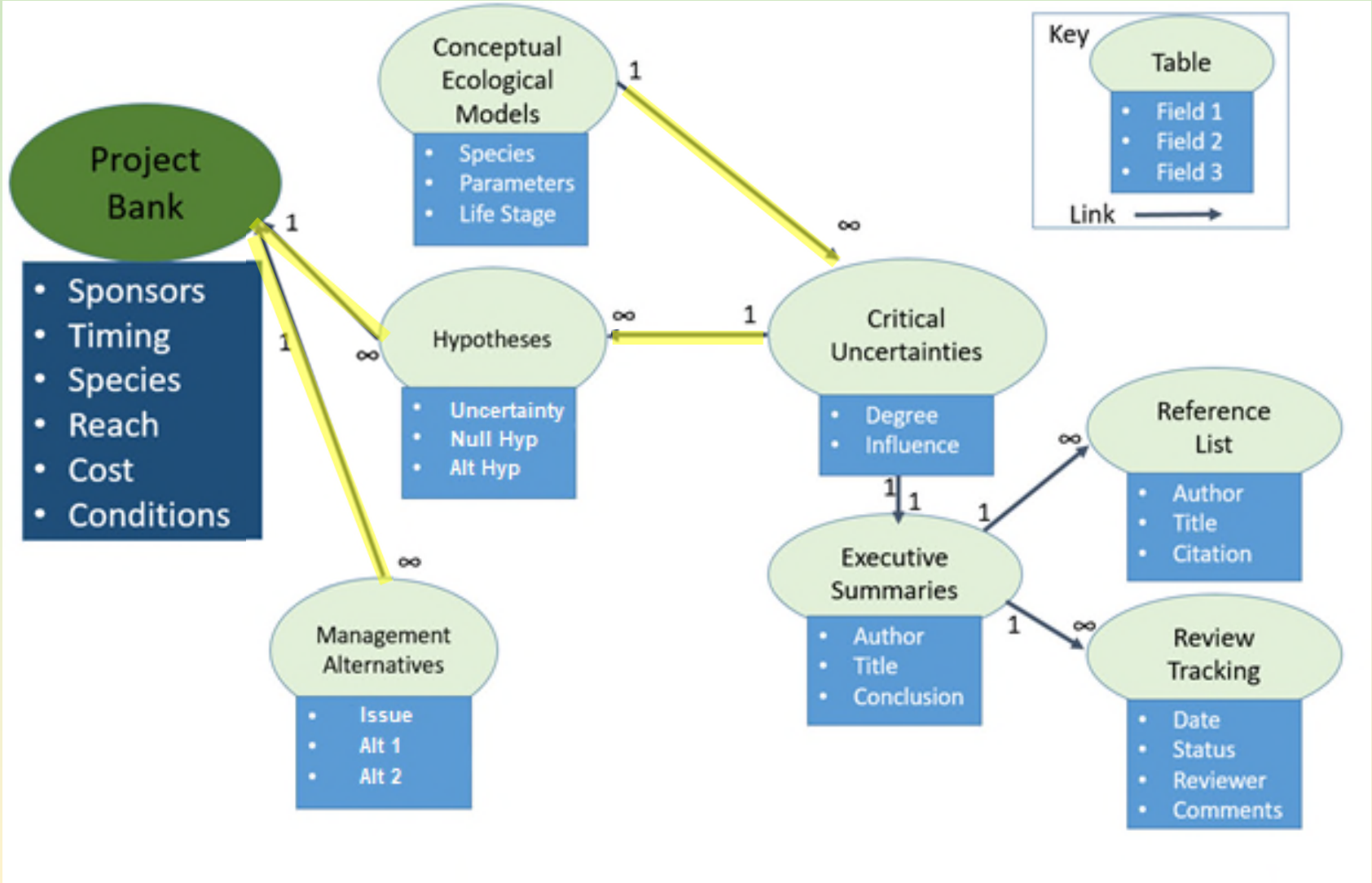
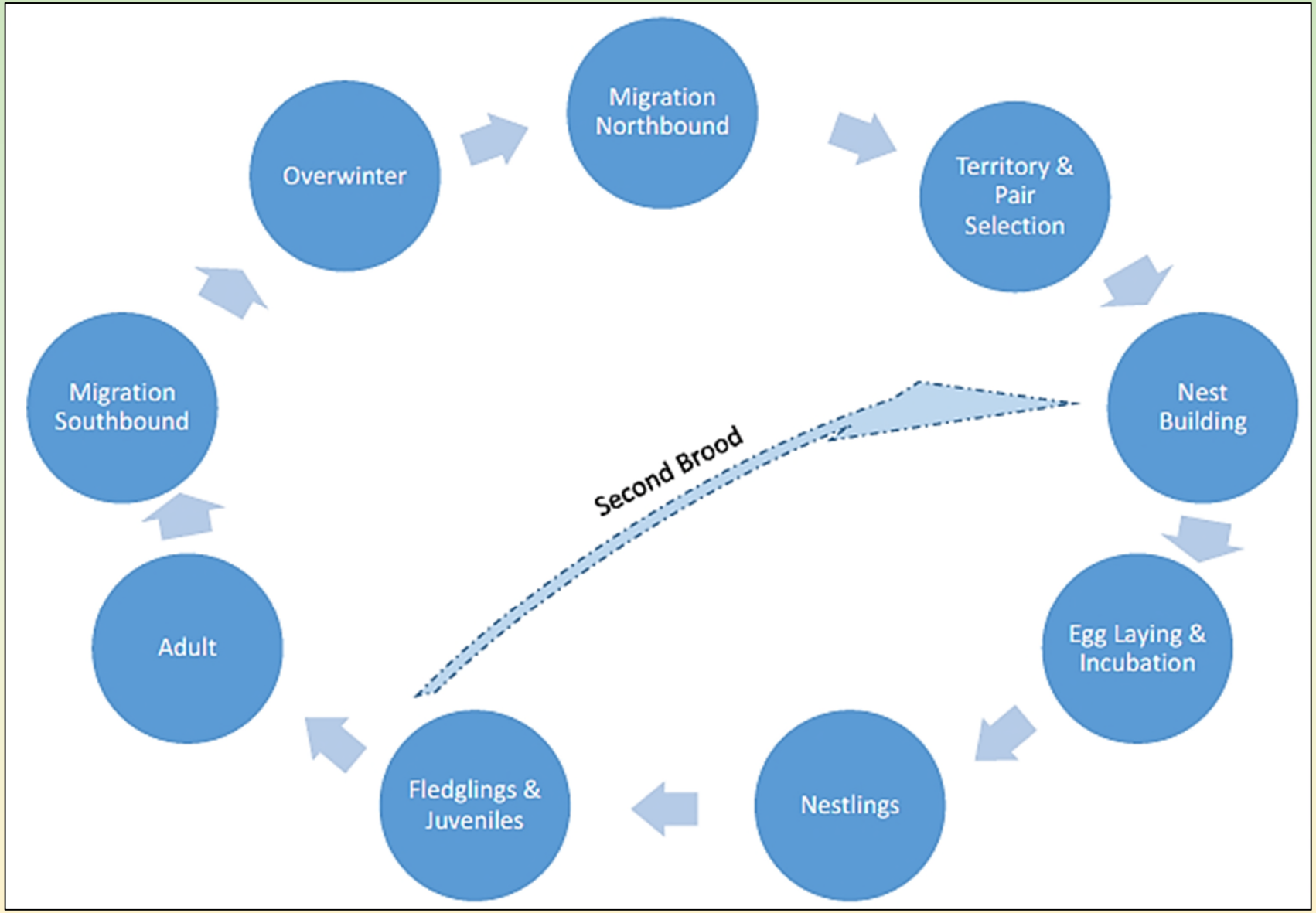


MRGESCP Species-level CEMs

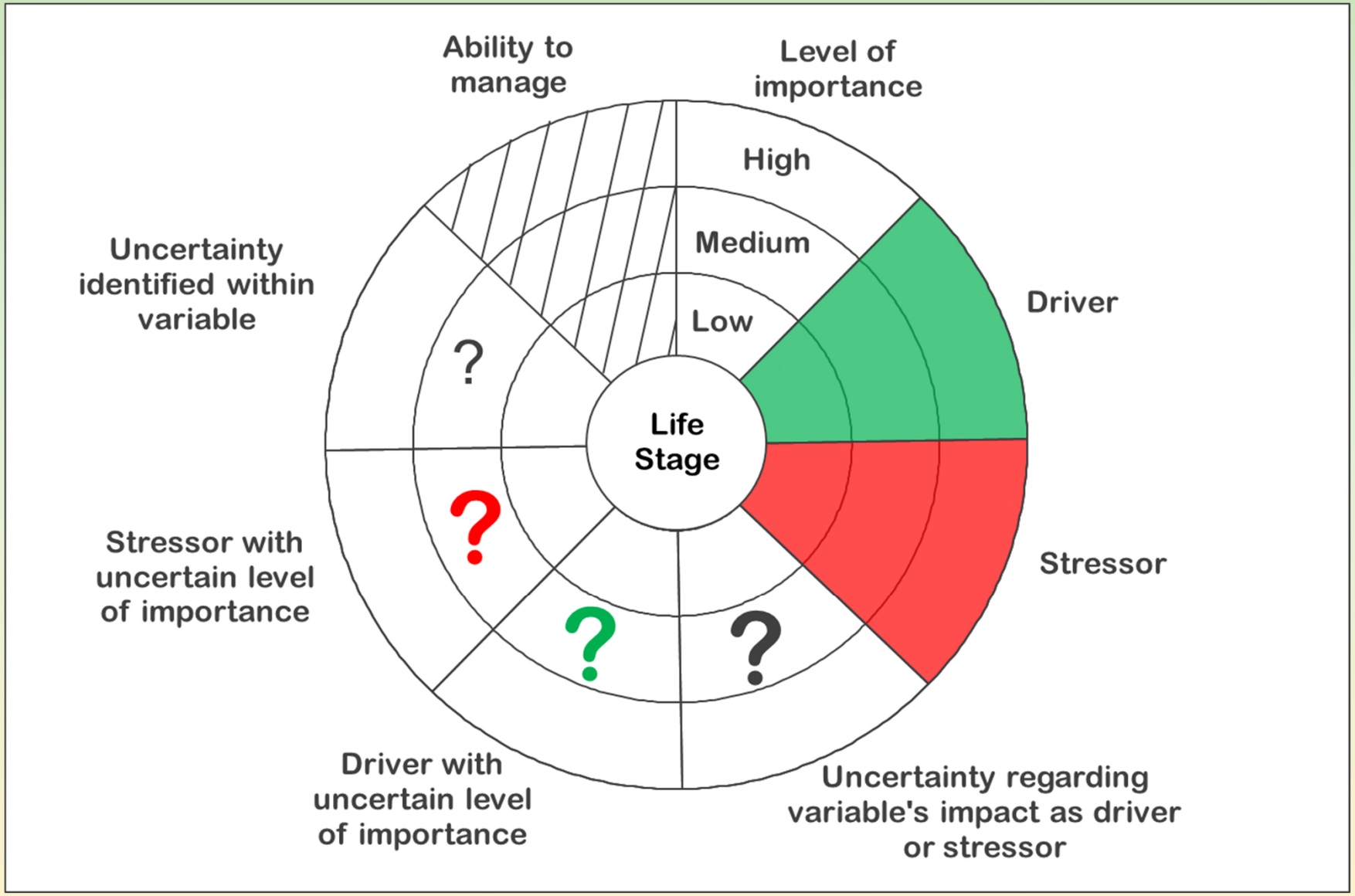
Avian Species CEMs

- CEMs for SWFL and YBCU were developed in tandem around the species' life cycles, as both are neo-tropical migratory songbirds
- Much uncertainty exists in both the SWFL's and the YBCU's basic life history
- These knowledge gaps must be addressed before detailed relationships among variables can be represented, as shown in the RGSM CEM

Avian Species CEMs



Avian Species CEMs



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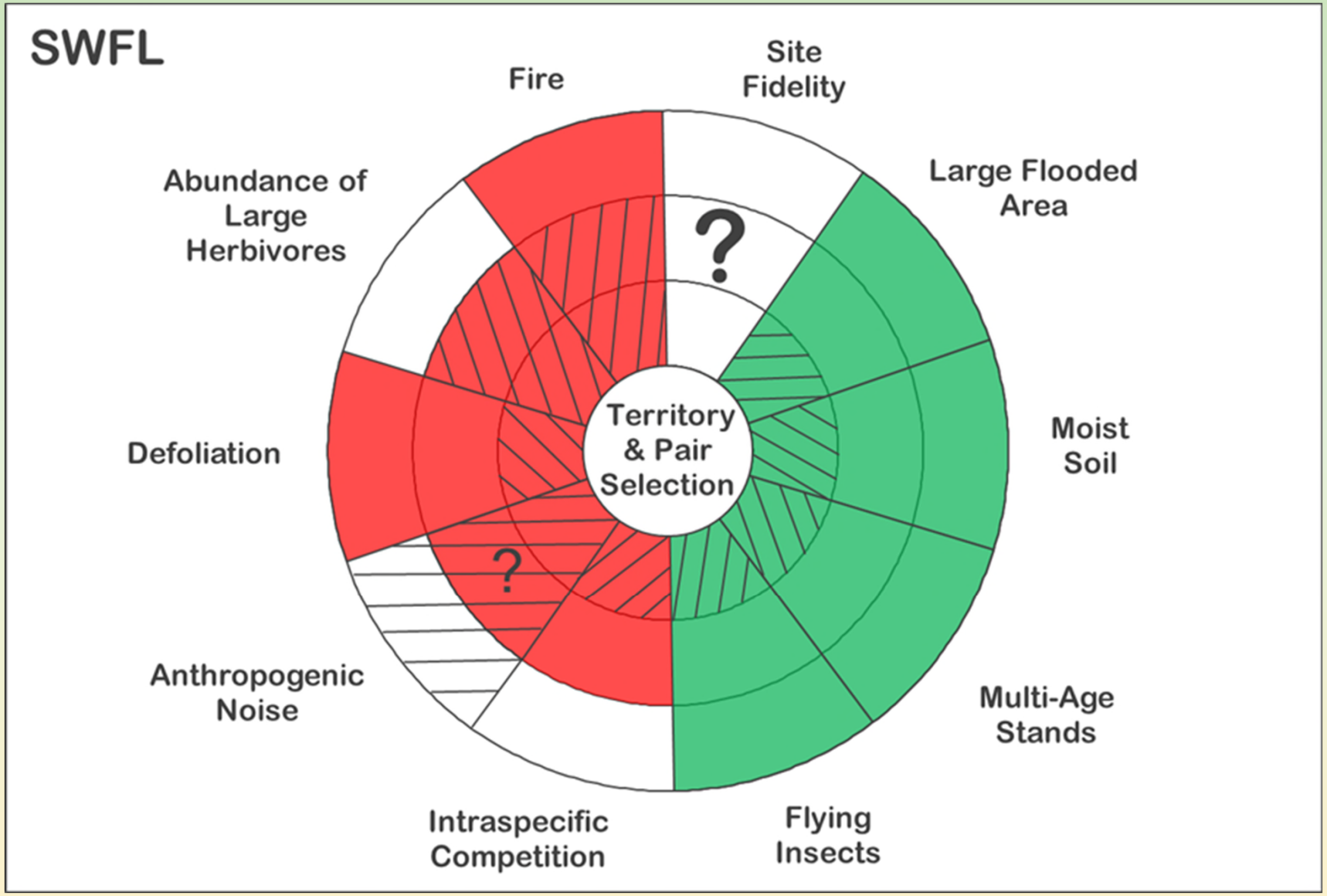
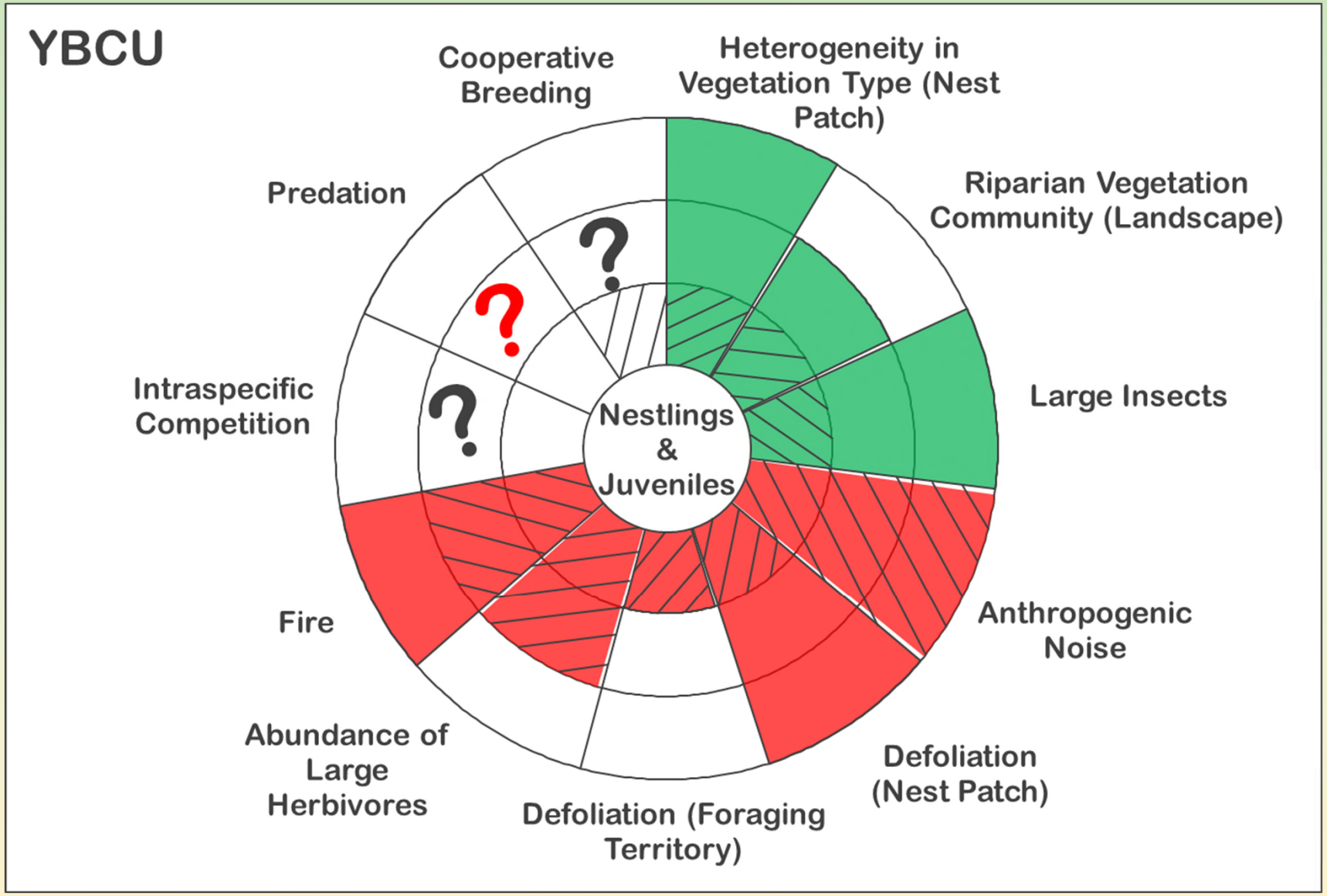
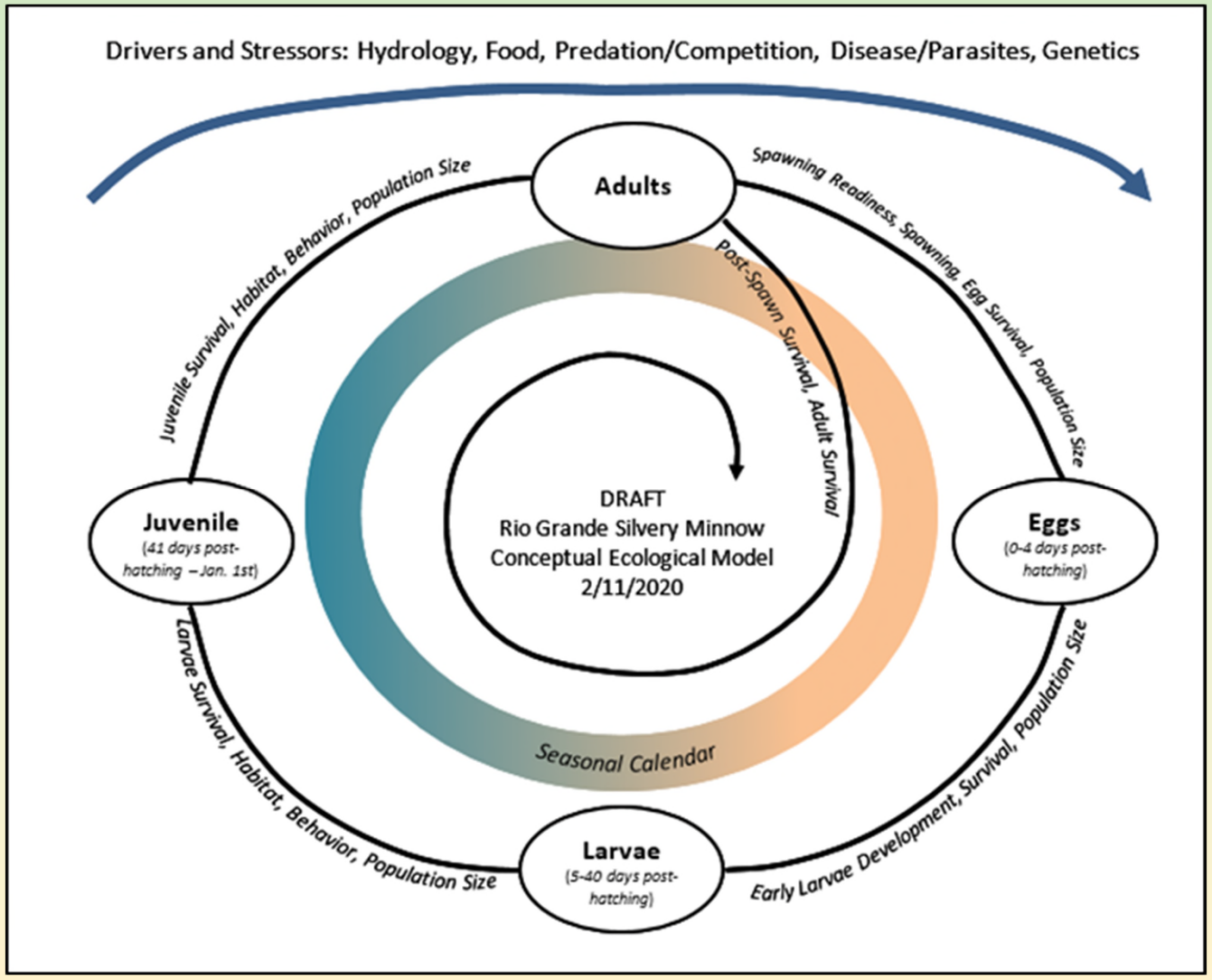
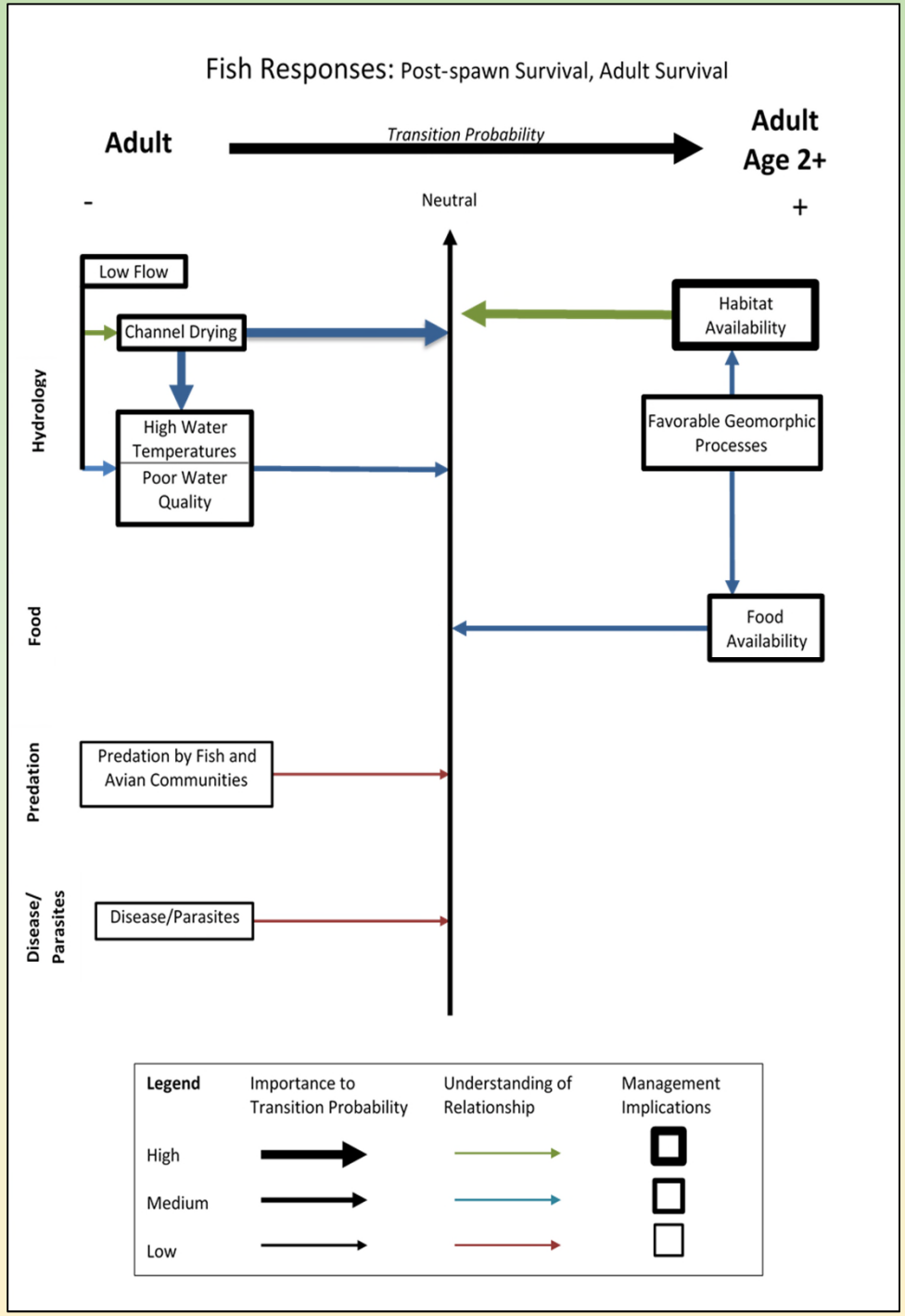


Avian Species CEMs



Rio Grande Silvery Minnow CEM





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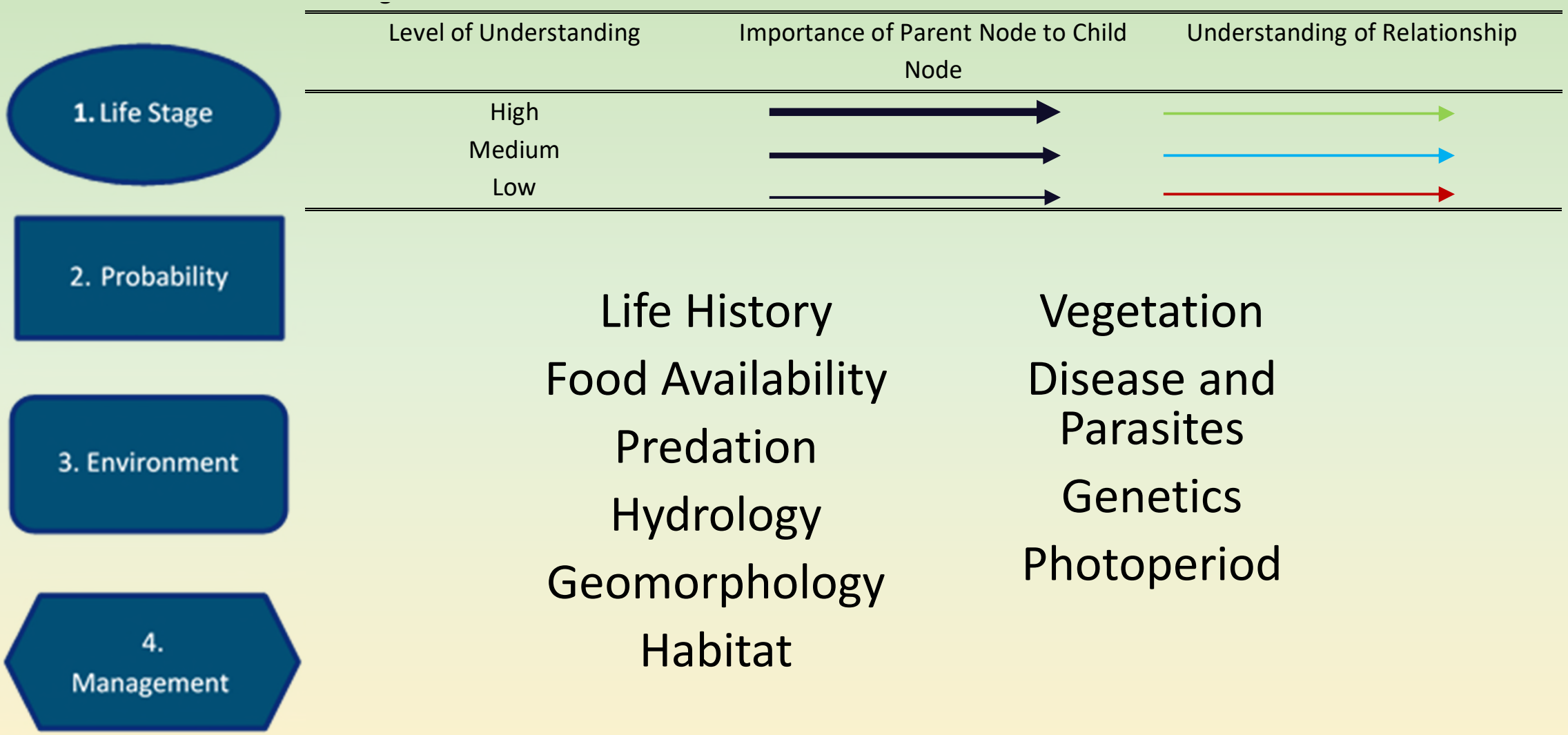
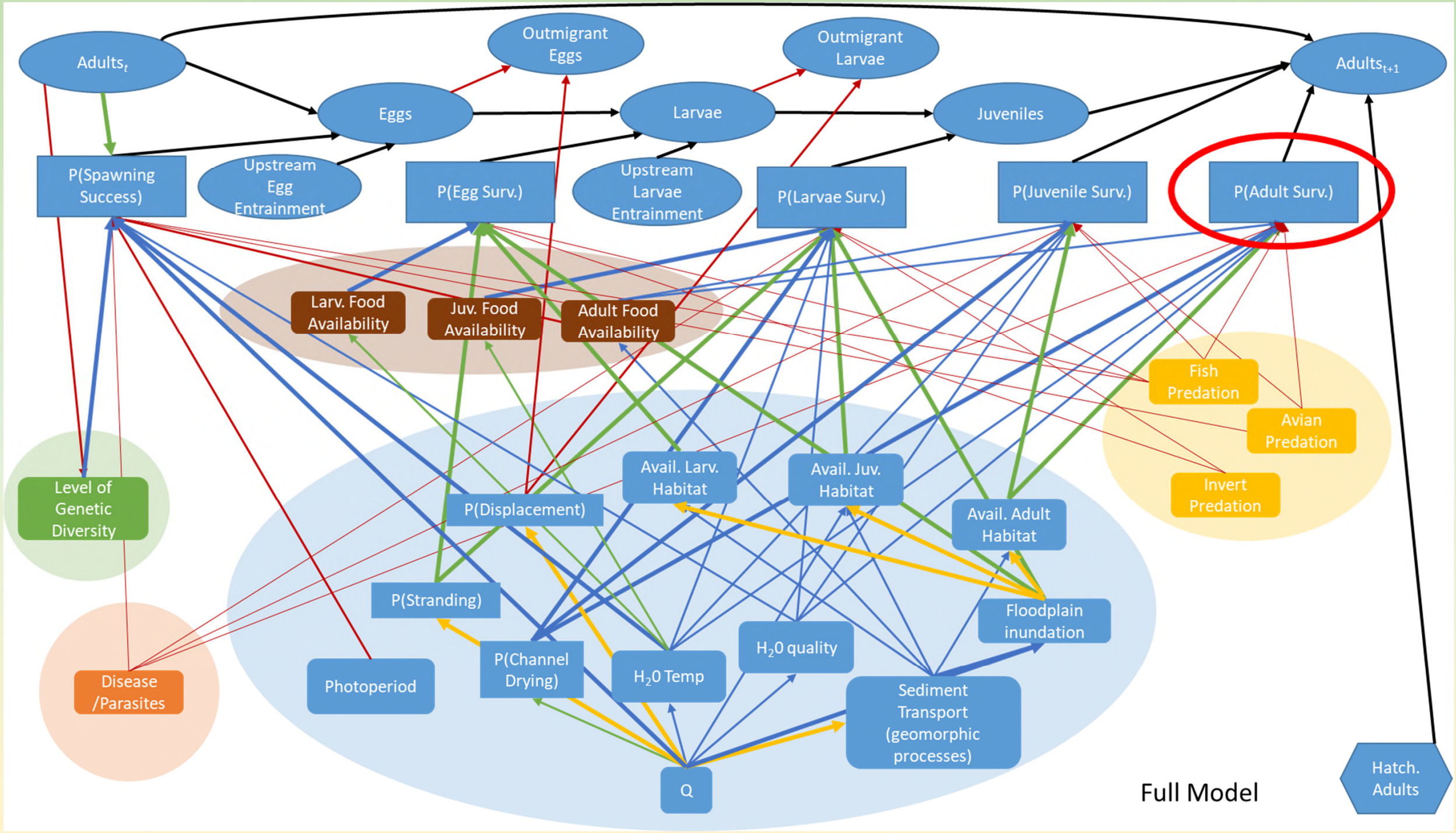
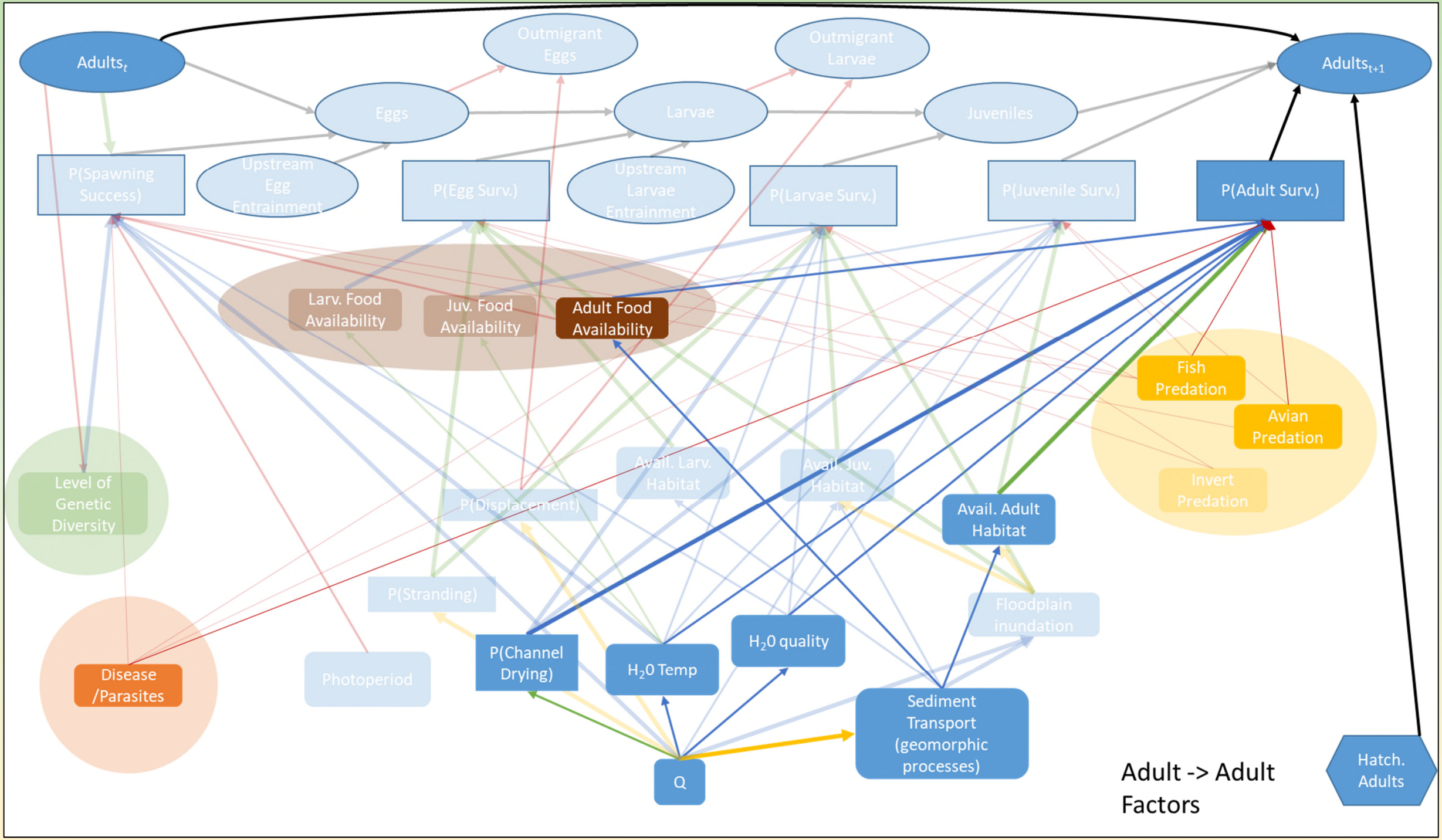



Adults$_t$
Outmigrant Eggs
Outmigrant Larvae
Adults$_{t+1}$
Eggs
Larvae
Juveniles
P(Spawning Success)
Upstream Egg Entrainment
P(Egg Surv.)
Upstream Larvae Entrainment
P(Larvae Surv.)
P(Juvenile Surv.)
P(Adult Surv.)
Larv. Food Availability
Juv. Food Availability
Adult Food Availability
Fish Predation
Avian Predation
Invert Predation
Level of Genetic Diversity
Avail. Larv. Habitat
Avail. Juv. Habitat
P(Displacement)
Avail. Adult Habitat
P(Stranding)
Floodplain inundation
Disease /Parasites
Photoperiod
P(Channel Drying)
H_20 Temp
H_20 quality
Sediment Transport (geomorphic processes)
Q
Hatch. Adults
Full Model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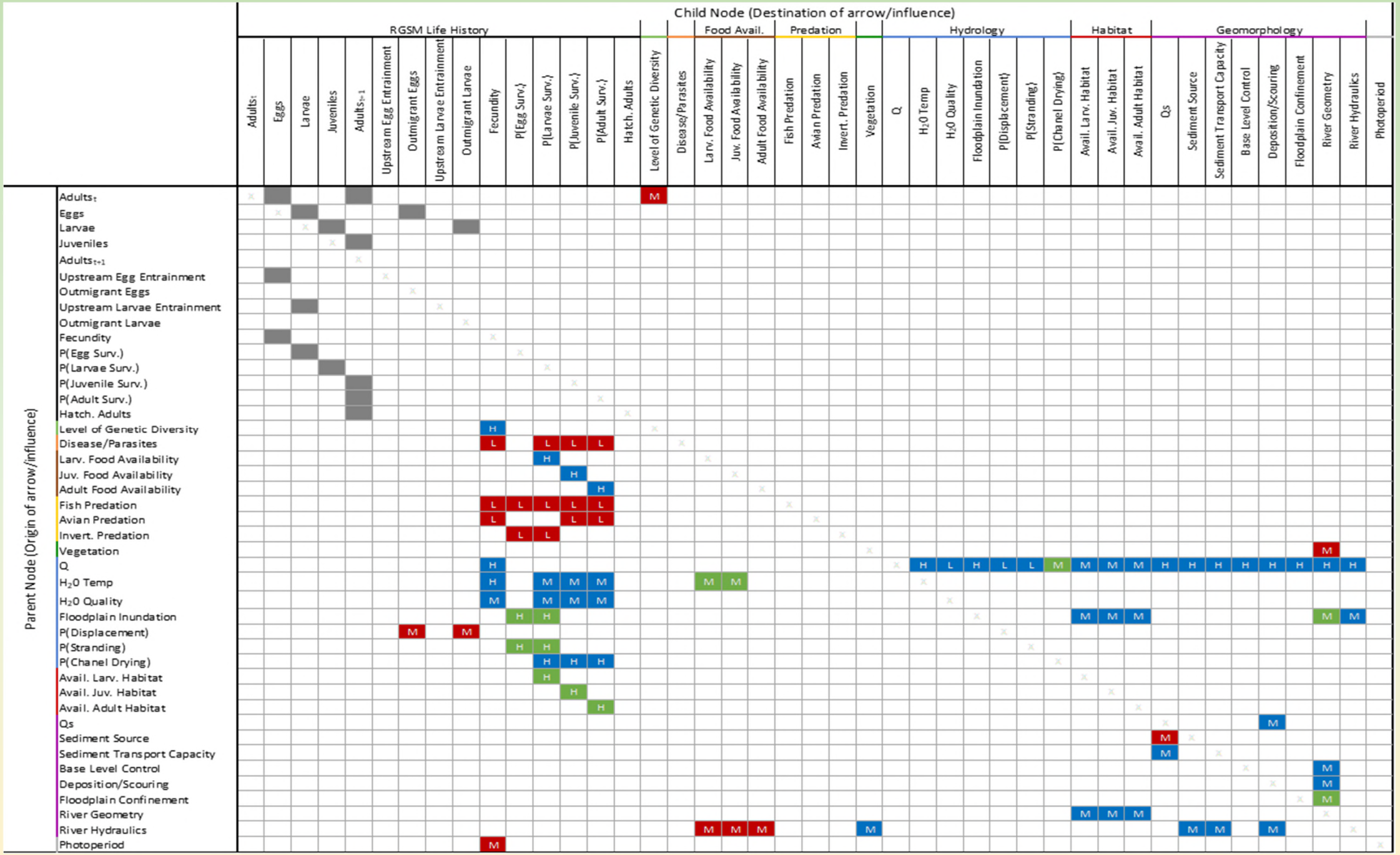
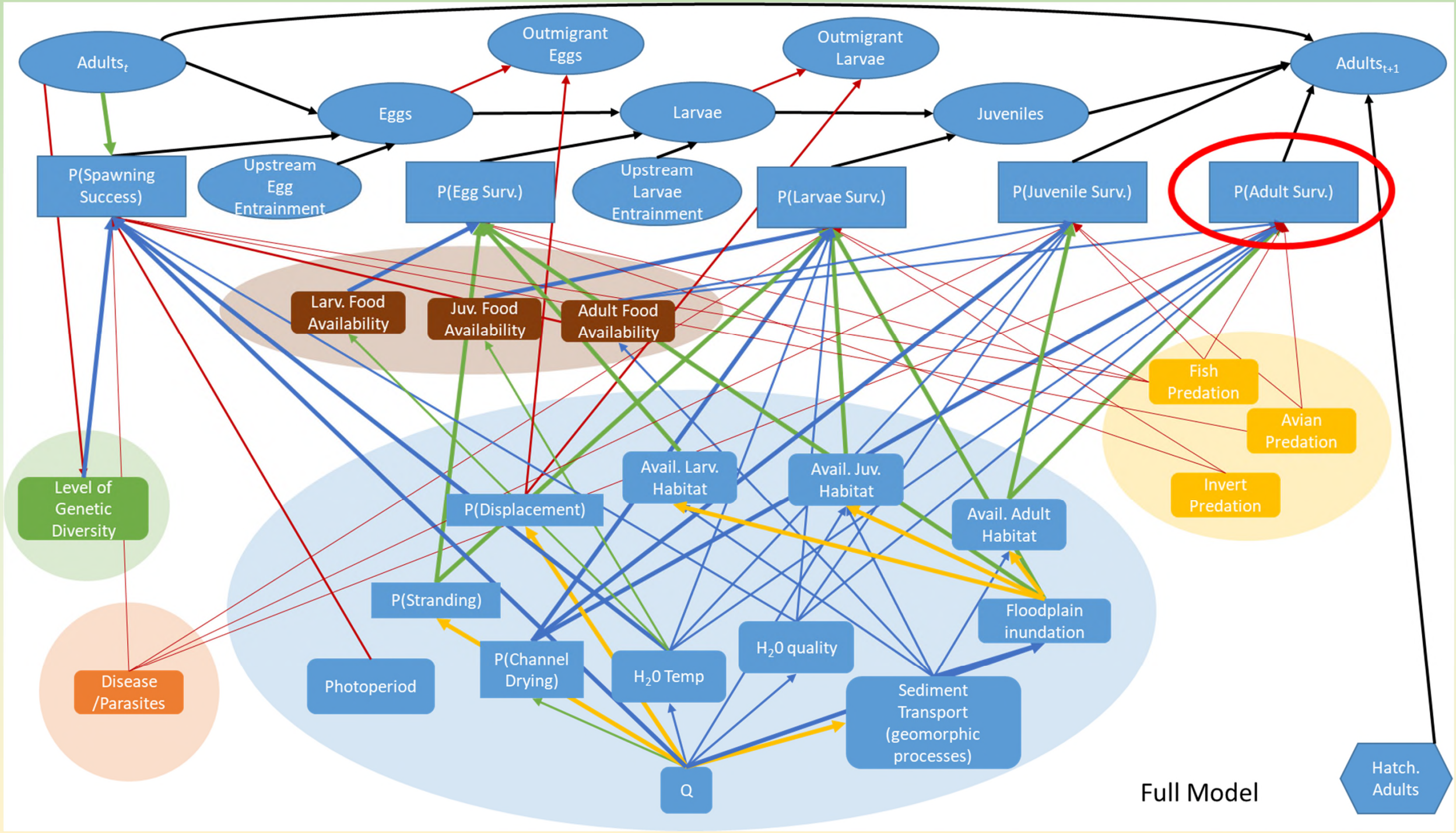
H_20 Temp
H_20 quality
Disease /Parasites
Photoperiod
Sediment Transport (geomorphic processes)
Q
Hatch. Adults
Adult -> Adult Factors


Child Node (Destination of arrow/influence)
RGSM Life History
Food Avail.
Predation
Hydrology
Habitat
Geomorphology
Adults$_t$
Eggs
Larvae
Juveniles
Adults$_{t+1}$
Upstream Egg Entrainment
Outmigrant Eggs
Upstream Larvae Entrainment
Outmigrant Larvae
Fecundity
P(Egg Surv.)
P(Larvae Surv.)
P(Juvenile Surv.)
P(Adult Surv.)
Hatch. Adults
Level of Genetic Diversity
Disease/Parasites
Larv. Food Availability
Juv. Food Availability
Adult Food Availability
Fish Predation
Avian Predation
Invert. Predation
Vegetation
Q
H$_2$0 Temp
H$_2$0 Quality
Floodplain Inundation
P(Displacement)
P(Stranding)
P(Chanel Drying)
Avail. Larv. Habitat
Avail. Juv. Habitat
Avail. Adult Habitat
Qs
Sediment Source
Sediment Transport Capacity
Base Level Control
Deposition/Scouring
Floodplain Confinement
River Geometry
River Hydraulics
Photoperiod
Parent Node (Origin of arrow/influence)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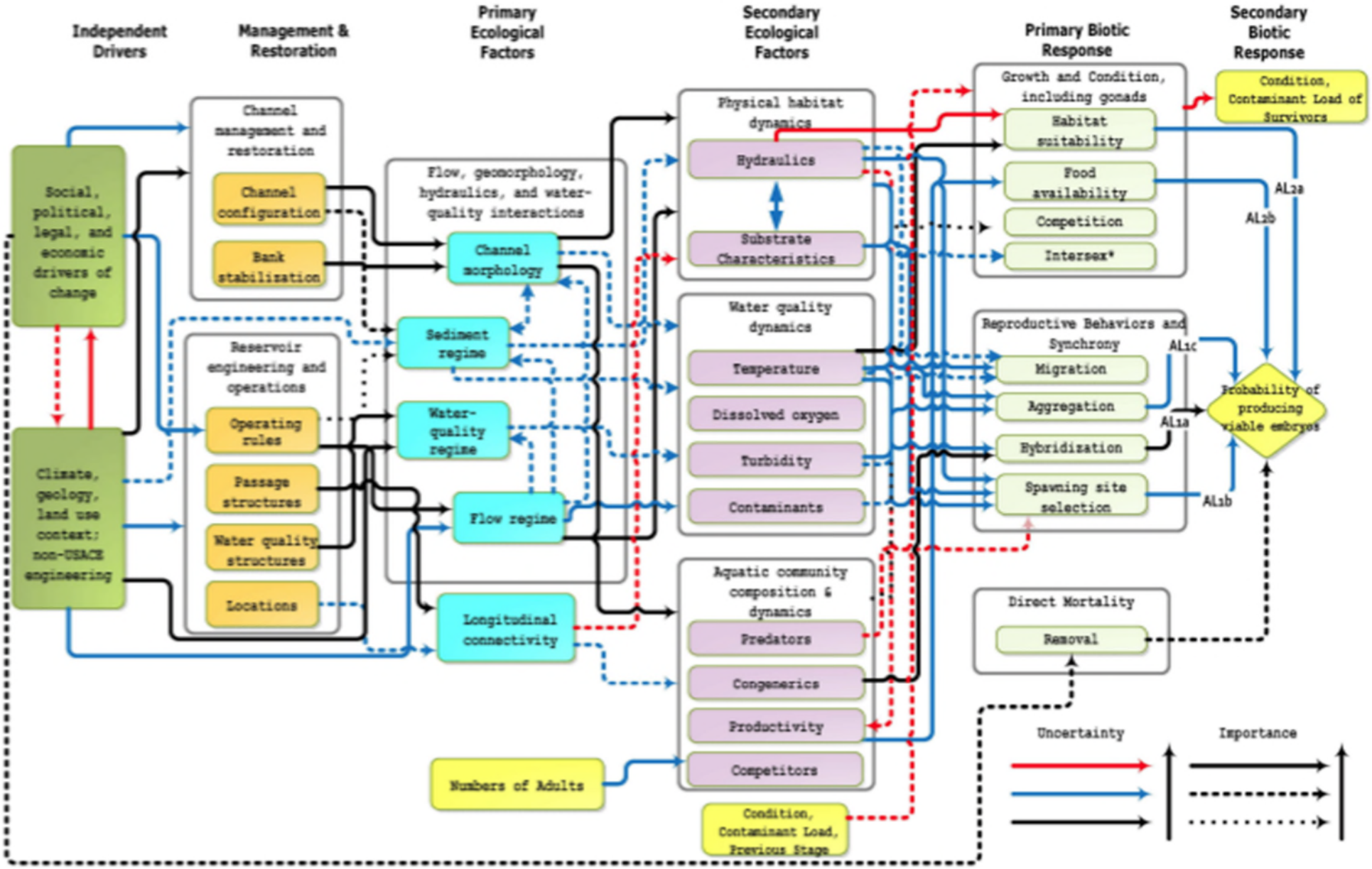
H_20 Temp
H_20 quality
Sediment Transport (geomorphic processes)
Q
Hatch. Adults
Full Model

Appendix A6

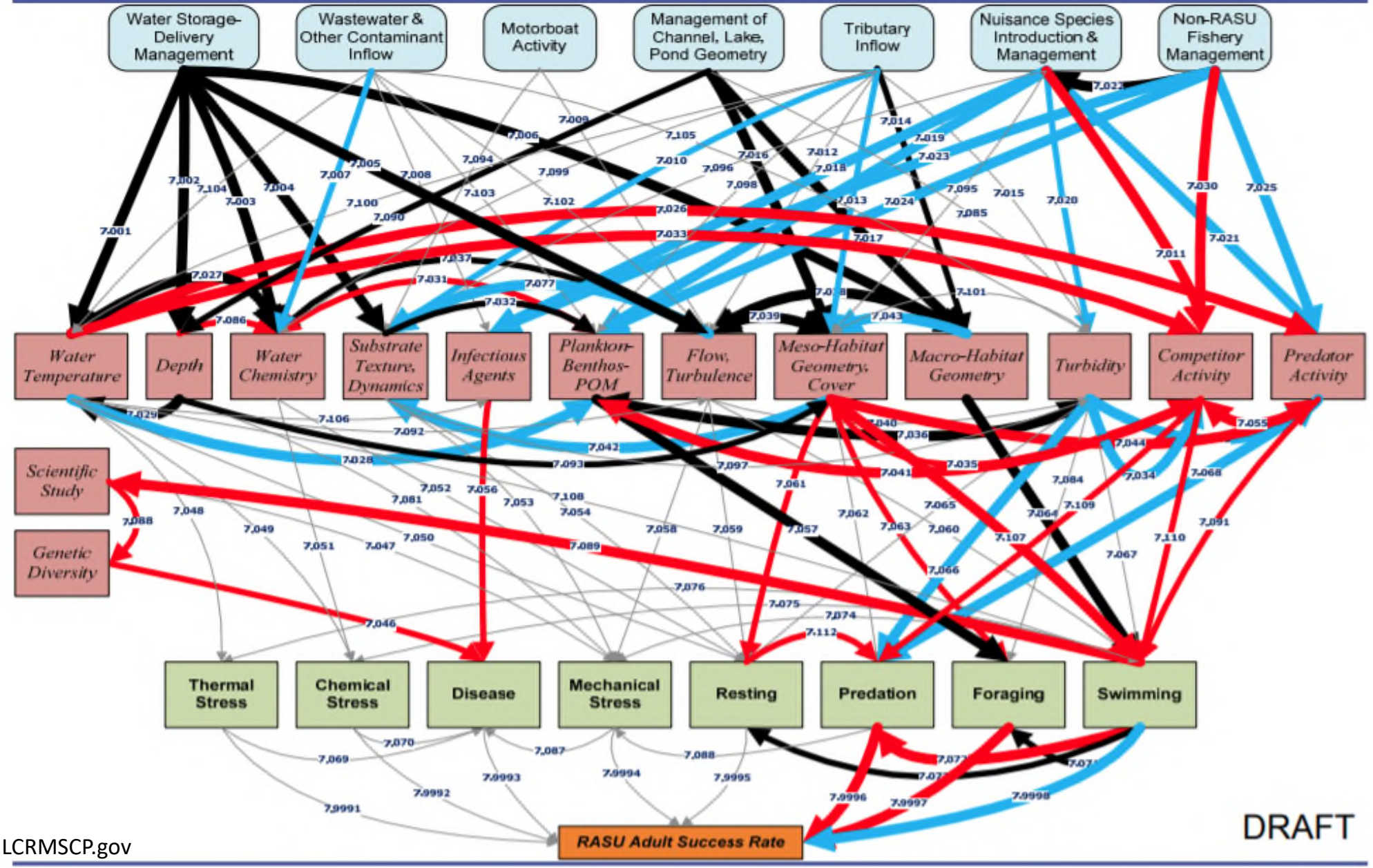
Lower River Pallid Sturgeon CEM

Pre-Spawn & Spawning Adults



Jacobson et al., 2014. http://dx.doi.org/10.3133/ofr20151038

RASU Adult



Source: S. Kokos, LCRMSCP.gov

Conceptual Ecological Models – Next Steps

- Characterizing uncertainties
  - Reducible?
  - Descriptive v. testable?
  - Magnitude
  - Relevance
- Incorporating into AM Database
  - Tabular formatting
  - Linking to hypotheses
- Prioritizing uncertainties
  - Using guiding principles for hierarchical approach

    Mission → Goals → Objectives → Strategies…
  - Objectives Workshop

    S.M.A.R.T. objectives
  - Short and long-term planning
  - CEMs can always improve