PREDICTIVE ECOLOGICAL MODEL(S) FOR THE COMAL AND SAN MARCOS ECOSYSTEMS

(Comal and San Marcos Springs)

Year 2

DRAFT SCOPE OF WORK

April 8, 2014

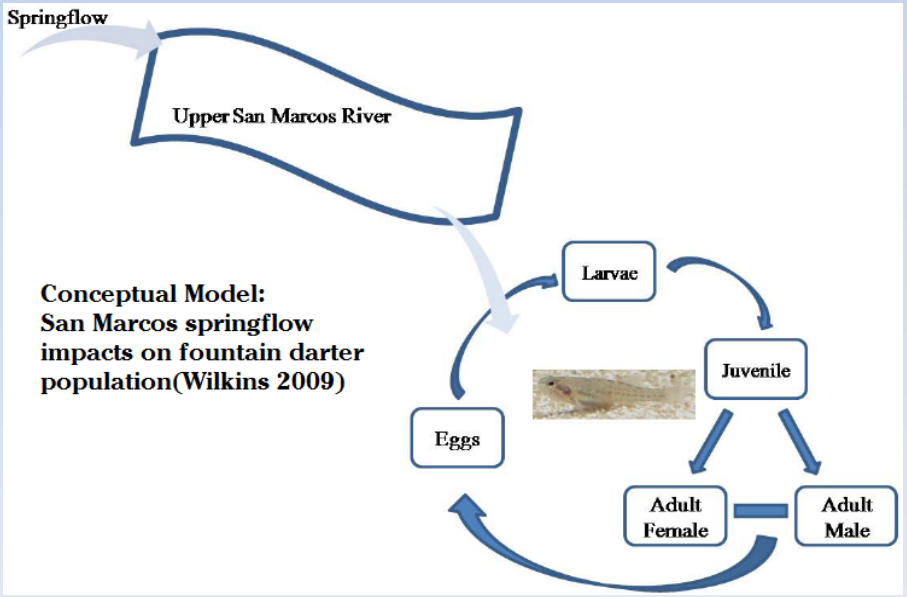
EDWARDS AQUIFER
AUTHORITY

Purpose of the HCP Ecological Modeling

- Identify and describe specific ecological responses (To answer unknowns in the HCP)
  - to predict specific ecological responses of the Comal and San Marcos Springs/River ecosystems and associated Covered Species to low-flow conditions; and
  - to assist in establishing potential threshold levels for Covered Species.
- Quantify, predict, and project impacts:
  - to project long-term effects of the Covered Activities on these ecosystems and associated species to facilitate designation of Phase II biological goals, flow-management objectives and strategies for achievement; and
  - to assist in mitigation design and implementation where applicable.
- Use in Incidental Take Permit (ITP) Net Disturbance Determination and Annual “Take” Estimation.

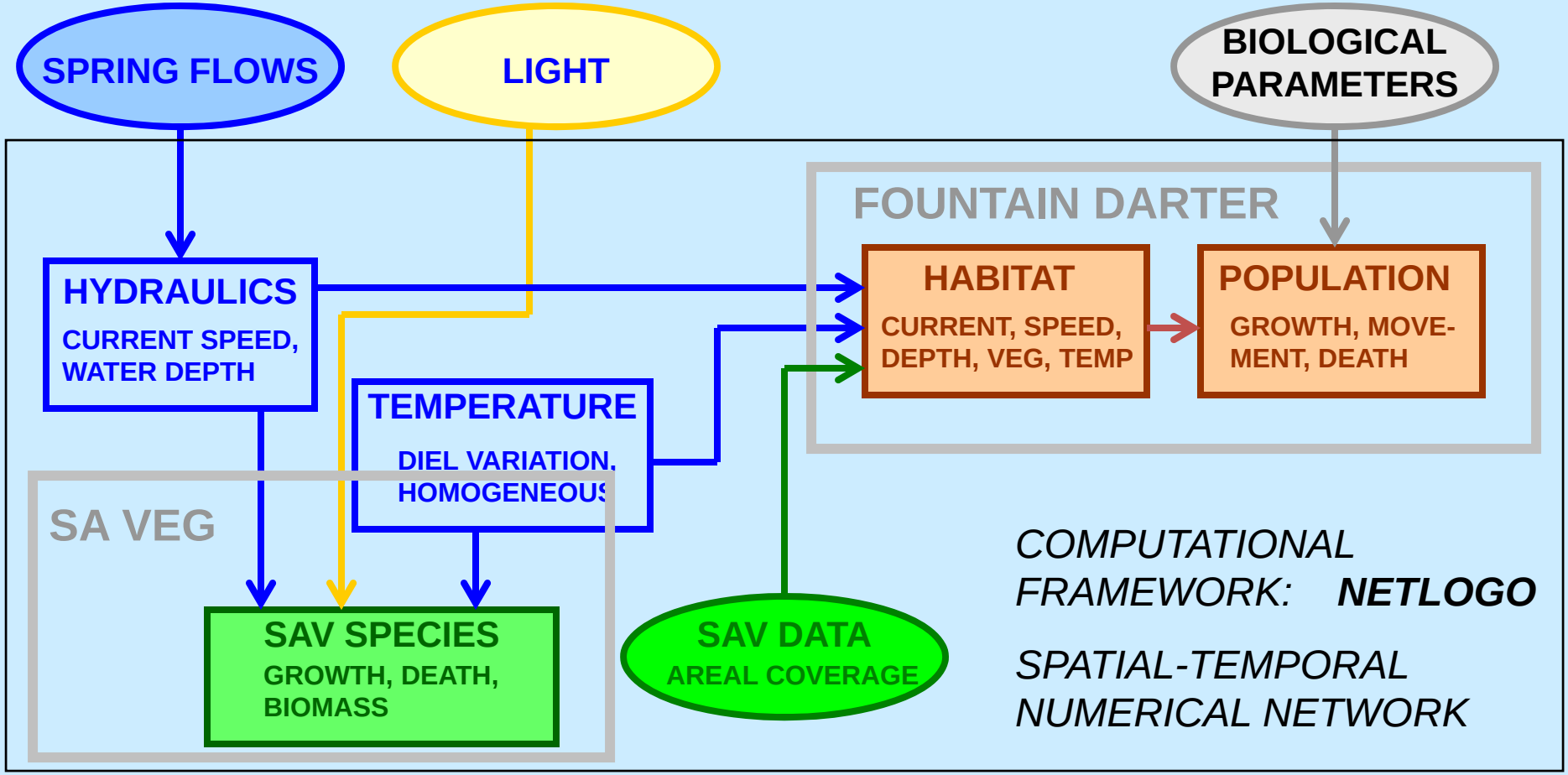
The Foundational Question to evaluate the HCP Phase I measures

- **What will happen to the covered species and their habitat at HCP (Phase I) allowed flow levels and durations?**
  - **Ecological Modeling**
    - **One tool available**

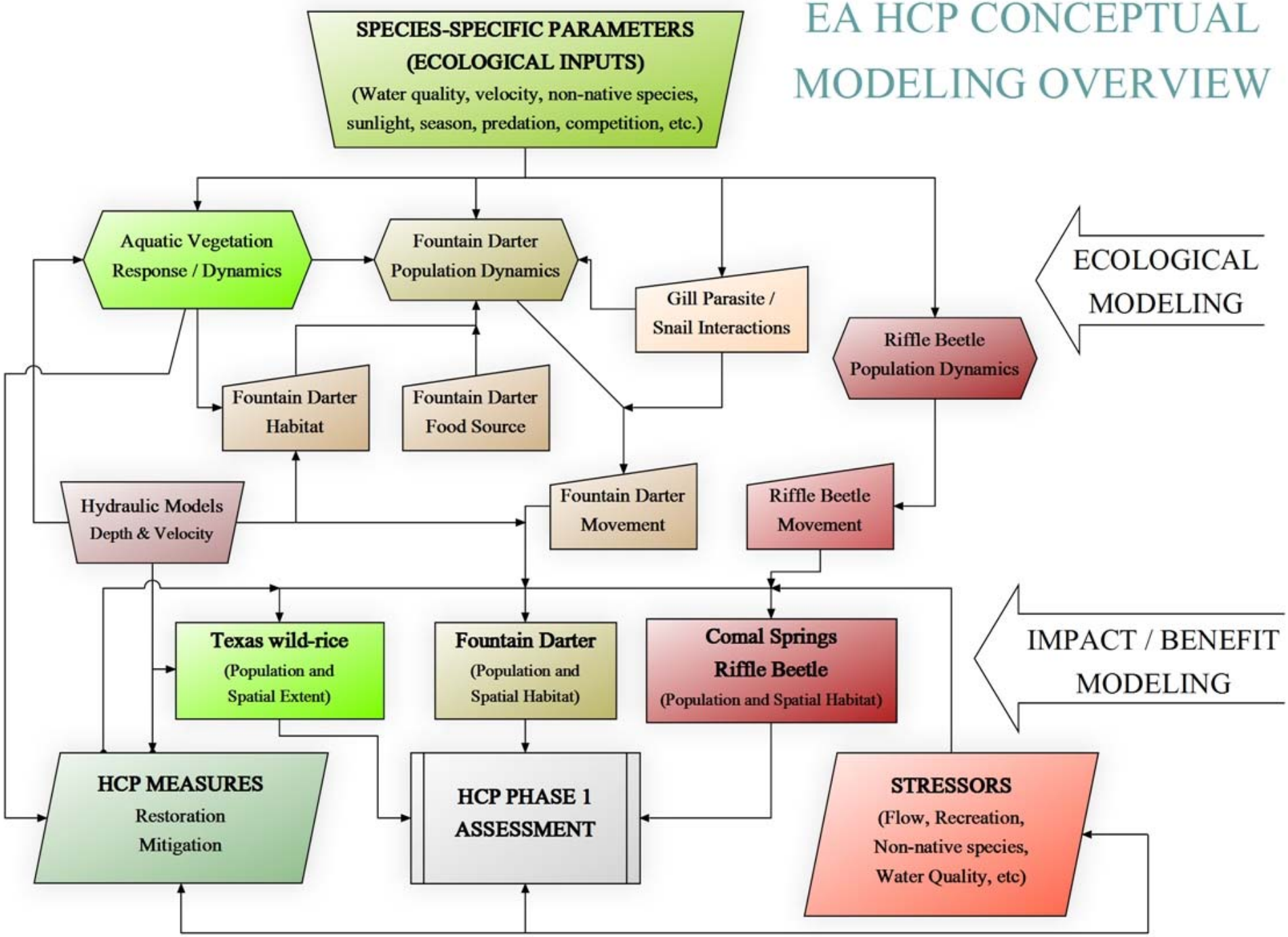


Conceptual Model: San Marcos springflow impacts on fountain darter population(Wilkins 2009)

Year 1 Modeling Status

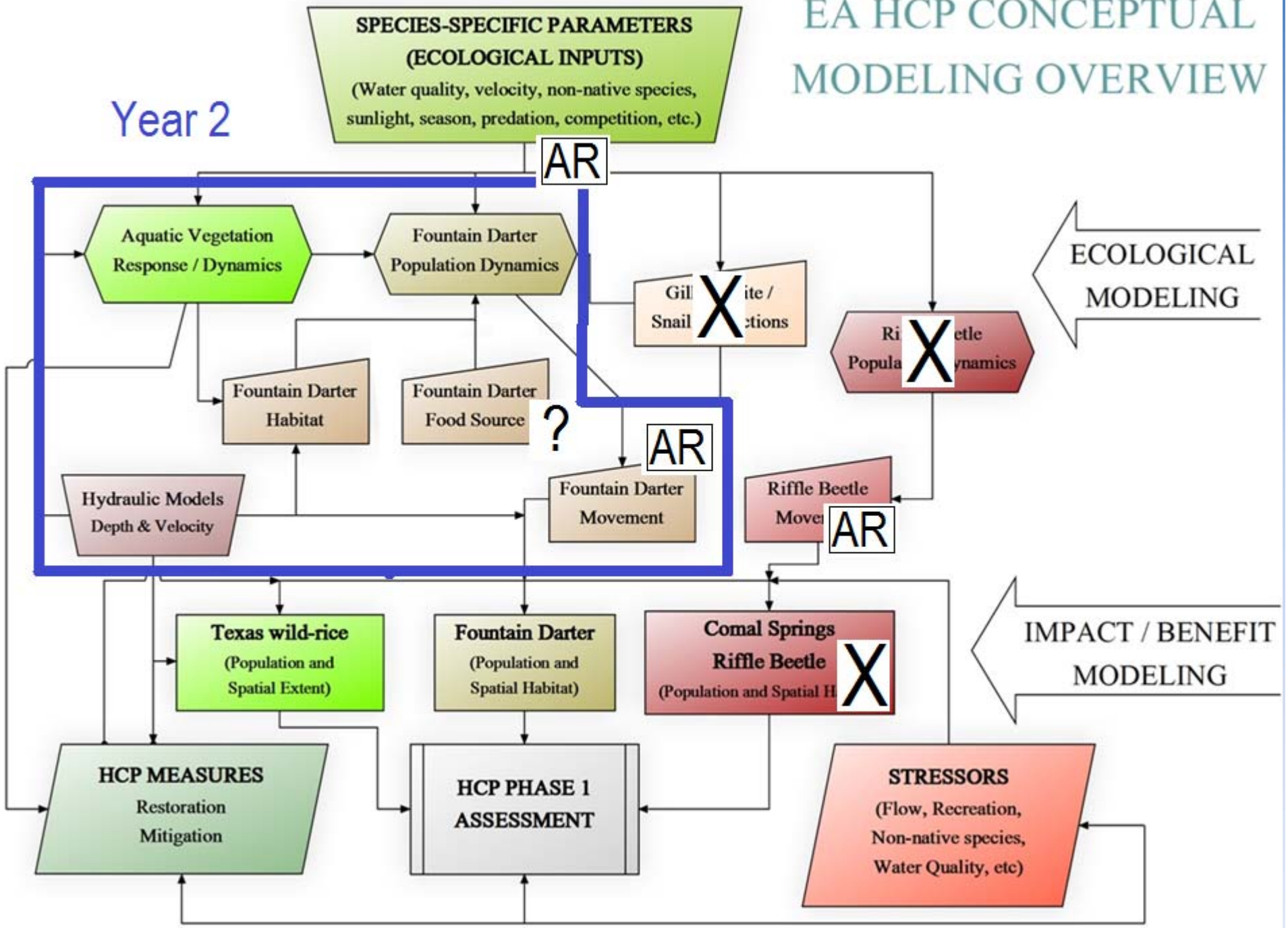


EA HCP CONCEPTUAL MODELING OVERVIEW



EA HCP CONCEPTUAL MODELING OVERVIEW

Year 2



Year 2 Proposed Scope

- Literature Review
  - Food sources
    - 2013 Macroinvertebrate Data (HCP Biological Monitoring Plan)
      - (BIO-WEST 2014)
    - Fountain Darter diet studies
      - (Schenck and Whiteside 1977)
  - Aquatic Vegetation Scour
    - Doyle, R.D. 2001; Green, J. C. 2005; Griffin, K. L. 2006; Madsen, J.D., P. A. Chambers, W. F. James, E. W Koch, and D. F. Westlake. 2001; Power, P. 1996.

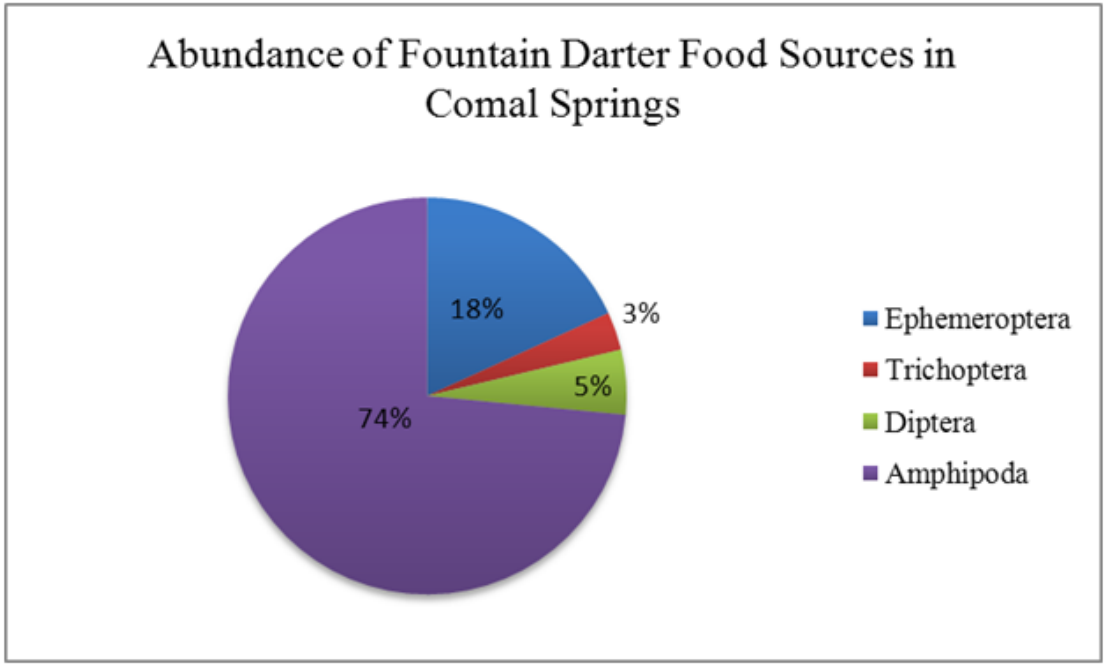


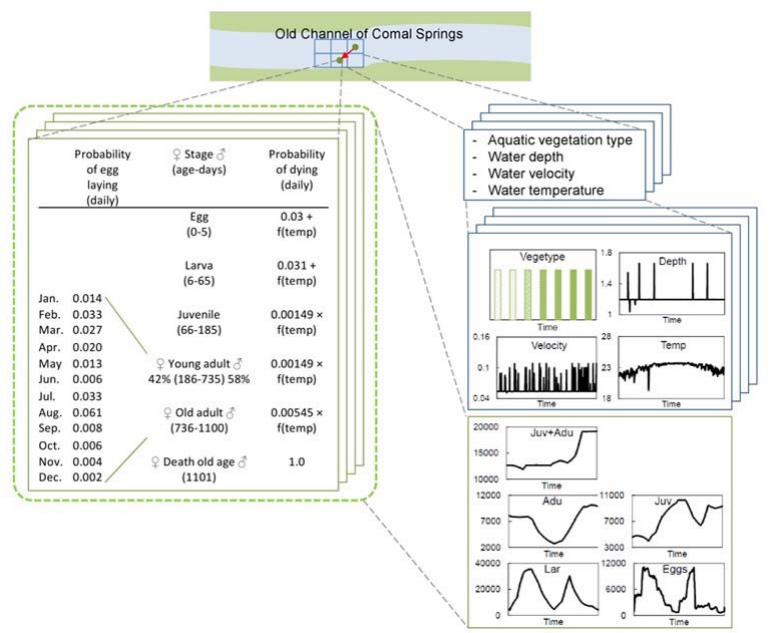
Figure 45. Percentage of total macroinvertebrate abundance comprised by four taxa representative of food sources to the fountain darter (*Etheostoma fonticola*) at all sites in the Comal River.

Table 22. Average and total invertebrate abundance (specific to fountain darter food source) for the vegetation types found in the Comal River sampling reaches in 2013.

VEGETATION TYPE	AVERAGE ABUNDANCE	TOTAL ABUNDANCE
Bryophytes	215.8	3638
Cabomba	133.4	3189
Hygrophila	70.9	4472
Ludwigia	245.6	6671
Sagittaria	70.6	2055
Vallisneria	20.0	647

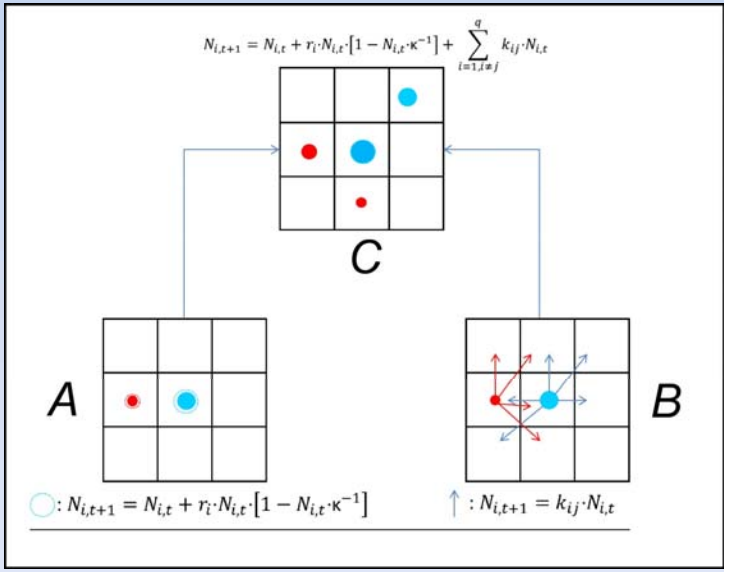
Year 2 Proposed Scope

- TASK 3 - Fountain Darter Modeling
  - Objectives:
    - improving specification of habitat characteristics
    - delineating dependency of fountain darter vital processes upon habitat variables, and
    - depicting effects of additional external forcing variables.
  - Application: Two Study reaches
    - Old Channel – Comal River
    - City Park – San Marcos River
  - Model Calibration
  - Sensitivity and robustness analysis



Year 2 Proposed Scope

- TASK 4 – Aquatic Vegetation Modeling
  - Objectives
    - defining structural groupings of aquatic vegetation
    - developing spatial interpolations of critical environmental and physical variables required to parameterize growth and dispersal of aquatic vegetation
    - developing growth function for each structural group
    - developing dispersal functions for each structural group, and
    - developing recolonization functions for each structural group.
  - Biomass to Percent Cover study
    - Baylor University
  - Two Study reaches (1 per system)
    - Old Channel – Comal River
    - City Park – San Marcos River
  - Model Calibration
  - Sensitivity and robustness analysis



INTERACTIONS

- Hydraulic Model
  - Generate the interpolated hydraulic grid properties for the necessary flow ranges.
- Aquatic Vegetation
  - Generate the 2003-2009 seasonal vegetation mapping spatial attributes within the computational grids for use in the NetLogo modeling framework.
- Water Quality Data and Existing Model
  - Data process the hourly temperature data for the 2003-2009 period for use within the NetLogo modeling framework.
  - Integrate the QUAL2E simulation model to allow input variable meteorological and flow data to generate hourly temperature data for use in the fountain darter model.
- Meteorological Data
  - Data process the 2003-2009 meteorological data for both the Comal and San Marcos Rivers.
- Linkages
  - Automate the integration and transfer of information between flow rate, daily meteorological data and simulated hourly water temperature data within NetLogo. (Note: NetLogo allows FORTRAN subroutine calls which is the underlying language employed in Qual2E.)

Year 2 Detailed Schedule

TASKS	DATES
• Task 1: PM / Meetings	
– Project team meetings	Monthly
– HCP Science, IC, and NRC meetings	To be determined
• Task 2: Literature Review	1 November 2014
• Task 3: Fountain Darter Modeling	
– Internal team progress memorandums	Aug, Nov 2014, Feb 2015
• Task 4: Aquatic Vegetation Modeling	
– Internal team progress memorandums	Aug, Nov 2014, Feb 2015
– Percent cover to biomass report	1 November 2014
• Task 5 Draft/Final Interim Status Report / Deliverables	
– Draft Interim Status Report	15 May 2015
– Calibrated models and documentation	15 May 2015
– Final Report	Within two weeks following comments from Authority

Future Schedule

- Contract will be extended through 2016
- 2014 - Calibrated Fountain darter and aquatic vegetation models for two study reaches.
- 2015 – Detail Scope to be prepared upon completion of Year 2 activities - Anticipated
    - Refine fountain darter and aquatic vegetation models with 2014 applied research results
    - Include additional representative study reaches on both systems
- 2016 – Detail Scope to be prepared upon completion of Year 3 activities – Anticipated
    - Model refinement based on 2015 Applied Research results, Model validation, Training
- 2017 and beyond - To be determined


Questions?